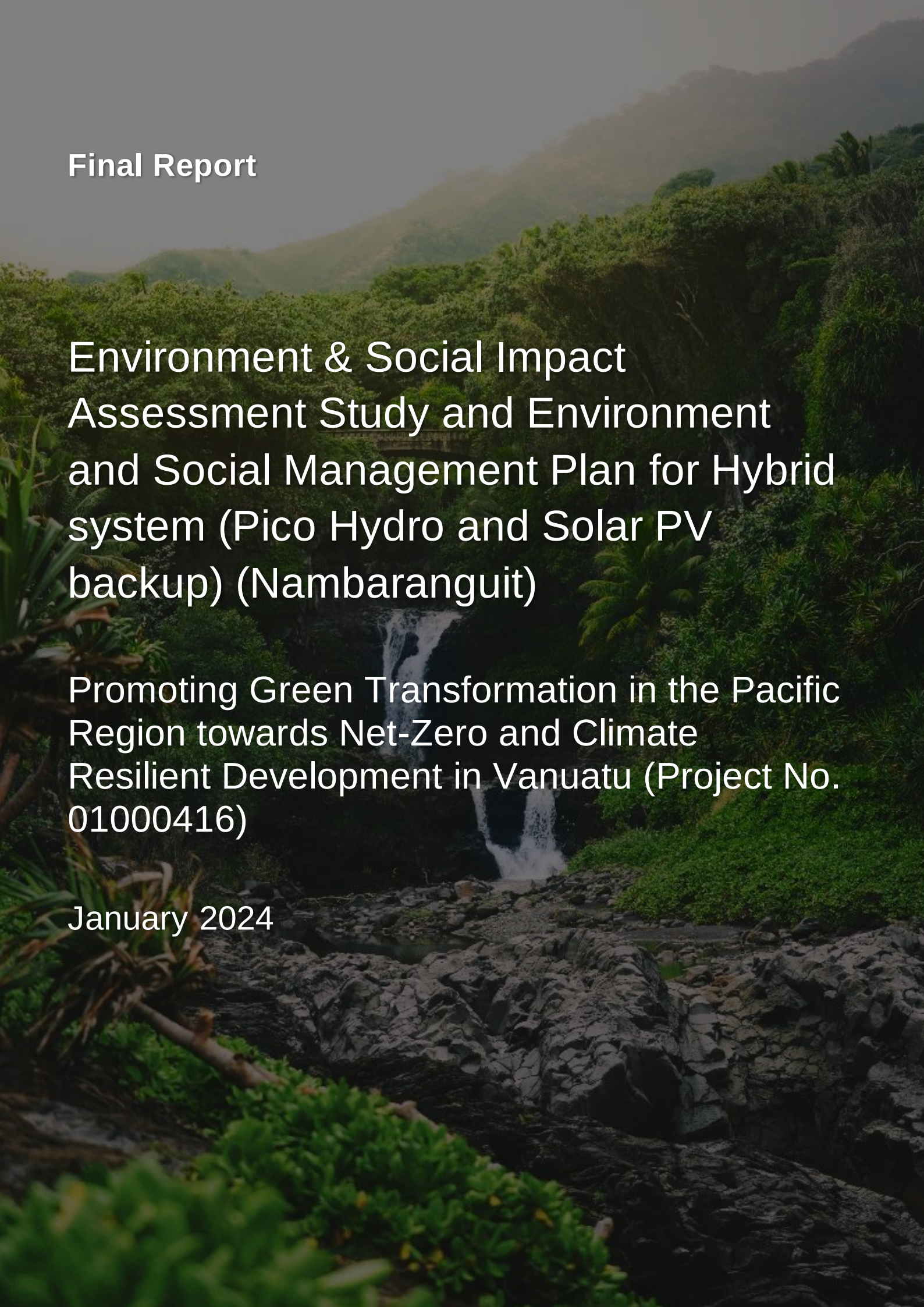

Final Report

Environment & Social Impact Assessment Study and Environment and Social Management Plan for Hybrid system (Pico Hydro and Solar PV backup) (Nambaranguit)

Promoting Green Transformation in the Pacific Region towards Net-Zero and Climate Resilient Development in Vanuatu (Project No. 01000416)

January 2024

Quality Control & Assurance Sheet

Project Name	Promoting Green Transformation in the Pacific Region towards Net-Zero and Climate Resilient Development in Vanuatu
Project Number	01000416
Report Title	Environment and Social Impact Assessment (ESIA) Report and Environment and Social Management Plan (ESMP) for Hybrid system (Pico Hydro and Solar PV backup) in Nambaranguit
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Report Reviewed by	UNDP Project Manager, Vanuatu and Team Leader, Resilience and Climate Change (RCC) Unit of the Pacific Office, UNDP

This report has been submitted on 24 January 2024.

