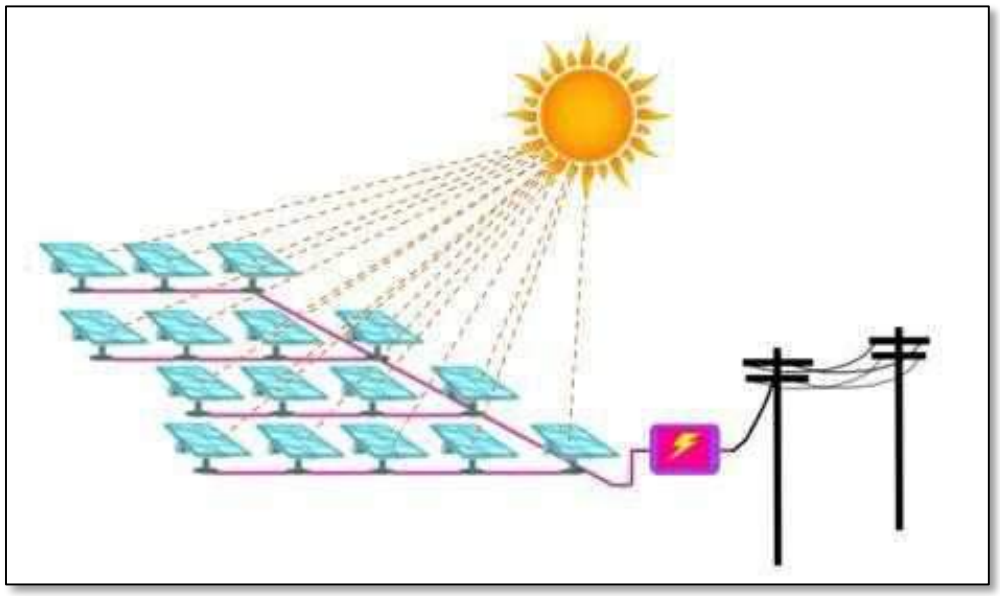
Nepal Electricity Authority
Environmental and Social Management Plan
of
Grid-Tied Solar Electricity Project, Helipad Area (Block – 3), Nuwakot



Prepared For:

Nepal Electricity Authority

Distribution and Consumer Service Directorate

Grid Solar and Energy Efficiency Project (GSEEP)

Durbarmarg, Kathmandu, Nepal

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Abbreviations and Acronyms

^oC	:	Degree Centigrade
$\mu g/m^3$	:	Microgram per Cubic Meter
µS/cm	:	Micro Siemen/ Centimeter
AC	:	Alternating Current
AP	:	Affected People
BS	:	Bikram Sambat
CFUG	:	Community Forest Users' Group
cm	:	Centimeter
CO_2	:	Carbon Dioxide
CSC	:	Construction Supervision Consultant
CSR	:	Corporate Social Responsibility
dB (A)	:	Decibel (A)
DBH	:	Diameter at Breast Height
DC	:	Direct Current
DFO	:	Division Forest Officer
DHM	:	Department of Hydrology and Meteorology
DIA	:	Direct Impact Area
DO	:	Dissolved Oxygen
DoED	:	Department of Electricity Development
EC	:	Electrical Conductivity
EM	:	Environmental Monitoring
EMP	:	Environmental Monitoring Plan
EMU	:	Environmental Management Unit
EPM	:	Environmental Protection Measures
ESMF	:	Environmental and Social Management Framework
ESMP	:	Environmental and Social Management Plan
FGD	:	Focus Group Discussion
FY	:	Fiscal Year
GIS	:	Geographical Information System
GLOF	:	Glacial Lake Outburst Floods
GoN	:	Government of Nepal
GRC	:	Grievance Redress Committee
GRM	:	Grievance Redress Mechanism
GSEEP	:	Grid Solar and Energy Efficiency Project
GTI	:	Global Irradiation at Optimum Tilt
GWh	:	Gigawatt Hour

H & S	:	Health and Safety
ha	:	Hectare
HP	:	Hydropower
HR	:	Human Resources
IDA	:	International Development Association
IIA	:	Indirect Impact Area
IP	:	Indigenous People
kg	:	Kilogram
KIIs	:	Key Informant Interviews
km	:	Kilometre
kV	:	Kilovolt
kVA	:	Kilovolt Ampere
kWh/kWp	:	Kilowatt Hour/Kilowatt peak
kWh/sq.m	:	Kilowatt Hour per Square Meter
L	:	Liter
L/MW	:	Liter per Mega Watt
LPG	:	Liquefied Petroleum Gas
LRMP	:	Land Resource Mapping Project
m	:	Meter
masl	:	Meters Above Sea Level
mg/L	:	Milligram/ Litre
mm	:	Millimeter
MoFSC	:	Ministry of Forests and Soil Conservation
MPPT	:	Maximum Power Point Tracker
MW	:	Megawatt
M_w	:	Moment Magnitude
MWh	:	Megawatt Hour
MWp	:	Megawatt Peak
NAAQS	:	National Ambient Air Quality Standards
NEA	:	Nepal Electricity Authority
NEFIN	:	Nepal Federation of Indigenous Nationalities
NRs.	:	Nepelese Rupee
OHS	:	Occupational Health and Safety
pc-Si	:	Polycrystalline Silicon
PFA	:	Project Footprint Area
pH	:	Percentage of Hydrogen Ions
PM	:	Particulate Matter
PMO	:	Project Manager Office
PPE	:	Personal Protective Equipment

ppm	:	Parts per Million
PV	:	Photovoltaic
RCC	:	Reinforced Cement Concrete
SCF	:	Sunadevi Community Forest
sq. m	:	Square Meter
TDS	:	Total Dissolved Solids
TL	:	Transmission Line
TTC	:	Temporary Traffic Control
US$	:	United States Dollar
WB	:	World Bank
Wp	:	Watt Peak

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Chapter 1. INTRODUCTION

1.1 PROJECT BACKGROUND

The implementation of Grid Solar and Energy Efficiency Project (GSEEP) started from January 01, 2015 with US$ 130 million credit from World Bank (WB)'s International Development Association (IDA) and US$ 8 million from the Government of Nepal (GoN), with Nepal Electricity Authority (NEA) being the Responsible Agency[1]. The GSEEP was conceived at a time when the country was facing load shedding of up to 14 hours a day during the dry season and access to electricity was alarmingly disproportionate between urban areas (90%) and rural areas (30%).

Currently, though we are free from load shedding, we are not yet completely self-reliant on electricity. According to the NEA, the sole electricity distribution authority in Nepal, the peak demand was 1,508 MW for the 2018 Fiscal Year (FY) against the operational installed capacity of 1,127.04 MW, creating a huge gap in the supply from national production.

The total energy imported from India in FY 2019/20 was 1,729 GWh as compared to 2,813.07 GWh in FY 2018/19; out of total available energy, 22.33% was imported from India[2]. On the other hand, the consumption of energy reached 6,422 GWh in the recent FY of 2019/20, a slight increase over the corresponding figure of 6,303 GWh in the FY 2018/19[2]. Out of the total installed capacity of 1,182.22 MW, hydropower contributes 95.47%, thermal energy contributes 4.52% whereas solar energy contributes 0.01% only[2]. Our major source of electricity, i.e. hydropower-based generation is prone to risks including dam failure due to seismic activity as most of the Himalayan arc including Nepal lies at a high level of seismic hazard with the potential for large earthquakes up to M_w 9.2[3]. Moreover, changing rainfall patterns and the risk of Glacial Lake Outburst Floods (GLOF) due to climate change pose further risks to the sustainability of hydropower. In this context, solar energy can be a good alternative for Nepal as the photovoltaic power potential of Nepal ranges from an average daily total of about 3.3 kWh/ kWp to about 6.0 kWh/ kWp[4] providing a good opportunity to tap the photovoltaic power.

NEA has identified seven sites in five different blocks to install solar farms near Devighat Hydropower Station in Bidur Municipality of Nuwakot district, with the aim of producing a total of 25 MWp energy under the GSEEP. Helipad area (Block – 3) of Devighat

[1] World Bank (2014): Project Appraisal Document on a proposed credit to Nepal for a Grid Solar and Energy Efficiency Project (Report No: PAD 1011)

[2] NEA (2020): Nepal Electricity Authority – A Year in Review (Fiscal Year 2019/2020)

[3] Stevans V.L. and Avouac J.P. (2016): Millenary Mw>9.0 earthquakes required by geodetic strain in the Himalaya. *Geophys. Res. Lett., 43,* 1118–1123, doi:10.1002/2015GL067336

[4] World Bank (2017): Solar Resource and Photovoltaic Potential of Nepal. Washington DC 20433

Hydropower Station is one of those sites and 3.09 MW is expected to be generated from this site.

1.2 LOCATION, AREA AND ACCESSIBILITY

The site (Helipad area) is located in ward no. 6 of Bidur Municipality, Nuwakot District, Bagmati Province, Figure 1-1 and Figure 1-2.

The site is bounded by Devighat Hydropower Station in North-East, Mandredhunga Village in North-West, Trishuli River in South-East, and government land in South-West.

Figure 1-1: Perspective view and location of Helipad area

The site got its name of "Helipad area" as it is the continuation of the terrace which consists of a helipad, along the bank of Trishuli River, constructed by the army deployed for security of the Devighat Hydropower Station.

The total permanent land required for the project in this block is 5.01 ha out of which the land area required for accessories and physical facilities is 2.01 ha and the area required for mounting structures and solar panels is 3.0 ha as per Engineering Study Report, 2019 (Risen Solar Technology).

The site is accessible from three different road routes from Kathmandu to Nuwakot. The route following Prithvi Highway up to Galchhi and then the road from Galchhi up to Batar Bajar along the Kerung-Galchhi Highway is the preferred route. From Battar Bajar, the site is accessible through the Devighat Hydropower powerhouse station and about 80 km away from Kathmandu.

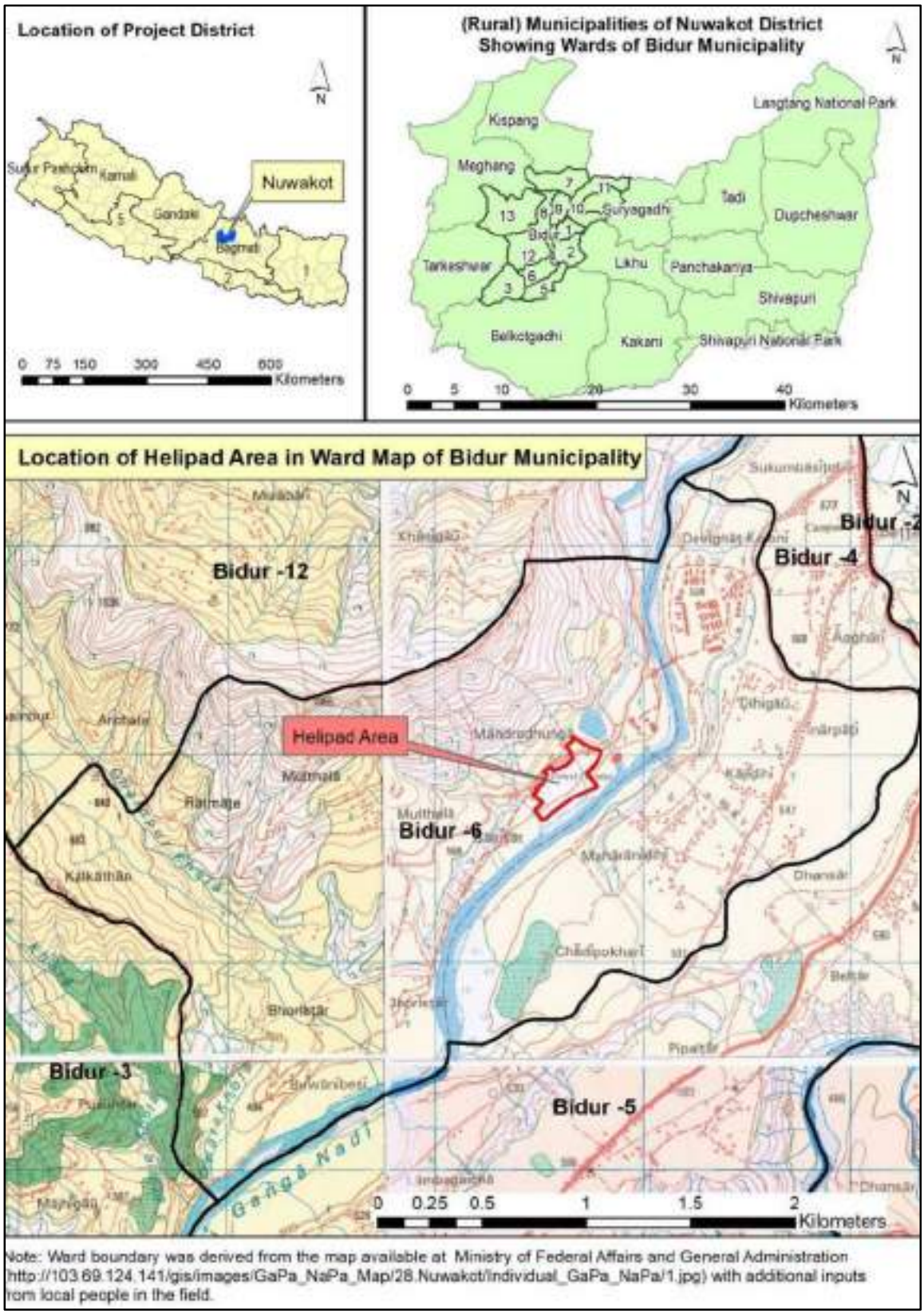


Figure 1-2: Location map of the project area

1.3 PROJECT DESCRIPTION

GSEEP was launched with the twin objectives: (a) **increasing solar photovoltaic generated electricity** supply **to the NEA grid**, and (b) reducing NEA's distribution losses in selected distribution centers. Development of solar farm at Helipad Area is a part of the first objective under the project component **Grid-Connected Solar PV Farms Development**.

The project site is a middle terrace along the right bank of the Trishuli River and is about 5.00 – 8.00 m high from the current water level. The site has little hump structures as it was used to dump deposits mainly consisting of sand, silt, and clay collected from the forebay of Devighat Hydropower Station.

As per the Desk Study Report[5], "Grid Tied Solar Electricity Project, Helipad area, Nuwakot" consists of the following project structures:

Solar panels

Polycrystalline Silicon solar (pc-Si) modules have been proposed at an inclination angle of 20 degrees or any other suitable angle with respect to the latitude of the site.

Inverter

Central inverters have been proposed to convert the DC power output of solar panels having a Maximum Power Point Tracker (MPPT) function for optimum power output from the pc-Si modules.

Mounting structure

The module mounting structure shall be fixed ground mount design considering site-specific wind and seismic characteristics. The module mounting structure will the face south direction at a suitable inclination angle.

Transmission line

The generated energy will be fed through 33 kV transmission lines and shall be evacuated at 66 kV at Devighat substation which is about a kilometer away far from the site.

The capacity of the project is 3.09 Megawatt Peak (MWp). The project is expected to generate a total of 6,092.62 MWh electricity annually.

1.4 CONSTRUCTION PLANNING

The total construction period of the project is about 6 months as per Engineering Study Report, 2019 (Risen Solar Technology). Construction works comprise of civil works (site clearance, grading and leveling; fencing; construction of internal roads, paths, drainage systems, and foundations for inverters), mechanical works (ram piles; erecting mounting structures; assembling modules), electrical works (string connection of modules; cable routing DC installation; installation of inverter station, ground cables AC cables, earthing

[5] Desk Study Report for Helipad (3.09 MW) of 25 MWp Grid Tied Solar Farms Project under Grid Solar and Energy Efficiency Project (GSEEP) – submitted to Department of Electricity Development (DoED), Kathmandu by GSEEP, NEA, Kathmandu, May 2019.

system, external lighting system, and weather station) and pre-commissioning and commissioning works. Construction of the project will be started by June 2021.

1.4.1 Preliminary work

The preliminary works for the proposed project are listed below;

a. Contract award
b. Preparation of detail design study and mobilization of the contractors
c. Preparation of longitudinal profiles
d. Geological field test and laboratory testing
e. Others

1.4.2 Land

The total permanent land required for solar panels erection and other accessories and physical facilities is 5.01 ha. The ownership of the land is with NEA. The land area required for mounting structures and solar panels is 3.0 ha and for accessories and physical facilities is 2.01 ha. Accessories and physical facilities comprise guard buildings, water control and drainage mechanism, underground water tank, internal road, fencing, transformer, inverter, weather station, etc.

1.4.3 Required workforce

The total workforce required during the construction phase is estimated to be 40 individuals, comprising of 8 skilled, 10 semi-skilled, and 22 unskilled workers. During the operation phase, an estimated total of 9 workers comprising of 7 skilled and 2 unskilled staffs will be required for the operation and maintenance of the plant. As far as applicable, the unskilled and semi-skilled workforce will be hired locally as per their working ability and experience.