Revision No.	Date	Revision	Signature
01	30 January 2024	Clarifications updated	 Susan Vauquelin

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List of Abbreviations

AWP	Annual Work Plan
BRANTV	Barrier Removal for Achieving National Energy Road Map Target of Vanuatu
BB	Business
CO	Carbon Dioxide
CP1	Central Pentecost 1
CP2	Central Pentecost 2
CAT	Convention Against Torture
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CRPD	Convention on the Rights of Persons with Disabilities
CRC	Convention on the Rights of the Child
CO	Country Office
COSQA	Country Office Support and Quality Assurance
CR	Critically Endangered
DoE	Department of Energy
DEPC	Department of Environment Protection and Conservation
DDR	Detailed Designed Report
DG	Diesel Generator
ENSO	El Nino Southern Oscillation
EN	Endangered
ESMAP	Energy Sector Management Assistance Program
E&S	Environment and Social
ESIA	Environment and Social Impact Assessment
ESMMP	Environment and Social Management and Monitoring Plan
EHS	Environment Health and Safety
EIA	Environment Impact Assessment
EPI	Environmental Performance Index
FPIC	Free Prior Informed Consent
GDP	Gross Domestic Product
HH	Household
II	Institution
ICCPR	International Convention on Civil and Political Rights
ILO	International Labor Organization
M&E	Monitoring and Evaluation
MSD	Musculoskeletal Disorders
NERM	National Energy Road Map
NDCs	Nationally Distributed Contributors
NCEW	Nature, Climate, Energy and Waste
OHS	Occupational Health and Safety
OD	Outside Diameter
PFE	Permanent Forest Estate
PPE	Personal Protection Equipment
PEA	Preliminary Environment Assessment
PMU	Project Management Unit
PM	Project Manager

PV	Photovoltaic
RoW	Right of Way
SIDS	Small Islands Development States
SE	South-East
BRH	UNDP Bangkok Regional Hub
SESP	UNDP Social Environmental Screening Procedure
SES	UNDP Social Environmental Standard
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
VSO	Vanuatu Statistics Office
WBG	World Bank Group

Executive Summary

The overall objective of this project is to contribute to the goal of the Government of Vanuatu to achieve the National Energy Road Map (NERM), i.e., 100% electrification with Renewable Energy by 2030 by the installation of eight (08) Pico hydro projects which is directly linked to the country's NDC target. The project intends to directly benefit 2,366 individuals comprising of 1,260 male and 1,106 females respectively. In addition, the project aims to also indirectly benefit 6,000 individuals comprising of 3,350 males and 2,650 females.

The Project is funded by the Government of Japan and is being implemented by UNDP Fiji MCO with overall coordination and technical management support from the regional project management unit based in Bangkok Regional Hub (BRH).

The focus of the Project is on the islands of Pentecost, Maewo, Santo, Malekula and Gaua. The UNDP Social Environment Screening Procedure (SESP) has categorized the overall Project as 'Moderate Risk' however, based on an understanding that the Project (in the country) is being planned to be developed in areas inhabited by indigenous and vulnerable communities, site specific Environment and Social Impact Assessment (ESIA) studies are required to be developed for four (04) identified areas which have completed the Detailed Designed stage. This report details the ESIA study of the Hybrid system comprising Pico Hydro and Solar PV project in Nambaranguit.

Project Site Setting

The project area is located in village Nambaranguit in Penama Province situated on the West Coast of Pentecost Island of Vanuatu. The project elevation ranges from 50m to 100m above mean sea level and is located in Nambaranguit. The project lies on geo co-ordinate Lat-15°35'4.63"S and Long-168°7'58.16"E.