1.4.4 Materials required

The construction materials that will be required for solar farming are listed below:

- Solar modules: Polycrystalline Silicon (pc-Si), Module capacity: 275 Wp, Number: 11,237, Dimension: 2 × 1 m, Glass: with anti-reflective and anti-soiling surface
- Inverters: Number: 2, Capacity: 1250 kW, String/ Central type
- Mounting Structures: Fixed type
- Power supply
- Aggregate
- Cement
- Sand
- Water

Power supply required during the construction phase will be obtained from 11 kV transmission line (TL) present at the project site and alternatively from Diesel generator (Capacity: 2 kVA, 15 L, consuming 1.15 L diesel per hour). Construction materials like sand and aggregate are required for the construction of physical facilities like guard room, water storage mechanism, fencing, and so on. Sand, coarse aggregates, and cement will be

purchased from the local market or a nearby marketplace. The excavated materials will be used for backfill for the mounting structure's foundation. The amount of water required to clean solar panels is estimated as 6,110 – 8,150 L/MW i.e. 1.5 – 2.5 L per solar panel for each wash. So, the total amount of water required for washing all the solar panels in the 3.09 MW plant is estimated as 16,856 – 28,093 L per wash. Solar panels will be cleaned on weekly basis for efficient power generation.

The required amount of water will be obtained by treatment of water from Trishuli River near the project site and a storage tank of 1,50,000 L capacity will be constructed for storing the water required for cleaning the solar panels.

1.4.5 Construction method

Landscaping like leveling, cut and fill, and construction of retaining wall will be done. For piling, drilling work will be done. Construction machines such as excavator, roller, drilling machine, and crane (Estimated number: 1 each) will be used for construction activities.

1.5 OBJECTIVES OF ESMP

The major objective of the Environment and Social Management Plan (ESMP) is to identify potential significant environmental impacts and issues. Mitigation and enhancement measures will be proposed to accomplish the project in an environment-friendly way. Some of the objectives are listed below:

- To predict and identify potential environmental and social impacts due to the installation and operation of the solar farm
- To define the roles and responsibilities of parties involved in project environmental and social management (including monitoring mechanism which will be consistent with the provisions in the project's ESMF)
- To identify and propose mitigation measures, including measures for impact avoidance, minimization of impacts, and estimate required cost for each activity
- To identify the environment and social management mechanism to ensure the implementation of mitigation measures and monitoring programs and to establish supervision, monitoring and reporting as well as grievance handling mechanisms
- To consult with potentially affected people, community, and stakeholders and
- To identify/ understand people's concerns and suggestions and address them, as per their priorities and relevancy

1.6 RATIONALE OF ESMP

The ESMP is prepared to address the potential impacts and to provide mitigation measures for them based on recommendations identified from the Environmental and Social Screening Report, Grid Tied Solar Electricity Project, Helipad Area, Nuwakot.

1.7 METHODOLOGY OF ESMP

The ESMP report is prepared in accordance with the screening report of the project, field study, consultation with local people/ stakeholders, and officials. The activities performed during the preparation of ESMP are listed below;

- Field investigation and surveys
- Identification of settlements near the project area
- Identification of stakeholders
- Identification of environmental and social issues
- Meetings/ Consultations/ Public participation including the indigenous community
- Verification of secondary data/ information and collection of data/ information from the field

A team of experts mobilized to the field (2077/ 11/ 20 – 28) to collect the required data and to carry out public consultations in the project area. The team of experts involved in the study are listed in Table 1-1.

Table 1-1: Experts involved in the study

S.N.	Position/ Expertise	Name
1	Team Leader/ Biological Environment Expert	Nawa Raj Chapagain
2	Deputy Team Leader/ Senior Environmentalist	Saroj Ghimire
3	Senior Environmentalist (ESMP Expert)	Ajit Shrivastav
4	Senior Electrical Engineer	Shyam Kumar Bohora
5	Electrical Engineer	Sushil Timilsina
6	Civil Engineer/ GIS (Survey) Expert	Niroj Karmacharya
7	Sociologist	Raju Khanal
8	Environmentalist	Shristi Sharma
9	Assistant Environmentalist	Bibek Shrestha

The team carried out a Focus Group Discussion (FGD) with women in the project affected community, an FGD with *Janjati* and community stakeholders, and two Key Informant Interviews (KIIs) to collect information about the overall socio-economic state of the project's Direct Impact Area (DIA) in Mandredhunga, Bidur Municipality Ward 6, Nuwakot. The summary of public consultations is presented in Table 1-2. The participant details of public hearing are presented in Annex B. Household socioeconomic surveys were conducted in 20 households (IP household) among the total 62 households in the project's DIA. In addition to these, KIIs were also carried out to collect information about the local biodiversity, ethnobotanical uses of trees found in the Project Footprint Area (PFA), and local climatic conditions.

The team also visited different line offices such as Ward no. 6 office of Bidur Municipality, Bidur Municipality office, and Office of Sunadevi Community Forest Users' Group.

Table 1-2: Summary of public consultation, FGD and KIIs

S.N.	Consultation	Date	Number of participants		
			Male	Female	Total
1	FGD with Women	2077/11/26	2	9	11
2	FGD with Janjati and Community stakeholders	2077/11/24	25	11	36
3	KII with Community leader and Chairperson of Sunadevi Community Forest Users Group	2077/11/27	1	-	1
4	KII with Ward member of Bidur Municipality Ward no. 6	2077/11/27	1	-	1
5	KII for local biodiversity, ethnobotany, and local climate	2077/11/26 – 27	4	1	5
	Total		33	21	54

Source: Field visit 2021

Field investigations for assessing the biophysical environmental conditions of the project footprint area include:

- Tree inventory in the project area to be fenced
- Opportunistic and walkover surveys for birds and other fauna
- Recording particulate pollutants and sound levels using portable, real-time sensors (Temtop Airing – 1000 air sampler for particulate pollution levels and UNI-T UT 353 sound level meter for sound levels)
- Water quality measurements using portable probes (EXTECH and Pancellent water quality probes) in Trishuli River near the point where the discharge of solar panel wash water is planned and collection of river water samples for water quality analysis
- Walkover surveys of topography, land instabilities, waste dumping, and land use

Chapter 2. EXISTING ENVIRONMENTAL AND SOCIAL SETTINGS

2.1 PHYSICAL ENVIRONMENT

The project site lies in the Middle Mountains (Middle Hills)[6] physiographic region of Nepal. Though the Middle Mountains region is characterized by a great variety of terrain types and intensively farmed hillside terraces[7], the site lies in river bank terraces with mild slopes created by the Trishuli River. The site lies within the altitudinal range of 493 – 509 masl and is covered by alluvial surface deposits.

2.1.1 Topography

The proposed solar plant site is located in the mid-hill belt of Nepal. The site is located on a gently sloping terrace on the right bank of Trishuli River and is located well outside any protected areas. The site is bounded by Devighat Hydropower Station in North-East, Mandredhunga Village in North-West, Trishuli River in South-East, and government land in South-West. The site is flanked by slopes on the south-eastern side facing the Trishuli River and towards the south-western side facing the Kuchera Khola stream channel and Gaitar Khola coming from further north-west. The steep slope in the south-western side of the project site towards the stream's channel is prone to land instability.

The project site comprises of two distinct terraces – the middle terrace is continuous with the helipad and ground of the army barrack and the upper terrace is on the level of the Mandredhunga settlement and gently sloping towards the south-eastern side. The two terraces are separated by moderate to steep slope/shelf which is unconsolidated/ unstable at some places. The middle terrace is elevated from the river by a height of 5.0 – 8.0 m from the river's average level.

Additionally, a sand quarry is located across the Mandredhunga-Multhala road, in the north-west of the project site and the school. As the Kuchera Khola channel runs alongside the quarry, mining activities in the quarry maybe of concern to the south-western slope of the project site in terms of slope stability.

[6] LRMP (1986): Land Utilization Report. Land Resources Mapping Project (LRMP), Kenting Earth Sciences Limited, Government of Nepal and Government of Canada

[7] GoN/MoFSC (2014): Nepal Biodiversity Strategy and Action Plan 2014-2020. Government of Nepal, Ministry of Forests and Soil Conservation, Kathmandu, Nepal

Figure 2-1: South-western side of the upper terrace of the project site

Figure 2-2: The middle terrace of the project site towards the south-west

Figure 2-3: The middle terrace towards the east

Figure 2-4: Exposed land use between middle and upper terraces

2.1.2 Land use

The project will be sited on 5.01 ha of land owned by NEA, Devighat Hydropower Station. However, the area occupied by solar panels is estimated to be 3.0 ha only. The structures of the project will not use any forest area or private land. In the project footprint area, the middle terrace and the western half of the upper terrace comprise mostly of barren land while the north-eastern part of the project site is partially used for the cultivation of vegetables by some local residents.

Figure 2-5: Barren land in the project footprint area

2.1.3 Local climate and sunshine condition

The area experiences sub-tropical climate greatly influenced by the monsoon rains that occurs from June to September. The average maximum temperature ranges from 17.8 °C during winter to 26.8 °C during monsoon; whereas the average minimum temperature ranges from 5.1°C during winter to 18.4°C during monsoon, as presented in Table 2-1. Nuwakot is one of the eight districts of Nepal receiving highest (> 2,000 mm) amount of average annual precipitation[8].

Table 2-1: Seasonal and annual climatic normal for Nuwakot

Season	Winter	Pre-monsoon	Monsoon	Post-monsoon	Annual
Precipitation (mm)	54.4	243.7	1,820.1	67.8	2,185.9
Maximum temperature (°C)	17.8	25.5	26.8	22.8	23.6
Minimum temperature (°C)	5.1	12.5	18.4	11.3	12.4

Source: DHM (2017): Observed Climate Trend Analysis in the Districts and Physiographic Regions of Nepal (1971-2014). Department of Hydrology and Meteorology, Kathmandu

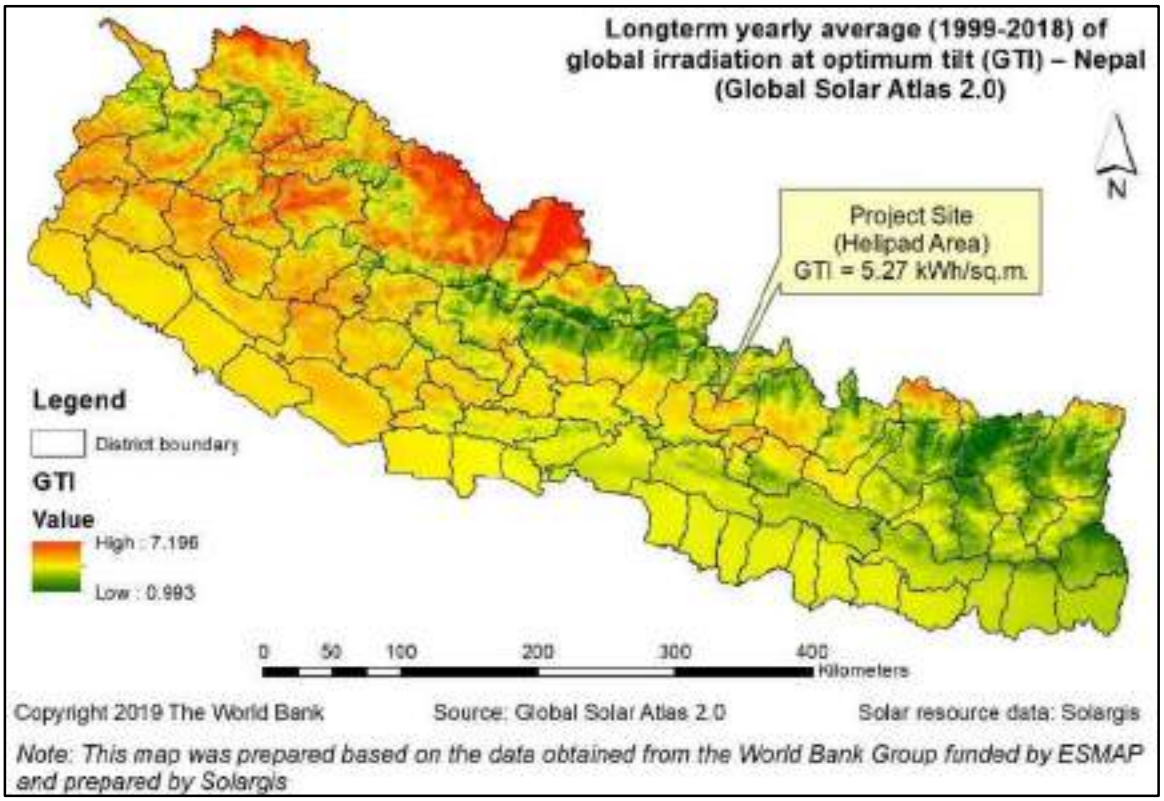


Figure 2-6: Average (1999 – 2018) irradiation at optimum tilt

[8] DHM, 2017. Observed Climate Trend Analysis in the Districts and Physiographic Regions of Nepal (1971-2014). Department of Hydrology and Meteorology, Kathmandu

The site receives an average of 8 hours of sunshine per day during the summer and an average of 6 hours of sunshine per day during the winter[9]. A recent analysis based on long-term yearly average (1999-2019), using Solargis global solar model (https://globalsolaratlas.info/), shows the project site to receive 5.27 kWh/sq. m of global irradiation at optimum tilt (GTI), Figure 2-6. There is no physical obstruction in the immediate vicinity of the eastern side of the project area to block the solar radiation whereas the hills in the south-western direction may block solar radiation to a small degree during the late hours of the day.

2.1.4 Air quality, noise and water quality

There are no industrial/ factory installations in the area to cause air, water or noise pollution. During the field investigations, unmanaged (open) burning of municipal waste nearly 1,200 m away from the project site, across the Trishuli River was observed as the major source of air pollution, Figure 2-7. Domestic smoke from household combustion of fuelwood and vehicular movement along the Mandredhunga - Multhala road are other sources of air pollution, though these can be considered insignificant compared to the open burning of the municipal wastes with a reported frequency of few times a week.

As per the observations of particulate matter pollution in the project area (Annex D), $PM_{2.5}$ levels mostly remained above the recommended limits (40 µg/m^3) prescribed in National Ambient Air Quality Standards while PM_{10} levels exceeded the recommended limit (120 µg/m^3) during the morning and after late noon. The spike of particulate pollution corresponded with the open burning of municipal wastes during the sampling on the evening of March 09, 2021.

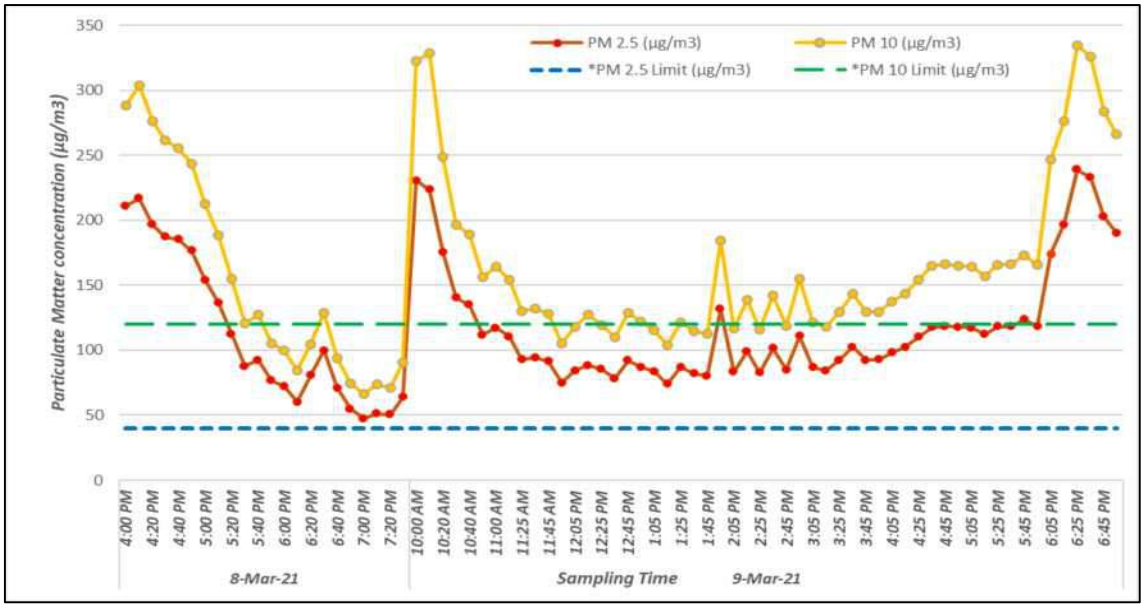


Figure 2-7: Graph of air pollution (PM_X levels) measured in the project area

[9] Desk Study Report for Helipad (3.09 MW) of 25 MWp Grid Tied Solar Farms Project under Grid Solar and Energy Efficiency Project (GSEEP) – submitted to Department of Electricity Development (DoED), Kathmandu by GSEEP, NEA, Kathmandu, May 2019.

Figure 2-8: Smoke from burning of municipal waste as seen from project site

As the vehicular movement along the road to Multhala is low, noise pollution was observed to be insignificant. However, brief spikes in sound levels observed were attributable to vehicular movement, especially the occasional movement of tippers and trucks. The sound level measurements are provided in Annex D.