For the proposed project, about 03 identical units of 1.75 kW Pelton type turbine (each turbine will have an output of around 1,164 W) will be installed in the Powerhouse. The turbines are required to have a total flow of 10.4 l/s with a combined output of approx. 3,493 W (1,164 W per turbine). The length of the penstock connecting intake and powerhouse is approx. 380m. A 25 kWp PV array on an elevated canopy with SE-NW orientation is expected to be installed as part of the project. It is expected that the PV and hydroelectric systems will deliver a combined generation capacity of up to 28kW.

Project Components

Intake: To capture the required water flow for the turbines' operation, the height of both existing intakes would need to be supplemented. The supplement of the intake may be made of masonry taking special measures to join the supplement with the existing intake by means of small anchors. Intake 1 will have to be supplemented by 15cm for the entire perimeter of the intake (approximately 9m). Section 2 will have to be supplemented by 30cm for the entire perimeter of the intake (approximately 8m). Additionally, both intakes will have to be emptied and cleaned from algae and vegetation growing on them.

Penstock and Valves: A 290m long 160mm OD PN8 PE penstock is to be installed between the intake and the powerhouse. All the joins between different sections and fittings will be electro fused. Particularly on the steep parts of the path, the penstock will be kept in place with reinforced concrete footings with the location of each footing to be agreed onsite between the contractor and the PMU.

Turbines and Elements: 03 identical units of 1.75 kW Pelton-type turbines will be installed in the powerhouse. Each turbine should output around 1,164 W with a total combined output of 3,492 W. The turbines will be equipped with jets whose diameter can be adjusted on-site to fine-tune the turbine output during the commissioning.

Grid – tied Inverter: The two AC-coupled turbines and part of the PV array will be connected to a single-phase grid-tied inverter.

Charge Controller: The charge controller to be used for the DC-coupled turbine is to be fully compatible with the turbines and approved for its use by the turbine manufacturer.

Grid forming Inverter and Accessories: A 48V_{DC} 15,000VA grid-forming inverters would be used to generate a three-phase, 50Hz providing a rated output of 15 kVA and capable of providing a peak power up to 25,000 W per phase.

Battery Bank: The system will be equipped with a 48V_{DC} LiFePo battery bank. The battery bank should be fully compatible with the selected battery inverter. The compatibility should have been tested and certified by both the battery and inverter manufacturer and key battery parameters need to be visualized in the remote monitoring platform from the battery inverter.

Powerhouse: The Powerhouse will have internal dimensions of 6.28 x4.32m (27.12m2) with 2.5 meters height. It will be constructed with a 250mm high reinforced concrete slab and walls made of concrete hollow blocks. A shed-type roof will be built with a timber structure treated for termites and a Colourbond steel roofing sheet with thermal insulation.

PV Solar Array: The PV array is to be of installed capacity of at least 25kWp. The array is to be composed of PV modules installed on portrait forming rows. A potential configuration of the PV array could be 48 x 540 Wp modules installed in 4 rows of 12 modules, 2 rows facing NW and 2 rows facing SE.

Communication and Monitoring: The system would be equipped with full cloud-based remote monitoring capabilities visualizing in the battery inverter manufacturer monitoring portal the operational parameters of the charge controller, battery inverter, and batteries together with key operational parameters of the ac-coupled generation.

Distribution Network: A total of 6.1 km of single-phase low-voltage underground distribution network will be installed to connect the 167 users currently living in the targeted communities.

Land Requirement: The Powerhouse and the Catchment area would require less than 50m^2 of land. Right of Way for the transmission and distribution line would also be attained. No historical sites and no 'tabu' sites were identified in the proximity of the water source. A site with up to 160m2 (8 x 20m) is available for installation of solar PV which has been allocated by the community next to the church.

Project Schedule: The Project Schedule for the pre-construction and construction phases would be one (01) year.

Legal and Institutional Framework

The ESIA has been developed based on the approach which includes desk-based review, data shared by UNDP Fiji CO, DOE and consultations undertaken with relevant stakeholders. The ESIA conforms with the overall mitigation measures mentioned in the Overall Project's SESP including the requirements as per UNDP SES, Environment Impact Assessment Regulations, 2012 and other National Regulatory requirements. Potential environmental and social impacts were assessed through the consultations, information available in project level reports and in public domain against UNDP's SES. For each impact, mitigation measures are described in Chapter 7 of the report.