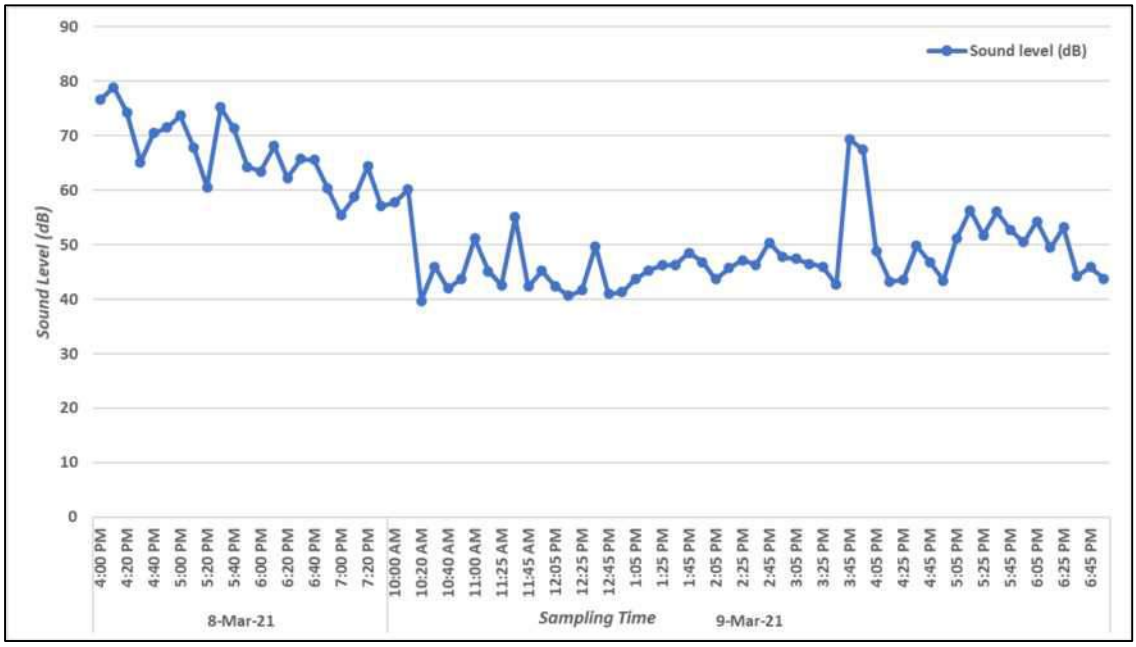


Figure 2-9: Graph of sound level/ noise pollution (PM_X levels) of the project area

In-situ water quality assessments were done in Trishuli River on March 12, 2021 near the point on the right bank of the river below the project site where the water after washing the panels is planned to be released. The results are presented in Table 2-2.

Table 2-2: In-situ Water quality measurements made in Trishuli River in the project area

Location	ST	Water Temp^{r} (°C)	pH	EC (µS/cm)	TDS (ppm)	DO (mg/L)	DO Saturation (%)
Site A	8:25 AM	15.2	7.85	92	46	9.4	112.2
Site B	8:40 AM	16.3	7.71	92	46	9.22	111.2
Average		15.75	7.78	92	46	9.31	111.7

Note: ST: Sampling Time, Temp^{r}: Temperature, EC: Electrical Conductivity, TDS: Total Dissolved Solids and DO: Dissolved Oxygen

Site A: Located about 50 m downstream of tailrace discharge from Devighat HP on the right bank of Trishuli River

Site B: Located about 50 m downstream of Site A

2.2 BIOLOGICAL ENVIRONMENT

The boundary line (500 m altitude) of lower tropical and upper tropical bioclimatic zones[10] passes through the project area. Surrounding areas, in addition to lower tropical and upper tropical bioclimatic zones, include lower subtropical bioclimatic zone.

The project area is mainly covered with grassland with short grasses and some cultivated areas. The grassy areas are used for cattle grazing and also to dump deposits collected from forebay of Devighat Hydropower Station. Major species of grasses observed are Dubo (*Cynodon dactylon*), Khar (*Andropogon pumilus*), Siru ghans (*Imperata spp*.), Kans (*Saccharum spontaneum*). There are around 31 trees and 6 fruit trees (DBH greater than 30 cm; largest DBH being less than 80 cm) and 309 pole size trees and 42 fruits (DBH: 10 – 30 cm) in the Project Footprint Area. The tree species include fodder trees, firewood/timber trees and fruits. Major species found are: Kutmero (*Listea monopetala*), Sissoo (*Dalbergia sissoo*), Ipil Ipil (*Leucaena leucocephala*), Mango (*Mangifera indica*), Khirro (*Sapium insigne*) and Litchi (*Litchi chinensis*).

Though there is no natural forest in the project area, Sal (*Shorea robusta*) and Pine (*Pinus roxburghii*) dominated natural stock is found in the Sunadevi Community Forest (114 ha.) which lies approximately 250 meters towards west from the project area. Other associated forest tree species are Kadam (*Anthocephalus chinensis*), Khirro (*Sapium insigne*), Tuni (*Toona ciliata*), Champ (*Michelia champaca*), Chilaune (*Schima wallichii*) and Chiuri (*Aesandra butyracea*).

As per social surveys and interactions in the local community, the mammal species spotted in Sunadevi Community Forest include Common Leopard (*Panthera pardus*), Barking Deer (*Muntiacus vaginalis*), Jungle Cat (*Felis chaus*), Indian Crested Porcupine (*Hystrix indica*), Small Indian Civet (*Viverricula indica*), Yellow-throated Marten (*Martes flavigula)* and Indian Hare (*Lepus nigricollis*).

[10] Dobremez, J.F. (1972): Le Népal, Ecologie et phytogeographie. Thése Université Grenoble. France. 373 p.

Kalij Pheasant (*Lophura leucomelanos*)

Steppe Eagle (*Aquila nipalensis*)

Plumbeous water redstart (*Phoenicurus fuliginosus*)

White-capped redstart (*Phoenicurus leucocephalus*)

Rose-ringed parakeet (*Psittacula krameri*)

Figure 2-10: Some bird species photographed from the project area

Common avifauna includes Kalij pheasant (*Lephura leucomelanos*), Plaintive Cuckoo (*Cacomantis merulinus*), Spotted Dove (*Stigmatopelia chinensis*), Drongo Cuckoo (*Surniculus lugubris*), Red-vented Bulbul *(Pycnonotus cafer),* Cattle egret *(Bubulcus ibis*), Red-billed Blue Magpie (*Urocissa erythrorhyncha),* Oriental Magpie Robin *(Copsychus saularis),* Steppe Eagle (*Aquila nipalensis*), Vulture (*Gyps spp.*), Plumbeous water redstart *(Phoenicurus fuliginosus),* White-capped redstart *(Phoenicurus leucocephalus), Rose-ringed parakeet (Psittacula krameri),* Common pigeon (*Columba livia*), and House Sparrow (*Passer domesticus*). The full list of birds observed and reported from the project area is presented in Annex E.

Buchche Asala (*Schizothorax richardsonii*), Chuche Asala (*Schizothoraichthys progastus*), Katle (*Neolissocheilus hexagonolepis*), Thed (*Labeo angra*), Karange (*Naziritor chelynoides*), Kabre (*Pseudecheneis sulcatus*) and Buduna (*Garra gotyla*) are commonly found fish species in Trishuli River near the project site. Key informants reported that because of major disturbance to aquatic habitat due to extraction of sand, operation of crusher plant and construction of hydropower dams has led to a noticeable decline in the diversity and abundance of fish in the river.

2.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

The project site lies in Ward no. 6 of Bidur Municipality. Bidur Municipality is one of twelve local government units (Municipalities and Rural Municipalities) of Nuwakot

District[11]. Bidur municipality, consisting of 13 wards, has 12,505 households and 54,351 people reside on it[12]. There are 781 households in Ward no. 6.

The project site is adjacent to Mandredhunga settlement. Out of 62 households of Mandredhunga, 59 households are Dewash Rai, 2 households are Tamang and one household is Brahmin (the Brahmin household was not available for survey during the field visit). Both "Dewash Rai" and "Tamang" are listed as indigenous people by the "National Indigenous Nationalities Commission Act, 2074 (2017) (आदिवासी जनजाती आयोग ऐन, २०७४)" and "National Foundation for Upliftment of Indigenous Nationalities Act, 2058 (आदिवासी/ जनजाती उत्थान राष्ट्रिय प्रतिष्ठान ऐन, २०५८)" of Nepal. Tamang is one of the 20 castes identified as "marginalized"[13]. Most of the households follow Hinduism and the remaining follow Buddhism and Christianity.

Table 2-3: Number of households and population

Caste	Number of households (%)	Population	Population (%)
Dewash Rai	59 (95.16%)	303	96.80
Tamang	2 (3.22%)	10	3.20
Brahmin*	1 (1.61%)	-	-
Total	62	313	100%

Source: Mandredhunga Drinking Water Users Committee

Note: *The Brahmin household owns a house at Mandredhunga but was not listed in the users list of the Drinking Water Users Committee and the family members were not available during the household survey.

Agriculture, animal husbandry, and wage labor are the major occupation of the local people. Major crops produced are corn, millet, mustard oil seed, and paddy. Nearly two hectares of the land owned by NEA bordering the settlement is being used for cultivation by the local people. Few households run small grocery shops and tea stalls. However, there will not be any adverse impact upon them. Nearly ten local youths are employed in the Nepal Army.

There is one school (Mandredhunga Basic School) adjacent to the project area. The settlement has piped supply of drinking water. All households use electricity for lighting. Nearly half of the households use LP gas for cooking whereas the rest use firewood.

Regarding social groups, there is one community forest users' group, one women development committee, and one adolescent girls' group. There is a temple, a cremation site, and a house where church gatherings are organized on weekends.

[11] Gazette Notice of Government of Nepal – 2073 Falgun 27 (Part 66, Number 58)

[12] Nuwakot District Profile (2074 BS) – Statistics Office, Nuwakot and District Co-ordination Committee Office, Nuwakot

[13] NEFIN (2004): 'Classified Schedule of Indigenous Nationalities of Nepal', prepared by the Janajati Classification Task Force and approved by the Federal Council of Nepal Federation of Indigenous Nationalities (NEFIN), March 1

Chapter 3. ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

This chapter addresses the potential impacts as a result of the proposed project. Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the project have been identified for physical, biological and social environments in the project area. Mitigation measures have been proposed to reduce the possible adverse impacts identified during the study. The possible impacts with their respective mitigation measures for construction and operation phases are mentioned in Section 3.1 Physical environment, 3.2 Biological environment and 3.3 Social environment.

3.1 PHYSICAL ENVIRONMENT

3.1.1 Land use and land take

3.1.1.1 *Impacts*

The total land required for the project is 5.01 ha out of which 3.0 ha will be used for erecting the solar panels while the remaining 2.01 ha will be used for associated facilities. As the ownership of the required land is with NEA, there will not be any significant impacts related to land use to the local community due to project activities.

3.1.1.2 *Mitigation measures*

It is recommended that a 20 – 25 m buffer strip be maintained between the solar panels and the houses/settlement adjacent to the project fencing area.

3.1.2 Air quality

3.1.2.1 *Impacts (Construction phase)*

The construction activities are likely to elevate the air pollution in the project area. The potential sources of air pollution will be emissions from construction vehicles and construction equipment such as power backup diesel generators. Also, activities like site clearance including clearance of trees, clearance of damaged structures, cut-fill work for the leveling and grading of the land, drilling for mounting structures will contribute to air pollution. Dust emissions may increase during the construction of project components and transport of construction materials. The operation of various construction equipment and vehicles mostly requiring diesel will emit gaseous pollutants such as carbon dioxide (CO_2) and oxides of nitrogen plus particulate pollutants as a by-product of fuel combustion.

3.1.2.2 *Mitigation measures (Construction phase)*

To minimize air pollution due to construction dust and vehicular emission, following mitigation measures have been proposed:

- Identification of sources of air pollution (such as uncovered earth/ sand/ aggregate piles) and appropriate measures such as covering, water spraying/wetting etc.
- Open storage/ heaping of loose soil in and around the construction site will be prohibited. Also, haphazard and unmanaged storage, stockpiling and disposal of excess material will be avoided

- All vehicles belonging to the project i.e. consultants, owner, contractors, will comply with the national emission standards and regular (monthly) check-up for maintenance of all vehicles will be made mandatory
- The project will ensure regular water sprinkling on the project access roads (at least twice daily in the dry season)

3.1.2.3 *Impacts (Operation phase)*

There will not be any significant air pollution during the operation phase of the project.

3.1.2.4 *Mitigation measures (Operation phase)*

Mitigation measures will not be required as there will not be any impacts during the operation phase.

3.1.3 Noise quality

3.1.3.1 *Impacts (Construction phase)*

Noise pollution will be generated by construction equipment like backhoe loaders, excavators, drilling machines etc. used at the project site and construction vehicles such as trucks and loaders used for transportation of construction material. Some of the major sources of noise pollution is listed below:

- Construction noise and vibration from construction equipment at construction sites
- Noise and vibration from the construction vehicular fleet

3.1.3.2 *Mitigation measures (Construction phase)*

Some mitigation measures are listed below:

- Construction activities which will high noise pollution will be scheduled during the daytime only
- High noise generating construction activities such as drilling in the south-western side of the project area will be carried out outside the school hours since the side of the project area is located in the vicinity of Mandredhunga Basic School
- Prohibition of vehicles and equipment which emit excessive sound
- Periodic servicing and maintenance plan of construction equipment and vehicles will be made mandatory
- The project will ensure restriction on the use of loud vehicular horns
- Provision of suitable PPE such as ear muffs will be made for the construction workers
- Routine monitoring of ambient noise levels at the construction sites will be made

3.1.3.3 *Impacts (Operation phase)*

Noise pollution due to the project operation will not be a significant issue. The project will not impact the ambient sound levels in the project area. Minimal sound will be generated from String Combiner Box which will be kept inside an insulated box.

3.1.3.4 *Mitigation measures (Operation phase)*

No mitigation measures will be required in the operation phase.

3.1.4 Soil pollution

3.1.4.1 *Impacts (Construction phase)*

Soil at and around the construction site may be contaminated by the deposition of construction wastes like spoil material, particulate matter, cement etc. and especially in case of unplanned deposition of solid and liquid wastes such as glues, diesel, oils, lubricants around the project sites.

3.1.4.2 *Mitigation measures (Construction phase)*

Some measures for the prevention of soil pollution are as follows:

- The excavated spoil/ muck debris will be piled properly in the designated area within the project site and will be reused for the landscaping of the project site
- Solid wastes generated during the construction activities will be segregated and managed/disposed reularly as per the nature of wastes thus minimizing the time period in which the wastes are kept exposed in the environment
- Proper storage of cement, paints, fuels, grease etc. will be managed to avoid spillage

3.1.4.3 *Impacts (Operation phase)*

Project activities that will cause soil pollution are not anticipated in the operation phase. There is minimal potential for soil degradation due to the project operation and maintenance activities.

3.1.4.4 *Mitigation measures (Operation phase)*

No mitigation measures are required during the operation phase.

3.1.5 Storage and stockpiling

3.1.5.1 *Impacts (Construction phase)*

11,237 number of solar panels, supporting facilities, and construction material will be used during this phase. 2.01 ha of land will be used for storage and stockpiling during the projet construction as construction is carried out in the rest of the project site. Location of storage area is just before the settlement starts. So, the construction vehicles and construction materials carrying vehicles will not enter in the settlement. As construction will be carried out simultaneously in different location of the 5.01 ha project area, a number of stockpiling sites will be allocated. Construction materials such as soil, gravel, sand, aggregates and stock materials are usually stockpiled within the construction site. Potential impacts include blowing away of dust particles and washing away of finer particles during rain and resulting pollution of topsoil, surface water and water bodies downstream.

3.1.5.2 *Mitigation measures (Construction phase)*

The area used for the storage of the construction material will be fenced and preferably enclosed. The entry of authorized person will be regulated, and security guards will be employed at the storage site. Construction materials will be stored within the area owned by the project and adequately away from the school and nearby settlement.

The following mitigation measures will be implemented:

- Stockpiles will be adequately covered with tarpaulin sheets or other cover material
- Garland drains around spoil and quarry sites will be constructed to capture the runoff and divert the same to the nearest natural drain
- Depression and/or craters created during construction will be filled with materials consisting of boulders, rock, gravel and soil from nearby plant/ working sites

3.1.5.3 *Impacts (Operation phase)*

During the operation, no large-scale construction activities is likely; only maintenance works will be carried out. Also, there will be a separate enclosed area allocated for storage of materials during the operation phase. Hence, the potential impacts in the operation phase will be minimal.

3.1.5.4 *Mitigation measures (Operation phase)*

No mitigation measures other than storage of materials in enclosed area/proper containment are required in the operation phase.

3.1.6 Land instability and erosion

3.1.6.1 *Impacts (Construction phase)*

A landslide-prone, exposed slope was observed in the south-western side of the project area, near the school side. Project construction activities may trigger small-scale land instability in the slope. Slope stabilization during the construction phase will mitigate the land instability and soil erosion from the slope thus minimizing the landslide vulnerability.

3.1.6.2 *Mitigation measures (Construction phase)*

Some of the enhancement recommendations are mentioned below:

- Slope of the cutting areas especially in project footprint area will be maintained. The excavated areas will be stabilized by applying proper bioengineering measures including shotcrete. Appropriate drainage structure will be managed to minimize the potential for soil erosion. Landscaping will be done in required sites
- Bioengineering will be done for the steep benched cut or fill slopes. All the benched cut and fill slopes will be planted with native varieities of vegetation. The top soils from the cut sites will be applied on the benched areas of the cut and fill slopes to promote vegetation growth
- Plantation will be done 2 weeks before the monsoon to ensure the proper growth of the vegetation

3.1.6.3 *Impacts (Operation phase)*

The potential for soil erosion in the operation phase will be minimal. However, there is potential for small scale landslide which may impact the project even after the completion of construction phase.