Environment and Social Baseline

Topography: Nambaranguit is situated on the west coast of Pentecost Island of Vanuatu. The landmass is predominantly basaltic, with a few limestone ridges formed by the uplifting of coral reefs. The elevation of the Pentecost Island ranges from 100m to 950m.

Land Use: Vanuatu's land area totals approximately 12,336 km^2. Almost 74 percent of that area is covered by natural vegetation, with more than 36.1 percent (440,000 hectares) covered by tropical forest. All lands, including forest lands, are customarily owned; that is, by individuals or communities (clans or families). Government-owned land with forest does not exist.

Geology and Soil: The oldest rocks of Vanuatu (Early Oligocene) are exposed on southern Pentecost. These are ultramafic serpentinites and peridotites, and gabbros, norites, schists and basalts. Soils in Pentecost have been derived from coral colluvial parent materials. These are young soils with limited development of a shallow dark coloured organic which overlies weathered coral detritus.

Climate and Meteorology: Across Vanuatu the annual average temperatures are between 23.5–27.5°C. Changes in the temperature from season to season are strongly tied to changes in the surrounding ocean temperature. Rainfall in Vanuatu is affected by the South Pacific Convergence Zone. This band of heavy rainfall is caused by air rising over warm waters where winds converge, resulting in thunderstorm activity.

Natural Hazards: Vanuatu is vulnerable to natural hazards including floods, droughts and tropical cyclones as well as earthquakes, tsunamis, and volcanic eruptions. A large percentage of the population is exposed to natural disasters and climate risk due to their proximity to the coastline. Further, the location of the archipelago relevant to this feature means that Vanuatu is located in an area of active seismic and volcanic activity.

Water Quality: No existing data on freshwater runoff and groundwater quality was available in the public domain for the study area and no new data was collected as part of the ESIA. As per the ESIA prepared for the BRANTV project, it was mentioned that the water flow exceeds demand. There is a low intensity of water use and the potential water use and its conflict also appears to be low.

Ambient Air Quality: No existing data on air quality was available in the public domain for the study area. However, as part of this ESIA study information was sourced from the Environment Officer at Department Environment Protection and Conservation (DEPC) on 23 October 2023 wherein it was understood that the Department has not set up any environmental monitoring station at the Project Area to monitor ambient air in the country. The ambient air quality is good as no other development or industry is present in the project area.

Ambient Noise Quality: No existing data on noise quality was available in the public domain for the study area. The ambient noise as understood based on responses received from DEPC in 2023 mentions that the noise quality is good as no other development or industry is present in the project area.

Ecology: The project site does not have any natural habitat, critical habitat, mangroves and wetlands. Based on discussion held with the local community of Nambaranguit village in November 2023, it was understood that there are no individuals whose livelihood depended on fishing activities on the river. Further, there in the project area, there is no cultural use of the land area by the local community of Nambaranguit.

Socio-Economic: The total number of end-users identified in the community is 167.

Analysis of Alternatives

No alternate site location, technology or route was considered for the project.

Stakeholder Consultation

As part of the ESIA undertaken for the overall Project by Department of Energy under the BRANTV project in 2019, stakeholder consultation with Project Affected Communities was conducted in line with the requirement of Free Prior Informed Consent (FPIC) as provided in UNDP Standard 6 on Indigenous People. A total of 12 individuals comprising of 7 males and 5 females belonging to the Nambaranguit community participated in the consultation process. In addition, , M/s Trama Tecnoambiental, S.L. (TTA) engaged as the Consultant to develop the Detailed Designed Report of the Project area in Nambaranguit by the Ministry of Climate Change & Adaptation, Department of Energy under the BRANTV Project in June 2023 undertook a socio-economic baseline profiling of the Nambaranguit community including discussions with stakeholders (local community, Department of Water Resources) were also held. UNDP Fiji MCO in collaboration with the DoE undertook another round of consultations with the local communities on 22nd November 2023 as part of the ESIA study wherein 25 (12 males and 13 females) participants attended. Further, Voluntary Land Consent forms providing consent from three (03) individuals were filled and signed consenting to voluntarily provide their land to the project for both the construction and operation phase.