3.1.6.4 *Mitigation measures (Operation phase)*

Some enhancement recommendations for the landslide-prone slopes and at toe of the project area are as follows:

- A gabion wall of about 1.5 m height and 2 m width will be required at the landslide area after a study of the land instability
- Bioengineering of the steep benched cut or fill slopes will be carried out. All the benched cut and fill slopes will be planted with native vegetation. The topsoil from cut areas will be applied on the benched areas of the cut and fill slopes to promote vegetation growth

3.1.7 Water pollution

3.1.7.1 *Impacts (Construction phase)*

There will not be a significant impact due to water pollution during the construction. Minimal amount of water will be used for piling up steel structures required to support erect the solar panels.

3.1.7.2 *Mitigation measures (Construction phase)*

Proper channels will be built to channel the waste to artificial pond constructed for settling the water. The water after settling can be used to sprinkle on dusty ground and access roads to prevent dust emission during construction activities and vehicular movement.

3.1.7.3 *Impacts (Operation phase)*

Discharge of water after washing the solar panels has the potential to cause water pollution in the operation phase if the water is discharged directly in the natural waterways without adequate preliminary treatment. The impact can be mitigated effectively with relatively simple primary/ physical treatment of washwater such as by settlement in settling pond/ tank prior to discharge. The amount of estimated waste water required per wash is 16,856 – 28,093 L (Section 1.4.4 Materials required). And, this waste water doesnot contain any harmful chemical components in it exceprt few amount of soil particles only, as pannel are anti-soiling in nature. Thus, there will be no any adverse impact on aquatic life of Trishuli River.

3.1.7.4 *Mitigation measures (Operation phase)*

Discharge of washwater is a concern particularly due to high turbidity and sediment concentration resulting from the particulate matter and dust deposited on the solar panels by deposition phenomenon. Treated water will be used for washing the panels and the washwater will bear the dust deposited on the panels. The washwater can be channelized to artificial pond or settling tank for physical settlement of the suspended solids before discharging to the natural waterway i.e. Trishuli River near the project area. The treated water prior to discharge to the river will be tested once every three months for chemical parameters and once every three months for physical parameters, primarily pH, turbidity and total dissolved solids using portable water quality probes.

3.1.8 Waste management

3.1.8.1 *Impacts (Construction phase)*

Major potential source of waste during the construction include chemicals such as additives, admixtures, cements, solar pannels, cardboards, polysheet, metal strips, equipments packing materials (Table 3-3) used in construction. The spillage or unplanned disposal of such chemicals has the potential to cause pollution of air, soil, and water. Source areas of these wastes are construction sites, mechanical yards, and other potential sources include damaged containers, leakages in storage places, unused materials and substances, etc. Improper handling of these substances can pose occupational health hazards to the workers and can lead to contamination of the surrounding land and waterbodies by possible wash outs or soil absorption and so on.

3.1.8.2 *Mitigation measures (Construction phase)*

Mitigation measures related to waste management shall include:

- All construction wastes will be segregated into bio-degradable, non-bio-degradable and recyclable items
- Proper handling of the refuse waste will be ensured according to the nature of the refuse. Inert materials which do not create leachate and which do not harden the groundwater will be buried at a safe depth. Recyclable items will be sent for recycling. Incineration will be done using a incinerator and open incineration will be avoided
- Minimization of waste generation will be practiced

3.1.8.3 *Impacts (Operation phase)*

The issue of waste generation will be minimal during the operation as the only major source of waste in the phase will be the waste generated by workers, which can be treated as household waste and will be managed through municipal waste management.

3.1.8.4 *Mitigation measures (Operation phase)*

The wastes will primarily consist of organic waste which can be segregated and managed by burial, composting etc. Non-biodegradable solid wastes will be collected and managed through municipal waste management system.

3.1.9 Light reflection from solar panels

3.1.9.1 *Impacts (Construction phase)*

Solar panel will be installed at the last period of construction phase. So, this impact wil be insignificant in the construction phase.

3.1.9.2 *Mitigation measures (Construction phase)*

Specific mitigation measures are not required for construction phase.

3.1.9.3 *Impacts (Operation phase)*

The solar panels are designed to maximize absorption and minimize reflection to increase photovoltaic efficiency/electricity generation. To limit reflection, solar PV panels are constructed of dark, light-absorbing materials and covered with an anti-reflective coating. The solar panels reflect as little as 2% of the incoming sunlight. Thus, the potential of impacts due to reflection of light from the solar panels will be minimal. From the study of various assessments relating to solar panels installation as well as the site visit of solar installation areas of Nepal (Training Center, Nepal Alectricity Authority and Chovar site), it is concluded that the glare and reflectance levels from a given PV system are decisively lower than the glare and reflectance generated by the standard glass and other common reflective surfaces in the built environment. (PV Systems: Low levels of Glare and Reflectance vs. Surrounding Environment).

3.1.9.4 *Mitigation measures (Operation phase)*

Specific mitigation measures will not be required as the potential for impact will be minimal.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Impact on standing trees and vegetation

3.2.1.1 *Impacts (Construction phase)*

Standing trees and vegetation will have to be cleared before the construction of the project. Site clearance comprises of removal/ clearance of the standing trees and shrubs in the project footprint area. Total number of tree need to be removed is 37. The details of the loss of trees and shrubs is presented in Table 3-1.

Table 3-1: Species and number of trees, fruits and shrubs to be cleared in PFA

S.N.	Local name	Scientific name	No. in terms of Diameter at Breast Height (DBH, cm) class			Total
			SS (Less than 10)	PS (10-30)	TS (30-80)	
A	Trees					
1	Amaro	*Spondias pinnata*	1	2	0	3
2	Ipil-ipil	*Leucaena leucocephala*	68	38	2	108
3	Kapur (Camphora)	*Cinnamomum camphora*	12	6	1	19
4	Kaabhro	*Ficus lacor*	0	1	2	3
5	Kimbu (Mulberry)	*Morus alba*	6	6	0	12
6	Kutsimal	*Bombax sp.*	0	1	0	1
7	Kutmero	*Listea monopetala*	25	54	5 + 1 (Dead)	85
8	Kyaamuna	*Cleistocalyx operculatus*	5	1	1	7

S.N.	Local name	Scientific name	No. in terms of Diameter at Breast Height (DBH, cm) class			Total
			SS (Less than 10)	PS (10-30)	TS (30-80)	
9	Kharseto/ Khashreto/ Gedilo	*Ficus hispida*	52	102	0	154
10	Khiriya/ Saano khirro	*Holarrhena pubescens*	2	2	1	5
11	Khirro	*Sapium insigne*	21	63	1	85
12	Chhatiwan	*Alstonia scholaris*	0	0	1	1
13	Taanki (Camel foot plant)	*Bauhinia purpurea*	7	9	0	16
14	Tooni	*Toona ciliata*	0	2	3	5
15	Paneli/Panel/Padel	*Flacourtia jangomas*	1	0	0	1
16	Peepal	*Ficus religiosa*	4	6	3	13
17	Bakaaino	*Melia azederach*	1	5	1	7
18	Badahar	*Artocarpus lakoocha*	0	1	1	2
19	Bel	*Aegle marmelos*	2	0	0	2
20	Sipli/ Sipligaan	*Crateva unilocularis*	1	3	0	4
21	Simal (Silk cotton tree)	*Bombax ceiba*	0	1	0	1
22	Sissau	*Dalbergia sissoo*	2	2	7+1 (Dead)	12
23	Titri/Imli (Tamarind)	*Tamarindus indica*	0	1	0	1
24	Jhauwa	*Anogeissus latifolia*	6	3	0	9
		Sub-total A	*216*	*309*	*31*	*556*
B	Fruits					
25	Amba (Guava)	*Psidium guajava*	10	4	0	14
26	Aanp (Mango)	*Mangifera indica*	15	15	6	36
27	Aaru (Peach)	*Prunus persica*	3	7	0	10
28	Nibuwa/ Amilo	*Citrus aurantifolia*	18	4	0	22
29	Bhogatey (Pomelo)	*Citrus maxima*	6	7	0	13
30	Litchi	*Litchi chinensis*	1	5	0	6
		Sub-total B	*53*	*42*	*6*	*101*
C	Shrubs					
31	Chiple ghaans	*Oreocnide frutescens*	24	7	0	31
32	Aank (Crown flower)	*Calotropis gigantea*	6	1	0	7
33	Simali	*Vitex negundo*	1	0	0	1
		Sub-total C	*31*	*8*	*0*	*39*
		Total (A + B + C)	300	359	37	696

Source: Tree Inventory in Project Footprint Area, Field Visit 2021

Note: SS: Seedlings and saplings, PS: Pole Size, and TS: Tree size

3.2.1.2 *Mitigation measures (Construction phase)*

The clearance of trees and vegetation will have to be carried out within the premises of NEA owned land/project footprint area. The procedures specified in the section 4 of the "Standard for Removing Government Trees, 2071 (सरकारी रुखहरु हटाउने सम्बन्धी मापदण्ड,२०७१)" will be followed. As required by the standard, upon the departmental decision of the District Forest Office (concerned agency), an Examination Committee comprising of 7 members with DFO as the coordinator will be formed for the purpose of the standard. The committee will examine the trees to be cleared and inspect the area for felling of trees as per the request for removing the trees in the project area. The cost for such monitoring will be the responsibility of related office/project. Following the recommendation of the committee and with the subsequent permission from concerned District Forest Office, the project/concerned agency should clear the trees in its own cost and can sell the forest products in accordance with "Standard for Removing Government Trees, 2071" (सरकारी रुखहरु हटाउने सम्बन्धी मापदण्ड,२०७१) and then deposit the income for royalty. In order to contribute to environmental conservation and as a part of CSR initiatives, the project will support Sunadevi CFUG to carry out forest conservation activities in Sunadevi Community Forest located in the vicinity of the project area.

3.2.1.3 *Impacts (Operation phase)*

Since the project will occupy the land area permanently, the ground vegetation and standing crops cover will be lost due to the project.

3.2.1.4 *Mitigation measures (Operation phase)*

There will not be any tree species in the project area during the operation phase. So, no mitigation measures will be required.

3.2.2 Impact of solar panels on birds

3.2.2.1 *Impacts (construction phase)*

The impact due to construction activities for the erection of solar panels at the project site will be insignificant.

3.2.2.2 *Mitigation (construction phase)*

Mitigation measures will not be required.

3.2.2.3 *Impacts (operation phase)*

The cumulative impact of all solar panels installed in the project area may impart the illusion/ appearance of water body in the area and may confuse/ misguide predatory birds to the solar panels. Also, illusion of water body will be very minimum, as the Solar pannels are anti-reflective in nature. However, as observed during the field surveys, the abundance and diversity of such predatory birds that dive in the water for prey is less in the project area (Blue-throated king fisher was the only representative of such birds in the area, Annex E). So, the potential for bird injuries or casualties potentially attributable to birds diving on to the panel appears to be insignificant issue for the project area.

3.2.2.4 *Mitigation (operation phase)*

No specific mitigation measures are required.

3.3 SOCIAL ENVIRONMENT

3.3.1 Labour influx, labor camp location and management

3.3.1.1 *Impacts (Construction phase)*

Issues such as sense of insecurity may become more pronounced with influx of outsiders as workers. Total number of HR is estimated 40. Out of which 8 are skilled, 10 semi-skilled and 22 are unskilled. Skilled and semi-skilled HR are supposed as outsider workers. The labor camp should be located inside project premises at an adequate distance from the settlement. Locating the labor camp reasonably away will minimize the potential for any disturbance and undesirable social consequence that maybe caused by the presence of migrant workers in the area. Moreover, project has already established it's labour camp at Staff quarter area. Since, construction of staff quarter area is completed and same will be used for this project as well.

3.3.1.2 *Mitigation measures (Construction phase)*

Impacts due to the presence of labor camp in and around project will be temporary but cannot be neglected. The mitigation measures recommended in this regard are:

- Priority will be given to local people from indigenous community as per their skills and experience as far as possible while sourcing workers required for the construction phase
- The workers in the camps will be oriented about desirable social behavior and conduct by organizing periodic orientation programs
- Proper solid waste management and sanitation practices will be managed in the camps
- Labour camp will be provided with closed toilet (gender based) with temporary septic tank

3.3.1.3 *Impacts (Operation phase)*

During operation phase, potential issues due to the location of labour camps will be insignificant as only a few workers will be stationed in the project area in the phase.

3.3.1.4 *Mitigation measures (Operation phase)*

It is recommended to prioritize the recruitment of qualified local people among the staff required during the operation phase. The staff should be oriented about proper social conduct with regard to their interaction with the community.

3.3.2 Impacts on cremation site

3.3.2.1 *Impacts (Construction phase)*

A cremation site is located at the right bank of Trishuli River near the project area. The access road to the cremation site from Mandredhunga passes through the project area and the access to the cremation site through the road will be obstructed due to the project. or Provision of alternate access road to the existing cremation site or relocation of the creamation site if needed should be done through public consultation so as to preserve the cultural values of the locals residing in the area.

3.3.2.2 *Mitigation measures (Construction phase)*

Cremation site is closely associated with the people's culture and religious practices. The impact due to the loss of access and potential relocation should be duly addressed with the following mitigation measures;

- An alternative access route will be provided to for the access of the public to the cremation site
- The project will support the local community in the improvement and maintenance of the cremation site

3.3.2.3 *Impacts (Operation phase)*

There will not be any impact on the cremation site during the operation phase once the issue of access road is resolved during the construction phase.

3.3.2.4 *Mitigation measures (Operation phase)*

No mitigation measures will be required during the operation phase.

3.3.3 Issues of security in the society

3.3.3.1 *Impacts (Construction phase)*

During construction phase, a large number of migrant workers will congregate in the project area increasing the pressure on the public infrastructures and the community resources. This may create potential for conflict between local people and outsiders. Activities like alcoholism, gambling, and prostitution may increase in the project area.

3.3.3.2 *Mitigation measures (Construction phase)*

The following mitigation measures are recommended to enhance the status of security in the project area and affected community:

- Local labourers from Mandredhunga village will be given priority in the work force to reduce need for migrant workers and social issues associated with influx of outsiders
- Social awareness raising programs and consultation with the community stakeholders will be organized to mitigate activities like gambling, alcohol abuse and prostitution
- A code of conduct for labors and their monitoring will be made to prevent potential social conflicts by NEA/ CSC

3.3.3.3 *Impacts (Operation phase)*

During the operation phase, potential issues of security in the community will be minimal as only a few workers will be stationed in the project area in the phase.

3.3.3.4 *Mitigation measures (Operation phase)*

It is recommended to prioritize the recruitment of qualified local people among the staff required during the operation phase. The staff should be oriented about proper social conduct with regard to their interaction with the community.

3.3.4 Disturbance in local infrastructure

3.3.4.1 *Impacts (Construction phase)*

During the construction period, temporary labour camp will be built. Providing the camp with essential facilities like electricity, water supply, waste disposal etc. will add burden on the existing infrastructure in the locality and may affect the access of the local residents to such facilities and infrastructure. Vehicular movement in the area will also be higher than usual which is likely to increase the problems of dust emission, traffic congestion, damage to the roads, increase in road accidents in the area etc. Influx of migrant workers in the area during the construction phase will add pressure on the available social facilities. For instance, increase in demand of consumer goods may lead to change in prices, rent rates etc. Noise pollution during the construction phase may affect the quality of teaching learning activities at Mandredhunga Basic School which is located in the vicinity of the project area.

3.3.4.2 *Mitigation measures (Construction phase)*

The following mitigation measures are recommended to minimize the potential impact on local infrastructure:

- Proper management of traffic will be done including mandated regular maintenance of vehicles, prohibition on honking of loud horns etc.
- Spraying of water on the roads used during project construction will be done on a regular basis
- Traffic signals and sign boards will be installed as per requirement and in coordination with the authorities
- Proper coordination with authorities will be done to ensure that the access of the community to public facilities and supplies such as drinking water, electricity is not affected due to increased pressure on the existing infrastructures
- Construction activities producing noise (drilling, land scaping, soil compaction) will be done during school off hour
- Vehicles transporting construction materials will not enter into settlement area. It will be stopped ar construction storage point as described in Section 3.1.5.1

3.3.4.3 *Impacts (Operation phase)*

The operation of the project will not affect the local infrastructure significantly as the operation will require small workforce and low vehicular movement for project activities.

3.3.4.4 *Mitigation measures (Operation phase)*

No mitigation measures will be required.

3.3.5 Occupational health and safety

3.3.5.1 *Impacts (Construction phase)*

Occupational safety and health issues may be pronounced during the construction phase which includes construction of internal roads and buildings, levelling of ground, works in mechanical yards, installation of steel pipes, drilling works, panel installation and so on. Some potential occupational health and safety hazards associated with the different activities during construction are listed below:

- Respiratory problems and eyes problems due to prolonged exposure to smoke and dust and potential contact with chemicals used in construction
- Fire hazards while working with inflammable petroleum products, electrical circuits and in labour camps
- Skin burn and skin problems while working with different construction materials/ chemical such as cement, bitumen, thinner, petroleum products, acids etc.
- Accidents and injuries while working with heavy equipments, construction vehicles, during loading and unloading of construction materials, earthwork at excavation site etc.
- Effects of prolonged exposure to noise and vibration for instance during road compaction, drilling sites etc.

3.3.5.2 *Mitigation measures (Construction phase)*

The health and safety of workers will be given utmost priority. Basic OHS measures to be implemented are as follows:

- Entry of unauthorized people will be prohibited inside the construction area
- Information about possible danger and their safeguards will be provided to the workers and will be made clearly visible in the required work sites
- Orientation and training on occupational health and safety will be provided to all workers
- Use of PPE such as helmets, gloves, masks, protective glasses, work boots will be made mandatory and the workers will be provided with the necessary PPE
- First aid kits will be made available and adequately accessible at the working sitee; adequate information about the same will be provided during toolbox talk
- Safe drinking water, toilets, sanitation facilities, will be made adequately available at the construction sites and the labour camp
- Firefighting mechanisms will be installed in the camps
- The contractor will prepare and submit for approval a comprehensive OHS plan before the commencement of construction
- Insurance of workers and staffs shall be done by the contractor as per prevalling laws, “Labor rule 2050 and Public Procurement Rule 2064”

3.3.5.3 *Impacts (Operation phase)*

The potential OHS impacts will be minimal in the operation phase compared to the construction phase. However, potential hazards to operators and maintenance workers such as fire hazards, electrical hazards cannot be ignored.

3.3.5.4 *Mitigation measures (Operation phase)*

OHS measures will be prioritized during the operation phase. The mitigation measures include:

- Rules and Standard Operating Procedures will be prepared and enforced by the project for all staff involved in the operation phase
- Regular training and updates on OHS will be provided to all workers and staff according to their specific nature of work
- PPE will be made mandatory in the work place
- Sign boards and notice boards with clear message and instructions will be kept at hazard and accident prone areas in Nepali as well as English languages

3.4 CORPORATE SOCIAL RESPONSIBILITY

An estimated amount of NRs. 65,00,000 shall be allocated for CSR activities by the project, Table 3-2. CSR activities can encompass the following areas/ activities:

i. Mandredhunga Basic School is located adjacent to the project area and is the closest school to the project-affected community in Mandredhunga. The project's CSR activities can benefit the local community through the improvement of basic infrastructure and facilities at the school. The school runs classes up to grade 5 currently and the school's infrastructure includes four buildings (one RCC building and three truss type buildings). During the consultation with the school management, it was found that CSR support from the project can help improve the library, computer lab, toilets, drinking water facility, fencing, and playground of the school. It is recommended that the project seek a plan from the school for CSR support and the project then review the plan and fund the school for improvement and expansion of facilities as appropriate and feasible.

ii. Provision of safe drinking water for the Mandredhunga community

iii. Drainage water management for improving the sanitation in the settlement area

iv. Organization of skill enhancement training for the local people such as: tailoring, high-value agriculture e.g.: mushroom farming, homestay management training

v. Land stabilization (retaining walls) in the south-western side of the project area and the school facing the stream channel will be vital for reducing the risk of landslide which is essential for the project and will benefit the school as well

vi. Construction and/or renovation of community infrastructures such as *Pati-pauwa* and *Chautara* as public resting places and gathering places

vii. Support to the Sunadevi Community Forest Users' Group for forest and bio-diversity conservation

Table 3-2: Possible CSR activities and estimated allocation of costs

S.N.	Dimension of CSR	Estimated Amount (NRs.)	Time schedule
1.	Support to Mandredhunga Basic School[14]	15,00,000	During Construction period and will be started after 3 month of contract awarded
2.	Drainage Water Management	5,00,000	
3.	Skill enhancement training for surrounding community	5,00,000	
4.	Landslide control	20,00,000	
5.	Paati pauwa and chautara	5,00,000	
6.	Support to Sunadevi Community Forest and Biodiversity conservation work (This amount has to be spent in conservation activities only)	5,00,000	
7.	Drinking water	10,00,000	
	Total	65,00,000	

Note: CSC will be responsible for monitoring

3.5 WASTE AND OCCUPATIONAL HEALTH & SAFETY MANAGEMENT PLAN

A major issue during the construction phase will be waste management and occupational health and safety. Related potential impacts and mitigation measures are presented in detail in Sections 3.1.8 Waste management and 3.3.5 Occupational health and safety. The management plan is intended for planned management of waste generated due to project activities and for implementation of occupational health and safety measures, the implementation of which will be overseen by the construction supervision consultant. Due to its degree of severity, separate management plans for each are made and are described in Sections 3.5.1 Waste management plan and 3.5.2 Occupational health and safety management plan.

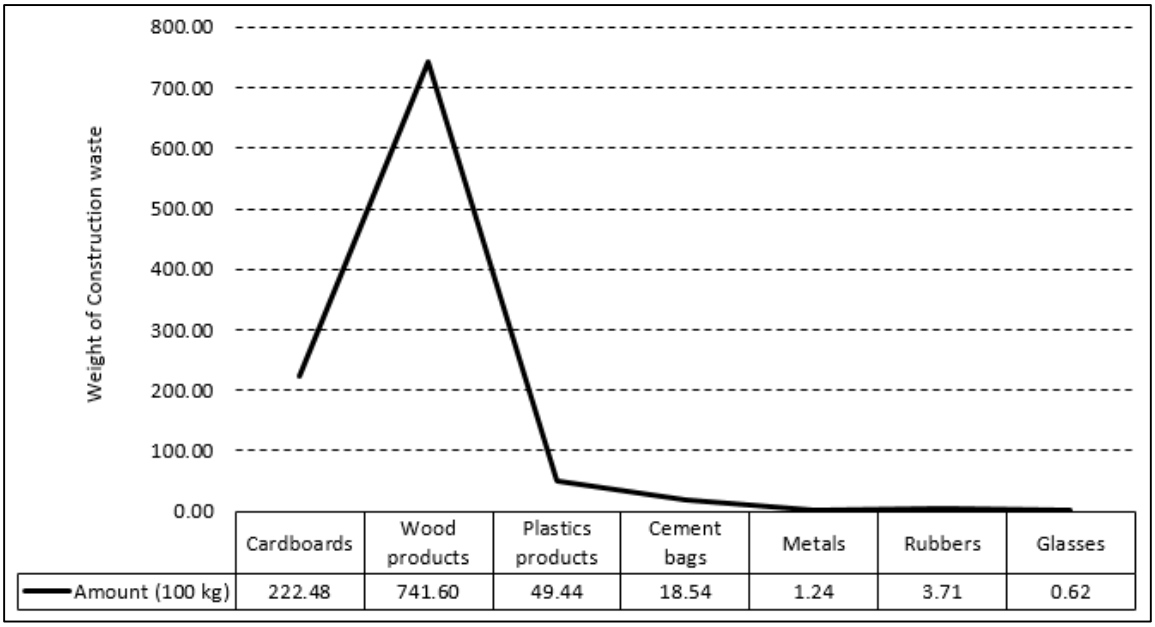
3.5.1 Waste management plan

The major objective of the waste management plan is to manage the wastes generated during project construction and operation in a safe and environment-friendly manner. This plan is mandatory and needs to be executed by the Construction Supervision Company. Some of the objectives of the plan are mentioned below;

- To reduce the amount of waste generated using 3R's (Reduce, Reuse, Recycle) principle
- To comply with the "methods of avoidance" which will promote the use of reusables and reusing materials after its repair and maintenance instead of buying
- To provide efficient and economical refuse collection, recycling, and disposal services

[14] To implement this CSR, NEA shall enter into aggrement/ MoU with school admistration.

The amount of construction waste generated is estimated to be around 103,762 kg during the construction phase of the project. Anticipated types of waste generated include cardboards and wood products (Wood pallet and its products) used in packaging and shipping of solar panels and other equipments, plastics products (Plastic and its products), cement bags, metals, rubber, and glasses. The types and estimated volume of wastes are presented in Figure 3-1.



	Cardboards	Wood products	Plastics products	Cement bags	Metals	Rubbers	Glasses
Amount (100 kg)	222.48	741.60	49.44	18.54	1.24	3.71	0.62

Figure 3-1: Types of waste with their estimated volume

3.5.1.1 *Waste minimization pyramid*

Waste minimization plans will help minimize the waste from the preliminary stages and at source. Generally, 4R's (Reduce, Reuse, Recycle and Recover) principles are in practice, but in the project's context "Energy recovery" is not possible due to the advanced level of technology required for the purpose. Thus 3R's (Reduce, Reuse and Recycle) will be feasible for implementation rather than 4R's principle. The diagrammatic representation of waste minimization pyramid in the context of the project is shown in Figure 3-2.

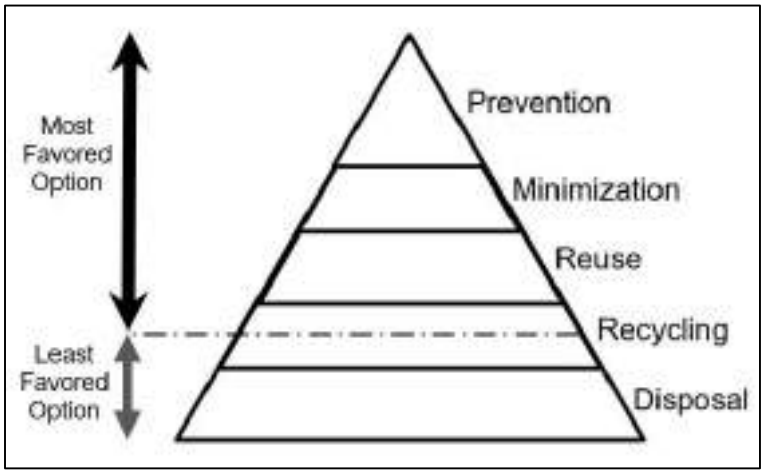


Figure 3-2: Waste minimization pyramid

3.5.1.2 *Source, mitigation, and management of generated waste*

The volume of the solid wastes generated at various sites during the construction, if discharged haphazardly, will degrade the quality of land and the adjoining water bodies. The envisaged pollution effects are not only aesthetic but also chemical and biological with implications extending to the general sanitary conditions and ecological health of water bodies in the vicinity of the project.

- A solid waste management system for collection, segregation, and final management of solid wastes in the camp and construction area will be established and operated for all the construction sites
- Haphazard disposal of solid waste shall be strictly prohibited within project area
- Spent oil, burnt mobil, grease, unused chemicals will be collected in a centrally located collection center and stored in plastic drums for safe disposal in coordination with the local municipality

Table 3-3: Source, mitigation, and management of generated waste

S.N.	Types of waste	Source	Method of Management	Waste	
				Stream	Destination
1.	Cardboards	Packaging of Solar module. Approximately 380 carton boxes of size 18 ft × 3.6 ft each will be required. Estimated total weight: 223 × 100 kg	Construction supervision consultant will hire a local waste collection company for collection and sale of the cardboards. This will not only save cost of disposal but will rather generate revenue.	Recycle	Waste collection company
2.	Wood products	From storage of stack solar module. Around 780 wooden pallets with 742 × 100 kg weight.	• Wooden pallets of good condition will be sold to local venders for furniture manufacture • Broken and unusable pallets will be used in labor camps for fuel woods	Recycle and Reuse	Local vendors, furniture company, and labor camp
3.	Plastic products	Covering of solar module. Estimated weight: about 50 × 100 kg.	Construction supervision company will donate reusable plastic waste to local plastic recycling organizations. The plastic waste which cannot be utilized will be disposed to a dumping site in coordination with the municipality.	Reuse and disposal	Local recycling agencies and municipal dumping site
4.	Cement Bags	Cement required for construction site. Estimated weight: around 19 × 100 kg.	Construction supervision company will donate reusable plastic waste to local cement bag recycling organizations. The bags which cannot be utilized will be disposed to dumping site in coordination with the municipality.	Reuse and disposal	Local recycling agencies and municipal dumping site

S.N.	Types of waste	Source	Method of Management	Waste	
				Stream	Destination
5.	Metals	Sources include metal pieces, binding wires, iron nails, cut rebar and so on. Estimated weight: around 1.24 × 100 kg.	Construction supervision company will sell the scrap metals and generate revenue.	Recycle	Recycling agencies
6.	Rubber	Sources of rubber wastes are worn out rubber tires, unused gloves and discarded rubber materials. Estimated weight: 3.71 × 100 kg.	The discarded rubber will be sold to recyclers or disposed to dumping site in coordination with municipality.	Reuse and disposal	Recycling agencies and municipal dumping site
7.	Broken glass	Solar module is the main potential source especially in case of accidental breakage and mishandling. Estimated weight: about 0.62 × 100 kg.	These wastes will be stored carefully in a separate containment/ bin with clear labels and will be disposed as per recommended disposal prescriptions at dumping site in coordination with the municipality.	Disposal	Municipal dumping site

Source: Estimated as per Engineering Study Report, 2019 (Risen Solar Technology)

3.5.2 Occupational health and safety management plan

3.5.2.1 *Introduction*

The purpose of this plan is to ensure that the health and safety (H & S) standards of the project conform to statutory requirements of the relevant laws of Nepal. Work should not proceed until the contractor, the consultant, and the NEA take proper precautions to ensure environmental protection, and health and safety of all the workers involved in the project.

3.5.2.2 *Scope*

The procedure applies to all subproject sites and covers all aspects of H & S procedures. It shall also cover the conduct of site H & S disciplines. It aims to reduce occupational and environmental risks during the construction and operation of the project to an acceptable level through H & S control.

3.5.2.3 *Procedures*

These procedures are prepared for managing H & S aspects of project as required by statutory regulation.

A. Subproject initiation

Subproject initiation includes addressing H & S requirements pertaining to the subprojects as summarized below.

a. The contractor shall obtain a copy of current standard H & S documents, such as the Health and Safety Manual and any other guidelines issued by the NEA or the World Bank
b. The NEA can make necessary amendments to the standard H & S documents to suit the subproject need and requirements in the tender documents
c. The NEA and CSC will ensure that the requirements on H & S in the tender documents are implemented throughout the construction stage. The requirements include the following particulars
    - Providing and using PPE such as hard hats, ear muffs, masks, breathing apparatus, high visibility vests, lifting harnesses with ropes, gloves, and/or safety shoes or boots
    - Appointing dedicated OHS officers (depending on the size of the subproject and workforce)
    - Providing safety signage
    - Providing measures for protecting the safety of workers and the public
d. Labors should file grivance through OHS officer of contractor and if grivance are not addressed will be forward to GRC
e. The Project Manager will ensure a smooth line of communication between NEA staff, related internal departments, the project, and the contractors

B. Submission of safety documents

a. The NEA shall ensure that H & S documents submitted by the contractors are adequate

b. The H & S documents comprise the Health and Safety Manual and contractor's H & S Plan in accordance with national laws
c. The environmental documents comprising the environmental policy, environmental laws and project ESMF
d. The Project requires that the contractor submit an Emergency Response Plan included in the H & S Plan
e. The NEA and CSC will review and approve the contractor's H & S documents prior to commencing the site work. The project will respond to all comments from the contractor for further action
f. Upon approval, the contractor will carry out its work in accordance with the approved Health and Safety Plan, Environmental Management Plan, and any other requirement of the GoN or WB

C. Monitoring of health and safety plan compliance plan during construction

a. The NEA and CSC will monitor health and safety aspects regularly and record all observations on issues concerning H & S
b. Methods of monitoring are listed below
   - Regular Monitoring: The contractor's H & S officer will conduct regular H & S monitoring on site. An H & S Inspection report is issued to the contractor for any activities found to be non-compliant to the H&S requirement
   - H & S Audit and Inspection: The Consultant together with the CSC's H & S Officer will carry out periodic H & S audits with the contractor to prepare the status report for submission
   - Subproject Site Meetings: H & S issues for particular subprojects are a part of the agenda in the regularly scheduled project review meetings

D. Health and safety training and awareness program

The NEA and CSC shall ensure that the contractor conducts H & S related programs and training to raise the level of H & S awareness, skills, and knowledge among its staff and workers. Such programs and training may include the following:

a. Toolbox meetings
b. Safety campaign
c. General safety awareness talks

E. Accident reporting procedure

The NEA and CSC shall ensure that the contractor complies with requirements of national laws for reporting of accidents. This will be done as per Occupational health and safety manual, Table of Contents for the same is proposed in sub-section G of this Section. Contractor is responsible to prepare this manual and need to get approval from NEA.

F. Fire prevention measures

The Project shall ensure that the contractor takes fire preventive measures during construction according to national laws.

G. Occupational health and safety manual

The CSC will be required to prepare occupational health and safety manual as per GoN and WB requirements for proper implementation of project. The manual shall consist of the following contents:

Chapter 1: Overview of health and safety features

Chapter 2: Safety policy of the project

- 2.1 Safety policy statement
- 2.2 Contractor's overall safety responsibilities
- 2.3 Contractor's safety specialist's responsibilities
- 2.4 Contractor's foreman's responsibilities
- 2.5 Worker's responsibilities
- 2.6 Disciplinary policy procedures
- 2.7 Involvement of the public
- 2.8 Color coding for PPE

Chapter 3: Health policy and amenities

- 3.1 Camp establishment and operation
  - 3.1.1 Accommodation (Washing, cooking, bedding facilities)
  - 3.1.2 Toilets
  - 3.1.3 Drinking water
  - 3.1.4 Waste collection bin
  - 3.1.5 Lighting
  - 3.1.6 Ventilation
  - 3.1.7 Maintenance of facilities
- 3.2 First-aid facilities
- 3.3 Insurance of construction workers
- 3.4 Site facilities for works of short duration
- 3.5 Avoiding fire hazards

Chapter 4: Employee training

- 4.1 Competent person designation
- 4.2 Safety induction for new employees
- 4.3 Toolbox meetings

Chapter 5: Accidents and emergency

- 5.1 First aid requirements
- 5.2 Assisting coworkers in medical emergencies
- 5.3 Emergency evacuation plan

6.14 Workplace violence

6.14.1 Reducing workplace violence hazards

6.14.2 Actions if someone witnesses or experiences workplace violence

Appendices

Appendix A: List of relevant laws and regulations

Appendix B: Sample health and safety plan format

Appendix C: Standard inspection and report formats

Appendix D: Worksite safety checklists

Appendix E: Sample health and safety signs

3.6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP comprising of the following mitigation measures, Table 3-4, have been proposed to mitigate the possible adverse impacts and enhance the potential beneficial impacts identified during the study.