Impact Assessment and Mitigation Measures

S. No.	Aspect and Potential Impact	Mitigation Measures
Pre-Construction and Construction Phase		
1	Land Use – Minimal Impact	The usage of land to be restricted to areas identified/voluntary consented by the local community. The land parcels wherein temporary usage is expected are to be returned to the landowners/community after proper treatment and rehabilitation. Area to be cleared for the project activities are to be undertaken post receiving consent of the local community. Information to be initiated onsite is to be shared with the stakeholders prior to start of the construction/installation works. Monthly meetings to be held with the Chief council of the area to update on the works on ground to create sense of ownership amongst the community members and provide a platform to raise any concerns directly. Chance Find Procedure developed is to be implemented onsite.
2	Topogrpahy and Drainage – Slight alteration to existing topography in project area including slight change in slopes.	All unstable zones are to be avoided. Drainage pattern area not to be disturbed during construction activities. Identification of possible and active erosion areas to be undertaken within the project area. To prevent soil erosion, measures such as soil stabilization measures to be adopted. Muck and debris to be backfilled to the extent possible. Sand trap to be provided onsite by the Contractor wherein all run offs and other water sources are to be directed to for pretreatment before discharge in natural water bodies.
3	Water Resources and Quality - Wastewater generated through construction activities, sediment runoffs from construction activities, Inadequate storage of fuel, oil etc. on site	Sand trap to be provided onsite. All muck and debris generated to be used for back filling to the extent possible and excess muck to be disposed off at pre-identified muck dumping site. Storage areas to be kept away from water bodies. Waste Management Plan developed is to be implemented. Conduct water quality monitoring once during construction and once post construction of the river. Provision of safe drinking water to be provided to all workers onsite.
4	Ambient Air Quality – Construction activities leading to dust and exhaust emissions.	Dust suppression methods to be adopted onsite. Conduct air quality monitoring at the construction work areas against international standards once during construction and once post construction. Trucks to be covered during transportation of construction materials. Reduce traffic speed on all unpaved surfaces to 15 km/hr or less to avoid dust emissions from vehicular movement. Ensure adequate stack height is provided to the diesel generator to be used onsite as per regulatory requirements.
5	Ambient Noise Quality - Construction activities and vehicles.	Operation hours of construction activities to be restricted during nighttime. Proper maintenance of construction equipment onsite. PPEs to be provided to workers as required. Monitoring of noise levels to be undertaken once during construction work to ensure compliance with applicable noise standards and regulations. PMU in collaboration with DoE to conduct public awareness campaigns to inform nearby residents about the construction schedule and the potential noise impacts.
6	Traffic and Transport – Traffic disruption and road related hazards	Contractor to prepare a Traffic Management Plan. Ensure that the existing road is maintained and repaired regularly to withstand heavy loads during construction. Designated parking areas to be assigned for construction vehicles. Skilled local drivers to be engaged for driving. Adequate safety signages to be placed at various locations.
7	Ecological Environment – Minimal tree clearing	Complete ban on use of fuel wood by workers during the construction period. Water quality control measures as provided in the above section to be implemented. All construction areas to ensure mechanism for trapping silt and other construction waste from being disposed into the river. Adequate permission/intimation of tree clearance/felling to be taken by Contractor from the Local Authority/ Community and records of communication on the same to be maintained
8	Occupational Health and Safety – Use of electrical equipment, welding activities, ergonomics injuries, working at height, respiratory diseases,	Construction Safety Management Plan and Emergency Preparedness and Response Plan developed are to be implemented onsite by the Contractor. PPEs to be provided to all workers. Construction contractor is required to ensure necessary safety measures to be taken up before and during the construction activities including vehicle movements, loading and unloading equipment. Provision of providing signages, training, first aid kits, ambulance, barricading etc. to be done by Contractor. Contractor to conduct a thorough