Table 3-4: Matrix of potential environmental impacts and mitigation measures

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
A	*Physical environment*							
1	Land use and land take	The project along with the buffer will use 5.01 ha of land area for the solar farm. The ownership of land is with NEA.	A 20-25 m buffer strip should be maintained between the solar panels and the houses/settlement adjacent to the project fencing area while erecting the solar panels.	Between the solar panels and the settlement	Construction phase	Project cost	Contractor	CSC/ NEA
2	Air quality	The source of air pollution will be emissions from construction vehicles and equipments. Also, activities like site clearance including clearance of trees, demolition of structures, cut-fill work for levelling and grading of the land will add to air pollution.	• Open storage, heaping of loose soil in and around construction site will be prohibited. Also, haphazard and unmanaged storage, stockpiling, and disposal of excess material will be avoided • Regular water sprinkling: The project will ensure that the project access roads will be regularly sprinkled with water at least twice daily in the dry season	Construction site	Construction phase	Project cost	Contractor	CSC/ NEA
3	Noise quality	Noise pollution will be generated by construction vehicles like backhoe loaders, excavators, construction vehicles and loaders.	• Construction activities which will produce high sound will be scheduled during day time only • Prohibition of vehicles and equipment which emit excessive sound and periodic	Construction site and access roads	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
			servicing and maintenance plan of the vehicles will be mandatory • The project will ensure restriction on the use of loud vehicular horns					
4	Soil pollution	Soil at and around the construction site will be contaminated by the deposition of construction contaminants like particulate matters, glues, diesel, oils, other toxic chemicals, and cement as well as haphazard deposition of solid and liquid wastes around the project sites.	• The excavated spoil/ muck debris will be properly piled up in the designated area within the project site and will be reused for the landscaping activities • Solid wastes generated during the construction activities will be segregated and disposed as per the nature of wastes regularly without letting the wastes to stay exposed for long periods of time • Proper storage of cement, paints, fuels, grease etc. will be practiced	Construction site	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
5	Storage and stockpiling	Construction materials such as soil, gravel, sand, aggregates etc. or excess material if used unmanaged will lead to blowing away of the dust particles. Heavy rain also can wash away the finer particles and pollute the top soil, surface water and water bodies downstream.	• Garland drains around spoil and quarry sites will be constructed to capture the runoff and divert the same to the nearest natural drain • Depression and/or craters will be filled by the dumping materials consisting of boulders, rock, gravel and soil from nearby plant/ working sites	Construction site	Construction phase	Project cost	Contractor	CSC/ NEA
6	Land instability and erosion	A landslide-prone, exposed slope in the south-western side of the project area may be triggered by construction activities may trigger small-scale land instability/ landslide.	• Slope of the cut areas especially in project component will be maintained • Landscaping will be done in required sites • Bioengineering methods will be used to stabilize the landslide-prone/unstable slopes	Construction site and landslide-prone slopes	Construction phase and operation phase	Project cost	Contractor	CSC/ NEA
7	Water pollution	*Construction phase:* There will not be a significant impact due to water pollution during the construction.	Proper channels will be built to channel the waste to artificial pond constructed for settling the water. The water after settling can be used to sprinkle on dusty ground to prevent dust emission during construction activities.	Construction site	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
		Operation phase: Minimal amount of water will be used for piling up steel structure, which will be used to erect solar panels.	The washwater can be channelized to artificial pond or settling tank for physical settlement of the suspended solids before discharging to the natural waterway i.e. Trishuli River near the project area. The treated water prior to discharge to the river will be tested once every six months for chemical parameters and once every three months for physical parameters, primarily turbidity and TDS using portable probes.		Operation phase			
8	Waste management	Improper handling of wastes can pose occupational health hazards and contamination of the surroundings by possible wash out or soil absorption and so on.	Wastes will be properly managed according to their nature. Inert materials which do not create leachate and which do not harden the groundwater will be buried at a safe depth. Recyclable items will be sent for recycling. Open incineration will be avoided.	Construction site	Construction phase and operation phase	Project cost	Contractor	CSC/ NEA
B	*Biological environment*							
9	Impact on standing trees and vegetation	Standing vegetation in the project footprint area including 37 trees (DBH: greater than 30 cm), 351 pole size trees (DBH: 10-30 cm) and 269 tree	The project will support Sunadevi CFUG to carry out forest conservation activities in Sunadevi Community Forest located in the vicinity of the	Construction site and Sunadevi Community Forest	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
		seedlings and saplings (DBH less than 10 cm) of about 24 varieties of trees, 6 varieties of fruits and 3 varieties of shrubs will have to be cleared in the project site. The tree varieties are mostly fodder trees. The loss of standing crop will be insignificant. The procedures specified in the section 4 of the "Standard for Removing Government Trees, 2071" will be followed.	project area as a part of CSR initiatives and in order to contribute to environmental conservation.					
C	*Social environment*							
10	Labour influx, labor camp location and management	*Construction phase:* Issues such as sense of insecurity may become more pronounced with influx of large number of outsiders as workers.	• Priority will be given to local people as per their skills and experience as far as possible while sourcing workers for the construction • Location of contractor camp, worker camp and project camp will be located well inside the project boundary and far away from settlement area • The workers in the camps will be oriented about	Construction site, camp area	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
			desirable social behavior and conduct by organizing periodic orientation programs					
		Operation phase: Potential issues due to staff camp will be insignificant as only a few workers will be stationed in the project area in the phase.	Recruitment of qualified local people among the staff required shall be prioritized. The staff should be oriented about proper social conduct with regard to their interaction with the community.		Operation phase			
11	Impacts on Cremation site	The construction of the project will obstruct the existing access road to the cremation site used by the local community.	An alternative access route will be provided for the access of the public to the cremation site. If this is not feasible, the cremation may be relocated to an appropriate alternative location in consultation with the stakeholders.	Cremation site	Construction phase	Project cost	Contractor	CSC/ NEA
			The project will support the local community in the improvement and maintenance of the cremation site.		Operation phase			
12	Issues of security in the Impact on indigenous people and	*Construction phase:* About 40 workers will congregate in the project area increasing the pressure on the public infrastructures and	• Local labourers will be given priority in the work force to reduce need for migrant workers and social issues associated with influx of outsiders	Construction site and surrounding settlement	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
	their livelihoods	resources may create potential for conflict between local people and outsiders. Activities like alcoholism, gambling, and prostitution may increase in the project area.	• Social awareness raising programs and consultation with the community stakeholders will be organized to mitigate activities like gambling, alcohol abuse and prostitution					
		Operation phase: Potential issues of security in the community will be minimal as only a few workers will be stationed in the project area.	• Recruitment of qualified local people among the staff required for the operation phase • The staff should be oriented about proper social conduct with regard to their interaction with the community		Operation phase			

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
13	Disturbance in local infrastructure	*Construction phase:* Providing the labour camp with essential facilities like electricity, water supply, waste disposal etc. will add burden on the existing infrastructure in the locality and may affect the access of the local residents to such facilities and infrastructure. Increased vehicular movement is likely to increase the problems of dust emission, traffic congestion, damage to the roads, increase in road accidents etc. Noise pollution can affect teaching in the school.	• Adequate number of camps for labourers, contractors and proponent staff will be constructed • Proper management of traffic including mandated regular maintenance of vehicles, prohibition on honking of loud horns etc. • Spraying of water on the roads used during project construction on a regular basis • Proper coordination with authorities to ensure that the access of the community to public facilities and supplies are not affected due to increased pressure on the existing infrastructures	Construction site and surrounding settlement	Construction phase	Project cost	Contractor	CSC/ NEA
14	Occupational health and safety	*Construction phase:* Respiratory and eyes diseases problems; Skin burn and skin diseases; Physical accidents; Effects of sound and vibration	• Entry of unauthorized people will be prohibited inside the construction area • Information about possible danger and their safeguards will be made clearly visible in the work sites • OSH training to workers, toolbox talk	Construction site, labour camps, staff quarters	Construction phase	Project cost	Contractor	CSC/ NEA

S.N.	Issues/ Aspects	Impacts	Mitigation measures	Location	Time of action	Mitigation cost (NRs.)	Institutional responsibility	
							Implementation	Supervision
			• Mandatory use of PPE at work sites • Provision of First aid kits, safe drinking water, toilets, sanitation facilities at the construction sites and the labour camp • Firefighting mechanisms; • Comprehensive OHS planning by contractor before the commencement of construction					
		Operation phase: The potential OHS impacts will be lesser than in the construction phase. However, potential hazards to operators and maintenance workers such as fire hazards, electrical hazards etc. cannot be ignored.	• Standard Operating Procedures will be prepared and enforced • Routine OHS training to staffs according to specific nature of work • Signage with clear message and instructions at hazard and accident prone areas		Operation phase			

Note: CSC – Construction Supervision Consultant

Chapter 4. MONITORING AND REPORTING MECHANISM

4.1 ENVIRONMENTAL MONITORING

Environmental Monitoring (EM) is undertaken to collect data/ information of the environment in the impact area of a project to assess the compliance of the implementation of Environmental Protection Measures (EPM) and other regulatory standards and to assess the effectiveness of EPM. It involves the observation and measurement of physical, biological and socio-economic, and cultural variables associated with a project at different stages. Environmental monitoring helps to assess the environmental impact of the project and the effectiveness of mitigation measures implemented with respect to the baseline conditions.

It gives meaningful information about the environmental changes due to the project and helps improve the implementation of mitigation measures. The types of environmental monitoring are baseline, compliance, and impact monitoring. The environmental monitoring will be done by the Environmental Management Unit (EMU) of the project. This EMU is a part of CSC for regular monitoring and inspection of project activities. It comprises a team of two members, Environmental officer (1) and Social liason officer (1). The EMU will perform its activities in coordination with relevant stakeholders as needed during the monitoring work. NEA is responsible for regular monitoring and reporting of the implementation of the project.

The experts from the Construction Supervision Company will visit the project site periodically for environmental monitoring and will prepare the monitoring report. The Project Manager's Office (PMO) will be responsible for the dissemination of the report to the concerned agencies and stakeholders. The details of monitoring parameters, schedule, method, and agencies to be consulted for physical, biological, socio-economic, and cultural environment during the construction and operation phases are presented in Table 4-1.

4.1.1 Objectives of environmental monitoring

- To ensure that the project baseline conditions were adequately documented such that a comparative evaluation of the environmental conditions before and after the commencement of the project can be made precisely for impact evaluation
- To ensure actual implementation of the prescribed measures for the minimization of adverse impacts and maximization of beneficial impacts by the project
- To assess the project impacts against the limits of the impact prediction and to devise mitigation measures for any unforeseen impacts that may be apparent after project development.

The following procedures will be adopted for monitoring by this project:

- Identification of the sources/ causes and characteristics of all observed environmental impacts
- Quantification of claims on resources and discharges to the environment

- Quantification and qualification of indirect effects on the environment to the extent possible.

To meet the aforementioned objectives and procedures, three types of monitoring plans are envisaged viz. Baseline Monitoring, Compliance Monitoring, and Impact Monitoring. Details of the monitoring plan are presented below:

4.1.1.1 *Baseline monitoring*

Baseline monitoring should be conducted based on the environmental conditions of the surrounding/project area of the proposed project before the commencement of construction. As a result, subsequent measurements of the corresponding environmental parameters after project construction can be used to assess changes over time in those parameters compared to the baseline conditions. Whenever possible, environmental conditions at reference sites (sites that are likely to be unaffected by the project) should also be assessed. The different components of baseline monitoring including indicators, locations, and methods are presented in Table 4-1. The baseline monitoring is scheduled before the construction phase.

4.1.1.2 *Compliance monitoring*

It involves periodic sampling or continuous recording of specific environmental quality indicators or pollutants during the construction and operation phases to ensure project compliance with recommended environmental protection standards. Compliance monitoring helps to assess the compliance of mitigation measures as proposed in the ESMP by the proponent. The compliance monitoring plan includes monitoring parameters, indicators, methods, and schedules as shown in Table 4-1. It will focus mainly on:

- Compliance with the tender clause
- Compliance with the mitigation measures
- Timely and adequate implementation of EMP, and
- Overall environmental and social performance of the project

4.1.1.3 *Impact monitoring*

Environmental parameters of the project area are expected to change due to the project-associated activities. These parameters must be measured during the project construction and operation phases to assess the impact of the project. Impact monitoring plan includes indicators, locations, methods, and schedules as shown in Table 4-1. It includes:

- Monitoring of the impacts of the project on the physical, biological, socio-economic, and cultural environment of the project area
- Monitoring of the accuracy of the predicted impacts
- Identification of the unforseen impacts due to project activities or natural process and development of remedial action including livelihoods of people, mainly Indigenous people, and
- Monitoring of the effectiveness of mitigation measures

Table 4-1: Environmental monitoring plan

S.N.	Parameter	Phase	Indicators	Methods	Locations	Frequency
A	*Physical environment*					
1	Air quality	Construction	• Foul smell • Dust emission at construction site and access roads and sprinkling of water on the roads • Smoke plumes • * Dust deposition on vegetation and houses near construction site and access roads	Site inspection and observations	Construction site and access road	Daily and * Weekly
		Operation	• Foul smell • Dust deposition on solar panels	Site inspection and observations	Project area	Weekly
2	Noise quality	Construction	• Noise level dB (A) • Tolerability of sound at construction sites • Movement of construction vehicles	• Site inspection and use of portable sound level meter/mobile phone applications for sound measurement • * Subjective assessment of tolerability of sound • Frequency of vehicle movement on access roads	Construction site, access road, and surrounding (school and settlement adjacent to project site)	Daily and * Especially during drilling works
		Operation	Noise level dB (A)	Site inspection and use of portable sound level meter/ mobile phone applications for sound measurement.	Near String Combiner Box	Monthly

S.N.	Parameter	Phase	Indicators	Methods	Locations	Frequency
3	Soil pollution	Construction	• Signs of chemical spills • Scattering of solid wastes and spoil material	Site inspection and observations	Construction site	Daily
		Operation	Soil quality (soil pH, heavy metal concentration)	Soil sampling and laboratory analysis	Near solar panels	Once in 2 years
4	Storage and stockpiling	Construction	Stockpiling of construction materials in safe areas	Site inspection	Construction site	Weekly
		Operation	Stored materials	Site inspection	Storage facility	Once a year
5	Land instability and erosion	Construction	• Erosion and slope stability • * Civil engineering and bioengineering measures	Site inspection	Slope along the stream channel	Weekly * Once
		Operation	Erosion and slope stability	Site inspection	Along the perimeter of the project site in the southern and south-western sides	Monthly
6	Water pollution	Construction	Water quality of Trishuli River (physical parameters including turbidity and total suspended solids, chemical parameters including heavy metal concentration)	In-situ tests using portable probes, lab testing of samples	Trishuli River near the project area	Once every 3 months
		Operation	• Quality of washwater • Physical parameters, primarily pH, turbidity and total	In-situ tests using portable probes, lab testing of samples	In the channel draining the washwater	Once every 3 months using

S.N.	Parameter	Phase	Indicators	Methods	Locations	Frequency
			dissolved solids using portable water quality probes • * Total suspended solids, chemical parameters including heavy metal concentration		after settlement in settling pond/tank (prior to discharge in the river)	portable probes; * Once every 6 months
7	Waste management	Construction	• Solid waste segregation and waste minimization; • Spills of chemicals, liquid wastes, solar pannels, cardboards, polysheet, metal strips, equipments packing materials (Table 3-3) etc. • Waste heaps in the project site	Site inspection	Project area	Weekly
		Operation	Solid waste segregation and disposal	Direct observation	Staff quarters, Workshops/ Scrap yard	Monthly
B	*Biological environment*					
8	Impact on standing trees and vegetation	Construction	Standing trees in the project area	Site observation	Project Footprint Area	Once
C	*Social environment*					
9	Labour influx, labor camp location and management	Construction	Number of workers in the labour camps/ project area and its surrounding settlement	Direct observation, survey of local people	Project area	Monthly
		Operation	Number of workers	Direct observation	Project area	Once a year

S.N.	Parameter	Phase	Indicators	Methods	Locations	Frequency
10	Impacts on Cremation site	Construction	• Condition of cremation site • Access to cremation site	Direct observation, survey of local people	Cremation site	Once
		Operation	Condition of cremation site	Direct observation, survey of local people	Cremation site	Once every 5 years
11	Issues of security in the community	Construction	Project area police records and issues from nearby settlement	Direct observation, survey of local people	Project area and settlement	Monthly
		Operation	Issues from nearby settlement	Survey of local people	Project area and settlement	When necessary or needed
12	Disturbance in local infrastructure	Construction	Condition of available water supply system, educational institutions, health care institution etc.	Direct observation, survey of local people	Project area and settlement	Once in 2 months
		Operation	Condition of available water supply system, educational institutions, health care institution etc.	Survey of local people	Project area and settlement	When necessary or needed
13	Occupational health and safety	Construction	• No. of workplace accidents • Use of PPE by workers • ***** Knowledge of OHS among workers	Inspection of the construction site and records of accidents, Survey of workers	Project area	Daily ***** Monthly
		Operation	• No. of workplace accidents; • Use of PPE by workers; • Knowledge of OHS among workers	Inspection of the project site and records of accidents, Survey of workers and staff	Project area	Once a year

4.2 ENVIRONMENTAL MONITORING COST

During the construction phase, the supervising engineer of the civil works will be entrusted with the responsibility for environmental monitoring, whereas during the operation phase, an Integrated Environmental Management System shall be established for the project involving the senior members from different departments of the project. The members of the environmental management system shall be responsible for the monitoring. The management cost for the monitoring is not envisaged as a separate cost. However, instrumental monitoring such as water quality, air quality, soil quality, and noise levels are not in the scope of the in-built mechanism of the environmental management system for the project and thus will require third-party monitoring. The cost of such monitoring and expenses on human resource is presented in Table 4-2 and Table 4-3.

Table 4-2: Environmental monitoring cost (Operation phase)

S.N.	Monitoring parameter	No. of locations	Unit rate/ Half-yearly cost (NRs.)	Amount (NRs.)
1	Air quality	5	30,000	1,50,000
2	Water quality	3	40,000	1,20,000
3	Noise levels	2	20,000	40,000
4	Soil quality	2	20,000	40,000
			Total half-yearly expense	3,50,000

Table 4-3: Expenses for HR required for environmental monitoring (Construction phase)

S.N.	Human resource	Rate (per day, NRs.)	Monitoring cost	
			No. of days	Amount (NRs.)
1	Physical environment expert	10,000	60	6,00,000
2	Biological environment expert	10,000	30	3,00,000
3	Socio-economic expert	10,000	30	3,00,000
4	Water quality expert	6,000	30	1,80,000
5	Lab technicians	3,000	30	90,000
6	Transportation	Lump sum	-	2,50,000
	Total			17,20,000

Note: The cost of establishment and operation of the Environmental Management Unit (EMU) during the construction phase shall be borne by the proponent. Mitigation management during the operation phase shall be supervised and implemented directly by NEA. During the operation phase, all the monitoring costs including those associated with the human resource will be done by NEA.

4.3 GRIEVANCE REDRESS MECHANISM (GRM)

A Grievance Redress Mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of Affected Peoples' (AP) concerns, complaints, and grievances related to social and environmental issues of the project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve the social and environmental concerns linked to the project.

A common GRM will be placed for social, environmental, and any other grievances related to the project. The GRM will provide an accessible forum for the resolution of affected persons' grievances related to the project. Every grievance shall be registered and carefully documented. The sociologist at the project management office (PMO) will have the overall responsibility for addressing the grievances related to environmental and social safeguards issues. The sociologist will be the focal person for facilitating the grievance redress at Rural Municipality/ Municipality level.

A town-level public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The social safeguards expert of the PMO will support the NEA and the community mobilizers with information and awareness raising programs to conduct the town-wide awareness campaign. The campaign will ensure that the poor, the vulnerable, and other needy people are made aware of the grievance redress procedures.

The secretary of the GRM will be responsible for convening timely meetings and maintaining minutes of meetings. The concerned social safeguards expert of Design Consultant (if hired) will support the NEA and PMO to ensure grievances are addressed, including those of the poor and the vulnerable. All Grievance Redress Committee (GRCs) shall have at least two women as committee members. Representatives of APs, civil society, and eminent citizens will be invited as observers in Grievance Redress Committee (GRC) meetings.

The GRC consists of the following members:

Chairperson	:	Project Coordinator
Secretory	:	Project Manager
Member	:	Project Engineer
Member	:	Ward Chairperson
Member	:	Chairperson of SCF
Member	:	Principal of Mandredhunga Basic School
Member	:	Chairperson of Mahila Samuha (woman group)

The functions of the local GRC will include the following:

(i) To support affected persons regarding problems arising from environmental or social disruption; asset acquisition (if necessary); and eligibility for entitlements, compensation, and assistance

(ii) To record grievances of affected persons, categorize and prioritize them and provide solutions within 15 days of receipt of complaints; and

(iii) To ensure timely response to the aggrieved parties about developments regarding their grievances and decisions of the GRC

4.4 IMPLEMENTATION OF MITIGATION/ ENHANCEMENT MEASURES AND MONITORING ACTIVITY

The proponent will be responsible for implementing the proposed enhancement measures, mitigation measures, and monitoring activities. The proponent will have an obligation to carry out all these activities and to bear the costs for the same.

REFERENCES

- Environment Protection Act 2076
- Environment Protection Regulation 2077
- National EIA Guidelines 1993
- DHM (2017): Observed Climate trend analysis in the district and physiographic regions of Nepal (1971-2014). Department of Hydrology and Meteorology, Kathmandu
- GSEEP (2014): Project Appraisal Document, World Bank
- Topographic Survey Maps (Sheet No: 2785 01a, 2785 01b, 2785 01c, 2785 01d)
- Nepal Electricity Authority (NEA)/Grid Solar and Energy Effieciency Project (2019): Desk Study Report for Helipad (3.09MW) of 255 MWp Grid Tied Solar Farms Project under Grid Solar and Energy Efficiency Development (DOED), Sano gaucharan, Kathmandu, Nepal
- Risen Solar Technology (2019): Civil Design Basis Annexed Survey Report: Spots Coordinates. NEPAL 25MWp Utility Scale Grid Tied Solar Farms. GSEEP/ICB-071/72-01 Nepal Electricity Authority.
- National Indigenous Nationalities Commission Act, 2074 (2017)
- National Foundation for Upliftment of Indigenous Nationalities Act, 2058

Annex A: Land ownershp certificates

NEPAL ELECTRICITY AUTHORITY
(A Government of Nepal Undertaking)
Distribution & Consumer Service Directorate
Grid Solar And Energy Efficiency Project

Ref: 077/78 - 681

Date: May 09, 2021

To,
NEA Engineering Co.
Trade Tower, Thapathali,
Kathmandu

Subject: Ownership of Land for development of Helipad Solar Farm Area

Dear Sir,

This is to inform you that a land plot of 1202.27 Sq. m (2-5-3-1 ropani, plot no. 1196, previously owned by Ram Bdr. Rai) which was all surrounded by plots possessed by Nepal Electricity Authority at Helipad Area Solar Farm, has been acquired by Nepal Electricity Authority on date B.S. 2077/05/31 compensating the original land owner. The copy of newly issued ownership document (lalpurja) of the same plot is attached herewith for your reference.

Hence, for your kind notification I here declare that all the land plots within the boundary of the designed solar farm for Helipad Area is under the possession of Nepal Electricity Authority.

Best Regards,

(Bikash Raghubanshi)
Project Manager
25 MW Grid Tied Solar Farm

Durbar Marga, Kathmandu, Nepal, Phone: +977-1-4153153, Fax: +977-1-4153150

नेपाल सरकार

भूमि व्यवस्था, सहकारी तथा गरिबी निवारण मन्त्रालय

भूमि व्यवस्थापन तथा अभिलेख विभाग

मालपोत कार्यालय...........मालपोत कार्यालय नुवाकोट

जग्गाधनी संकेत नम्बर :

जग्गाधनी दर्ता प्रमाण पूर्जा

संस्थाको नाम: नेपाल विद्युत प्राधिकरण ग्रिड सोलार एण्ड इनर्जी इफिसियन्सी आयोजना

ठेगाना: जिल्ला: नुवाकोट गा.पा. / न.पा. / गा. वि. स.: विदुर नगरपालिका वडा नं.: ६

दर्ता नं.: ३२

जारी गर्ने कार्यालय: नेपाल सरकार,

वेबसाइट: ईमेल:

दर्ता मिति (वि.सं.): २०७७/०५/२९

संस्थाको छाप प्रमाणित गर्नेको दस्तखत

साबिक कित्ता नं.	प्रमाण संकेत / कारोबार व्यहोरा		जिल्ला / गा. वि. स. / न. पा.	वार्ड नं./ नक्सा सीट नं.	कित्ता नं./ खण्ड नं.	विवरण (घर, आवादी, इत्यादि)	जग्गाधनी को हकहिस्सा	मोहीको नाम थर	किसिम वा वर्ग	क्षेत्रफल/ व.मि.	कैफियत	प्रमाणित गर्नेको दस्तखत
११६८	२०७७/०५/३१	ML००००००७	नुवाकोट	१	११६६	आवादी	एकलौटी		सिट/नापी/ जाति	१-३-३-१ (रोपनी)		
	जग्गा दर्ता		चारघरे	१		[illegible]						
	दाखिल खारेज								अबल	१२०२.२७		
									जम्मा क्षेत्रफल १२०२.२७ वर्ग मिटर			

नेपाल विद्युत प्राधिकरण ग्रिड सोलार एण्ड इनर्जी इफिसियन्सी आयोजना

प्रिन्ट गर्नेको दस्तखत ....[signature]

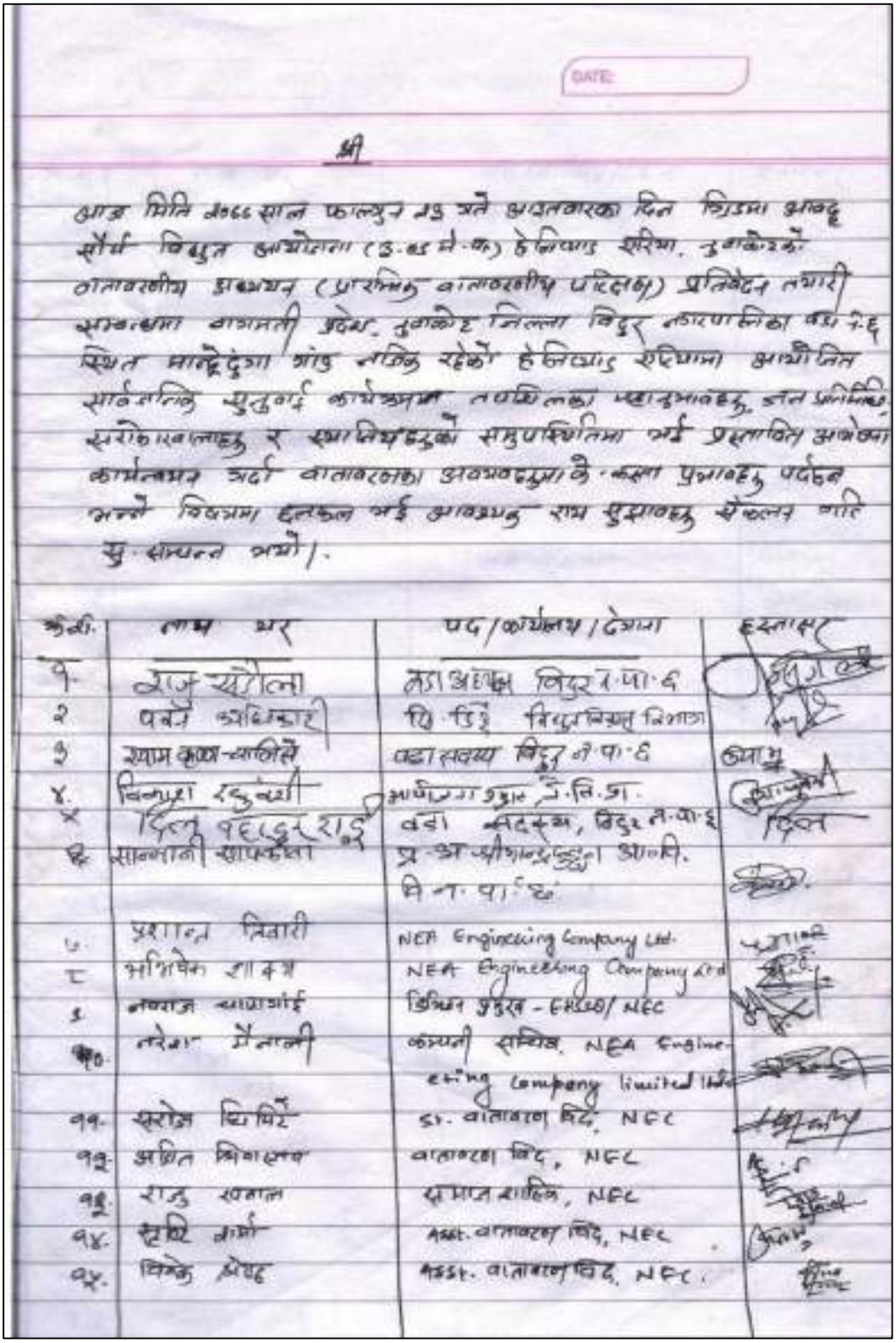
प्रिन्ट गर्नेको नाम : हरेन्द्र महर्जन

प्रिन्ट मिति : २०७७/०५/३१

बुझ गर्नेको दस्तखत ....[signature]

Annex B: Attendance of public consultations

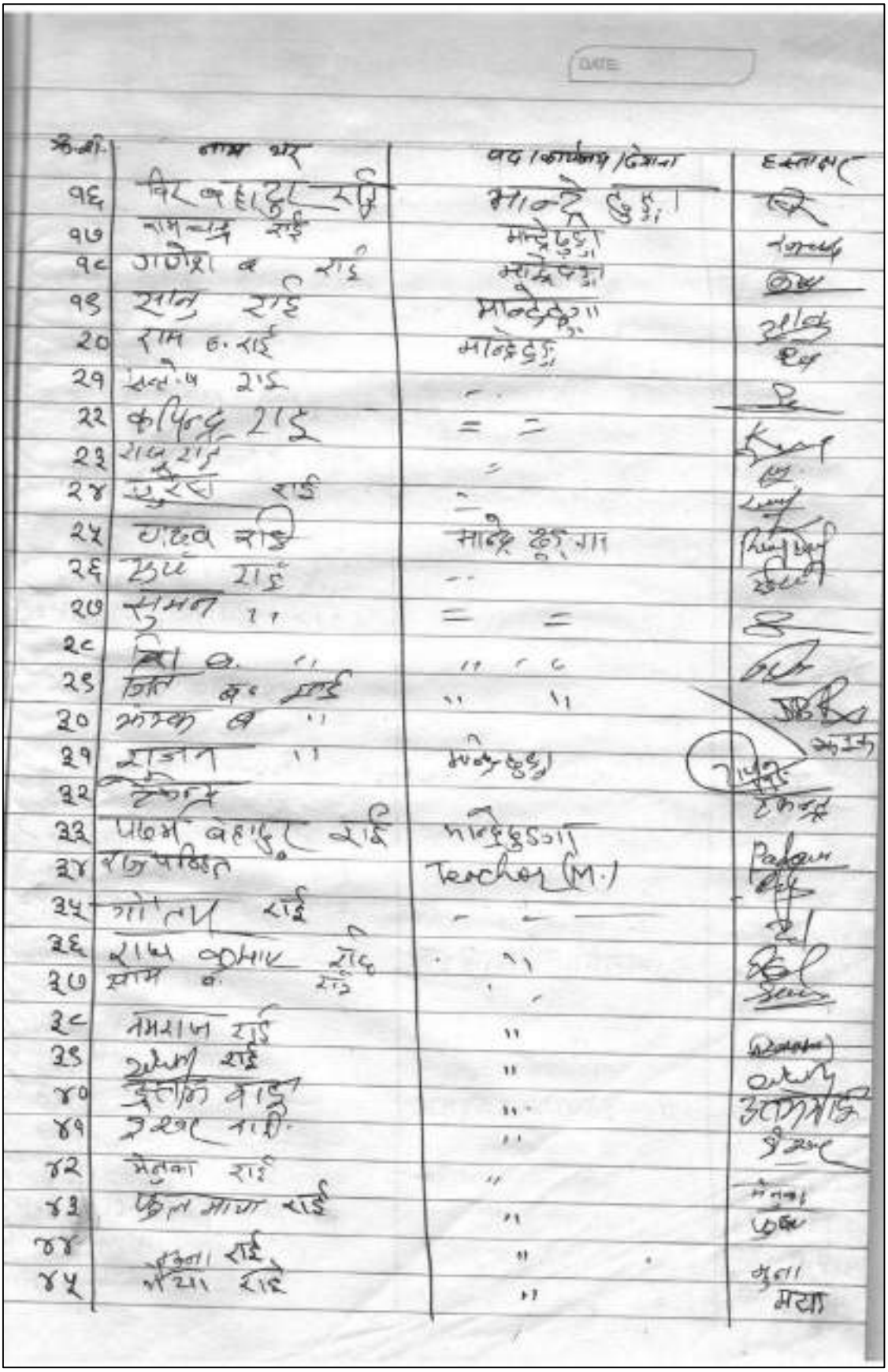
Minute of Public Hearing conducted on 2077/11/23 at Mandredhunga Basic School, Mandredhunga, Bidur Municipality Ward no. 4



श्री

आज मिति २०७८ साल फाल्गुन २३ गते आइतवारका दिन शिउमा आयोजना सौर्य विद्युत आयोजना (३.४८ मे.वा.) हेलिप्याड साईट, दुवाकोटको वातावरणीय प्रभाव मूल्यांकन (प्रारम्भिक वातावरणीय परीक्षण) प्रतिवेदन तयारी सम्बन्धमा जानकारी प्रदेश दुवाकोट मिलन विदुर नगरपालिका वडा नं.६ स्थित मान्द्रेदुंगा गाउं नजिक रहेको हेलिप्याड साईटमा आयोजित सार्वजनिक सुनुवाई कार्यक्रममा उपस्थित महानुभावहरु, जन प्रतिनिधि, सरोकारवालाहरु र स्थानिय्हरुको समुपस्थितिमा भई प्रस्तावित आयोजना कार्यान्वयन गर्दा वातावरणका अवयवहरुमा के-कस्ता प्रभावहरु पर्दछन भन्ने विषयमा छलफल भई आवश्यक राय सुझावहरु बैठकमा प्राप्त भए।

क्र.सं.	नाम थर	पद/कार्यालय/ठेगाना	हस्ताक्षर
१.	राजु योगी	वडा अध्यक्ष विदुर न.पा.६	
२	पर्वते अधिकारी	पि.डि.ई विदुर विद्युत शिखा	
३	श्याम कृष्ण-थापाली	वडा सदस्य विदुर न.पा.६	
४.	विनुदा रुचाली	आयोजना प्रमुख, NEA.	
५	दिलु पहाडी राई	वडा सदस्य, विदुर न.पा.६	
६	सान्त्वानी खापकोटा	प्र.अ. श्रीगणेशदुङ्गा आ.वि. मि.न.पा.६	
७.	प्रशान्त तिवारी	NEA Engineering Company Ltd.	
८	अभिषेक शाक्य	NEA Engineering Company Ltd	
९	नवराज चालाउंई	डिभिजन प्रमुख - EMSD/ NEC	
१०.	नरेश मैनाली	कम्पनी सचिव, NEA Engineering Company limited	
११.	सरोज तिमिल्सिना	ज्ञा. वातावरण विद्, NEC	
१२.	अजित त्रिपाठी	वातावरण विद्, NEC	
१३.	राजु खनाल	वरिष्ठ इन्जिनियर, NEC	
१४.	सृष्टि गार्ग	Asst. वातावरण विद्, NEC	
१५.	विनोद ओझा	Asst. वातावरण विद्, NEC.	



क्र.सं.	नाम थर	पद/कार्यालय/ठेगाना	हस्ताक्षर
१६	वीर बहादुर राई	मान्देढुङ्गा	
१७	रामचन्द्र राई	मान्देढुङ्गा	
१८	गणेश ब. राई	मान्देढुङ्गा	
१९	रामु राई	मान्देढुङ्गा	
२०	राम ब. राई	मान्देढुङ्गा	
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२२	कविन्द्र राई	"	
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२४	[illegible] राई	"	
२५	राजेन्द्र राई	मान्देढुङ्गा	
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२७	सुमन "	"	
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३२	[illegible]		
३३	पदम बहादुर राई	मान्देढुङ्गा	
३४	[illegible]	Teacher (M.)	
३५	[illegible] राई	"	
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४३	[illegible] माया राई	"	
४४	[illegible] राई	"	
४५	[illegible] राई	"	

DATE:

क्र.सं.	नाम थर	पद/कार्यालय/पेशा	हस्ताक्षर
४६	Roshni Rai		Rai
४७	Amika Rai		[illegible]
४८	Lalita Rai		[illegible]
४९	Indra Bdr. Rai		[illegible]
५०	Thumi Rai		[illegible]
५१	Ramesh Rai		Rai
५२	ओम		ओम
५३	दलबहादुर राई		
५४	सूर्यबहादुर राई		
५५	Lila Bahadur Rai		[illegible]
५६	चन्द्रबहादुर राई		
५७	हर्क बहादुर राई		
५८	तुल बहादुर राई		[illegible]
५९	सुरी राई		सुरी
६०	Dhanbir Rai		[illegible]
६१	RAMES RAI		[illegible]
६२	लाल बहादुर राई		लाल
६३	केदार रिमाल	ग्रिड सोलार आयोजना	[illegible]
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६५	दिपक अधिकारी	" "	[illegible]
६६	निरज [illegible]	" "	[illegible]
६७	सुशिल तिमिल्सिना	एनइइ इन्जिनियरिङ्ग क.प्री	[illegible]
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६९	ललित राई		ललित
७०	मिलन राई		मिलन
७१	मनोज राई		[illegible]
७२	[illegible] राई		[illegible]

क्रम सं	नाम थर	पद/कार्यालय/ठेगाना	हस्ताक्षर
७३	सुनिता राई	मान्देढुंगा	
७४	सुनिता	"	सुनिता राई
७५	रीता राई	"	रिता राई
७६	सम्झना राई	"	
७७	बिनिता राई	"	बिनिता
७८	निमेला राई	"	निमेला
७९	कमला	"	कमला
८०	साविना	"	साविना
८१	दीपावती राई	"	
८२	श्रीकृष्ण राई	"	
८३	अतिन कुमार राई	"	
८४	विनाश राई	"	
८५	वीर बहादुर राई	"	
८६	शैलीकला राई	"	गोपी कृष्ण
८७	गोपु राई	"	
८८	बसलाल राई	"	
८९	पम्फा राई	"	पम्फा
९०	डुली राई	"	डुली
९१	काछे राई	"	काछे
९२	रिता राई	"	रिता
९३	मैया राई	"	मैया
९४	गंगा राई	"	गंगा
९५	मानमैया राई	"	
९६	अम्बा बहादुर राई	"	
९७	कृष्ण बहादुर राई	"	
९८	रहिमत लामा	Nea	
९९	दिपेन्द्र आचार्य	"	
१००	इद्रु इस्लाम	"	

क्र.सं	नाम थर	पद/कार्यालय/ठेगाना	हस्ताक्षर
१०१	बदुली राई	मान्देबुंगा	घाटना
१०२	प्रेमबहादुर राई	"	प्रेम
१०३	माइली राई		
१०४	बुद्धीबहादुर राई		

Annex C: Field photographs

Public hearing

A local community member expressing his opinion during the Public Hearing

Group photo of participants of Public hearing

Interaction with local community members

Group discussion with community Stakeholders for social mapping prior to household survey

KII with Chairperson of Sunadevi CFUG

FGD with Women

Enumeration of trees

Field assistant measuring DBH of tree

Barking deer spotted in Forebay area near Mandredhunga settlement

Grey-backed shrike

Pied bushchat

Oriental white-eye

Himalayan bulbul

Measurement of water quality of Trishuli river in the project area using portable probes

Measurement of air quality and sound levels on site

Waste dumping in the project footprint area

Annex D: Air quality and sound level measurement data

S.N.	Time	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	Sound level (dB)	Ambient Temperature (°C)	Relative Humidity (%)
	March 08, 2021					
1	4:00 PM	211.3	288.5	76.6	22.2	40.7
2	4:10 PM	216.8	303.9	78.9	21.1	42.9
3	4:20 PM	196.7	276.3	74.3	21.8	40.4
4	4:30 PM	187.4	261.6	65.2	22.1	39.5
5	4:40 PM	185.3	255.714	70.5	21.5	38.8
6	4:50 PM	176.5	243.57	71.5	21.2	39.1
	Average/Hourly	*195.67*	*271.60*	*72.83*	*21.65*	*40.23*
7	5:00 PM	154.1	212.658	73.7	21.4	39.4
8	5:10 PM	136.7	188.646	67.8	20.9	39.2
9	5:20 PM	112.4	155.112	60.6	20.5	38.6
10	5:30 PM	87.6	120.888	75.3	20.4	38.8
11	5:40 PM	92.5	127.65	71.4	19.8	40.4
12	5:50 PM	76.5	105.57	64.3	20.2	39.1
	Average/Hourly	*109.97*	*151.75*	*68.85*	*20.53*	*39.25*
13	6:00 PM	72.3	99.774	63.5	19.7	38.7
14	6:10 PM	60.2	84.3	68.1	19.6	38.1
15	6:20 PM	80.8	104.4	62.3	19.7	34.7
16	6:30 PM	99.8	128.5	65.8	19.6	34.9
17	6:40 PM	70.9	93.7	65.6	19.4	35.2
18	6:50 PM	55	74.4	60.3	19.3	33.4
	Average/Hourly	*73.17*	*97.51*	*64.27*	*19.55*	*35.83*
19	7:00 PM	47.3	66.5	55.4	19.1	33
20	7:10 PM	51.2	73.6	58.8	19.4	35.4
21	7:20 PM	50.6	70.9	64.4	19.2	34.4
22	7:30 PM	64	90.3	57.1	18.9	37.3
	Average/Hourly	*53.28*	*75.33*	*58.93*	*19.15*	*35.03*
	March 09, 2021					
1	10:00 AM	230.5	322.4	57.8	18.5	54.5
2	10:10 AM	223.6	328.6	60.2	19.4	48.4
3	10:20 AM	175.5	248.7	39.7	23.7	40.5
4	10:30 AM	140.4	196.6	46	23.4	36.5
5	10:40 AM	134.9	188.9	42	23.9	30
6	10:50 AM	111.8	156.5	43.8	26.2	24.3
	Average/Hourly	*169.45*	*240.28*	*48.25*	*22.52*	*39.03*
7	11:00 AM	117.3	164.2	51.2	26.1	24.3
8	11:15 AM	110.4	154.6	45.1	29.5	20.6
9	11:25 AM	92.8	130	42.6	30.8	20.5

S.N.	Time	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	Sound level (dB)	Ambient Temperature (°C)	Relative Humidity (%)
10	11:35 AM	94.5	132.3	55.1	30.7	18.7
11	11:45 AM	91.5	128.1	42.3	31.3	16.2
12	11:55 AM	75.1	105.2	45.2	31.8	15.3
	Average/Hourly	*96.93*	*135.73*	*46.92*	*30.03*	*19.27*
13	12:05 PM	84.4	118.2	42.4	32.7	15
14	12:15 PM	88.3	127.5	40.6	33.3	15.2
15	12:25 PM	85.5	119.7	41.7	33.7	14.7
16	12:35 PM	78.4	109.8	49.7	34.6	14.1
17	12:45 PM	92	128.8	41	34.3	15.3
18	12:55 PM	87.2	122.1	41.3	33.7	14.3
	Average/Hourly	*85.97*	*121.02*	*42.78*	*33.72*	*14.77*
19	1:05 PM	83.6	115.6	43.7	32.5	14.5
20	1:15 PM	74.1	103.8	45.3	32.1	14.9
21	1:25 PM	87	121.7	46.2	31.8	14.5
22	1:35 PM	82.1	115	46.3	30.6	15
23	1:45 PM	80.2	112.4	48.5	30.2	15.6
24	1:55 PM	131.8	184.5	46.8	30.4	15.4
	Average/Hourly	*89.80*	*125.50*	*46.13*	*31.27*	*14.98*
25	2:05 PM	83.5	116.9	43.7	31.1	16.5
26	2:15 PM	99.2	138.9	45.7	30.9	16.8
27	2:25 PM	82.8	116	47.2	32	16.5
28	2:35 PM	101.5	142.1	46.3	31.1	15.2
29	2:45 PM	85	119	50.4	30.8	15.5
30	2:55 PM	110.9	155.3	47.8	30.8	16.1
	Average/Hourly	*93.82*	*131.37*	*46.85*	*31.12*	*16.10*
31	3:05 PM	86.6	121.3	47.4	31.4	16.4
32	3:15 PM	84.2	117.9	46.5	31.6	15.8
33	3:25 PM	92.3	129.3	46	30.2	16.5
34	3:35 PM	102.5	143.6	42.7	27.8	16.5
35	3:45 PM	92.3	129.3	69.4	28.1	17.3
36	3:55 PM	92.7	129.8	67.5	27.5	17.7
	Average/Hourly	*91.77*	*128.53*	*53.25*	*29.43*	*16.70*
37	4:05 PM	98.2	137.5	48.9	26.3	18.9
38	4:15 PM	102.4	143.3	43.3	24.9	22.4
39	4:25 PM	110.2	154.3	43.5	22.9	23.6
40	4:35 PM	117.7	164.8	49.8	22.6	24.4
41	4:45 PM	118.6	166.1	46.8	21.9	26
42	4:55 PM	117.8	165	43.4	22.3	24.8
	Average/Hourly	*110.82*	*155.17*	*45.95*	*23.48*	*23.35*
43	5:05 PM	117.3	164.2	51.2	22.1	24.3

S.N.	Time	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	Sound level (dB)	Ambient Temperature (°C)	Relative Humidity (%)
44	5:15 PM	112.3	157.3	56.3	19.9	29.2
45	5:25 PM	118.4	165.8	51.8	19.8	29.1
46	5:35 PM	118.3	166.4	56.1	19.4	29.4
47	5:45 PM	123.6	173	52.8	20.9	31.8
48	5:55 PM	118.6	166	50.5	20.3	32.5
	Average/Hourly	*118.08*	*165.45*	*53.12*	*20.40*	*29.38*
49	6:05 PM	174.1	246.8	54.3	19.9	33.6
50	6:15 PM	197.2	276.2	49.5	19.4	36
51	6:25 PM	239	334.6	53.2	19	37.8
52	6:35 PM	233	326.2	44.3	19.1	37.8
53	6:45 PM	202.9	284.1	45.9	18.7	37.9
54	6:55 PM	190.4	266.5	43.8	18.6	39.3
	Average/Hourly	*206.10*	*289.07*	*48.50*	*19.12*	*37.07*

Open Incineration of wastes across the river (Prison area)

*National Ambient Air Quality Standards prescribed limit for 24-hour average
Source: Field survey 2021

Annex E: Bird diversity recorded in the project area

S.N.	Common name	Scientific name	Survey method	Location
1	Titra (Black francolin)	*Francolinus francolinus*	DS and SS	SCF
2	Kalij (Kalij pheasant)	*Lophura leucomelanos*	DS and SS	SCF
3	Bakulla (Cattle egret)	*Bubulcus ibis*	SS	PFA
4	Kalo chil (Black kite)	*Milvus migrans*	DS and SS	PFA
5	Giddha (Himalayan vulture)	*Gyps himalayensis*	DS and SS	PFA and SCF
6	Gomayu mahachil (Steppe eagle)	*Aquila nipalensis*	DS	PFA
7	Parewa (Rock pigeon)	*Columba livia*	DS	PFA
8	Taame Dhukur (Oriental turtle dove)	*Streptopelia orientalis*	DS and SS	PFA
9	Kurle Dhukur (Spotted dove)	*Stigmatopelia chinensis*	DS and SS	PFA
10	Kanthe suga (Rose ringed parakeet)	*Psittacula krameri*	DS and SS	PFA
11	Dhode gokul (Greater coucal)	*Centropus sinensis*	DS	PFA
12	Biu kuhiyo koili (Common hawk cuckoo)	*Hierococcyx figax*	C	PFA
13	Gothe laatokosero (Common barn owl)	*Tyto alba*	SS	PFA
14	Sano dundul (Spotted owlet)	*Athene brama*	SS	PFA
15	Setokanthe maatikore (White-throated kingfisher)	*Halcyon smyrnensis*	DS and SS	PFA
16	Theuwa (Indian roller)	*Coracias benghalensis*	DS and SS	PFA
17	Nyauli (Great barbet)	*Megalaima virens*	C	PFA
18	Kuthurke (Blue-throated barbet)	*Megalaima asiatica*	DS	PFA
19	Faafre (Common hoopoe)	*Upupa epops*	DS	PFA
20	Rani chara (Scarlet minivet)	*Pericrocotus flammeus*	DS	PFA
21	Bhadraai (Long-tailed shrike)	*Lanius schach*	DS	PFA
22	Chibey (Black drongo)	*Dicrurus macrocercus*	DS	PFA
23	Nilo Laampuchhre (Red-billed blue magpie)	*Urocissa erythrorhyncha*	SS	PFA
24	Kokale (Rufous treepie)	*Dendrocitta vagabunda*	SS	PFA
25	Pahadi kokale (Grey treepie)	*Dendrocitta formosae*	DS	PFA
26	Kaag (House crow)	*Corvus splendens*	DS	PFA
27	Kaalo Kaag (Large-billed crow)	*Corvus macrorhynchos*	DS	PFA
28	Chichilkote (Great tit)	*Parus major*	DS	PFA
29	Paandu chichilkote (Black-lored tit)	*Parus xanthogenys*	DS	PFA
30	Ghar gauthali (Barn swallow)	*Hirundo rustica*	DS	PFA

S.N.	Common name	Scientific name	Survey method	Location
31	Gerukati gauthali (Red-rumped swallow)	*Cecropis daurica*	DS	PFA
32	Jureli (Red-vented bulbul)	*Pycnonotus cafer*	DS	PFA
33	Julfe jureli (Himalayan bulbul)	*Pycnonotus leucogenys*	DS	PFA
34	Paat siune fisto (Common tailorbird)	*Orthotomus sutorius*	DS	PFA
35	Kankir (Oriental white-eye)	*Zosterops palpebrosus*	DS	PFA
36	Katuse matta (Chestnut-bellied nuthatch)	*Sitta (castanea) cinnmoventris*	DS	PFA
37	Dangre rupi/Saarau (Common myna)	*Acridotheres tristis*	DS	PFA
38	Jangali saarau (Jungle myna)	*Acridotheres fuscus*	DS	PFA
39	Jurey saarau (Brahminy starling)	*Sturnia pagodarum*	DS	PFA
40	Kalchaude (Blue whistling thrush)	*Myophonus caeruleus*	DS	PFA
41	Dhobini chara (Oriental magpie robin)	*Copsychus saularis*	DS	PFA
42	Setotaauke jalkhanjari (White-capped redstart)	*Chaimarrornis leucocephalus*	DS	Trishuli River
43	Kaale jhyaapsi (Pied bushchat)	*Saxicola caprata*	DS	PFA
44	Jhekjhek jhyaapsi (Common stonechat)	*Saxicola torquatus*	DS	PFA
45	Siparaja bungechara (Crimson sunbird)	*Aethopyga siparaja*	DS	PFA
46	Bhangera (House sparrow)	*Passer domesticus*	DS	PFA
47	Rukh bhangera (Eurasian tree sparrow)	*Passer montanus*	DS	PFA

Source: Field survey 2021

Note: DS: Direct sighting, SS: Social survey, C: Call, SCF: Sunadevi Community Forest and PFA: Project Footprint Area