S. No.	Aspect and Potential Impact	Mitigation Measures
	hearing damage and other occupational hazards.	risk assessment prior to work and provide necessary trainings to workers. An accident reporting and monitoring record should be maintained.
9	Socio-Economic – Voluntary Land Consent Landowners	Continuous stakeholder engagement activities to be undertaken with the land consent owners and land lessors (if any) to understand and resolve any grievances that might arise. Records of all engagements and grievances to be maintained by the Contractor. Contractor to ensure that no issues pertaining to dust emissions, muck and wastewater overflow in adjoining land parcels, barrication etc. to be carried out for the communities residing within the vicinity of the construction activities (if any).
10	Labour Related Aspects – Engagement of local workforce	Labour Management Plan developed is to be implemented onsite. Contractor to develop Code of Conduct for workers. Information on GRM to be disseminated to all workers. Ensure labour practices are implemented onsite.
Operation Phase		
11	Water Resource and Quality – Non-maintenance of E-flow of water	Ensure that adequate environmental flow is maintained in the river as mentioned in the DDR. Six monthly testing of water quality by third party to be undertaken in first two years of operation and thereafter, an annual testing to be conducted.
12	Noise Quality – Minimal noise generation	Rehabilitation near the project features with indigenous species is to be planted as a noise barrier between the project areas and the surrounding areas.
13	Right of Way Maintenance including areas with PV Solar System Installed – Marginal loss of tree cover and limiting regeneration of plant species	Selective clearing of tall-growing tree species and encouragement of low-growing shrubs, herbs and grasses should be undertaken by the Operation and Maintenance team. Vegetation maintenance should be kept limited to pruning and not to be removed completely. Use of machinery for vegetation maintenance should be strictly avoided and it should be done manually as far as possible. Use of herbicides to control fast-growing plant species within the ROW should be prohibited. Such species could be controlled through manual weeding.
14	Health and Safety Hazards – Transmission line mishaps	Risks to general public during operation will be reduced by public awareness and education and physical measures by attaching an appropriate warning sign where required. Once the stringing work is complete, notices and permanent anticlimbing devices are to be installed on the transmission poles. The operational start date for electricity transmission and safety implications are to be publicized locally in advance.

Environment and Social Management and Monitoring Plan

In preparing the ESMMP, the project impacts were categorized into pre-construction, construction, and operation phases with appropriate mitigation measures provided to minimise or offset the risks identified. The ESMMP outlines the risks identified, mitigation measures provided, responsibilities and monitoring frequency to be adopted across the various phases of the project. The responsible parties to implement the ESSMP are the Contractor, PMU, O&M Contractor and DOE which have been outlined against each mitigation measures.

As required under the UNDP SES, certain Management Plans have also been developed as part of the Report pertaining to Stakeholder Engagement Plan, Grievance Redressal Mechanism, Construction Safety Management Plan, Labour Management Plan, Waste Management Plan, Chance Find Procedure and Emergency Preparedness and Response Plan which are to be implemented by the Contractor and PMU.

Conclusion and Recommendation

Based on the assessment undertaken, there are potential marginal social or environmental impacts present due to the project activities which are largely reversible and can be addressed through relevant mitigation measures as provided in the ESMMP. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help the Project Team in complying with the environmental and social standards, as part of national regulatory and UNDP SES requirements.

1.0 Introduction

1.1 Project Background

At the 51st Pacific Islands Forum Leaders Meeting held in July 2022, the leaders of Pacific Islands endorsed the 2050 Strategy for the Blue Pacific Continent wherein they reaffirmed the commitment to fully implement the Paris Agreement, including a collective aim to achieve carbon neutrality in the Pacific by 2050. Based on this, the Pacific Small Islands Development States (SIDS) have been aligning their country's pledges on climate change by outlining the targets for energy transition and increasing resilience to climate impacts. The targets have been defined to support the inclusive implementation of gender-responsive actions to make women's and men's concerns and experience an integral dimension of climate-related policy and program.

UNDP's Project for Promoting Green Transformation in the Pacific Region towards Net-zero and Climate Resilient Development (Green Transformation for Pacific SIDS) aims to respond to the direct need to enhance human security through green transformation. This project seeks to help Pacific countries address urgent, necessary, unpredictable, and un-substitutable needs to achieve ambitious climate actions. These include both mitigation – primarily focused on clean energy and just transition- and resilience and adaptation – focused on supporting fragile settings on energy security and resilience. Using countries' recent submissions on national climate targets under the Paris Agreement, the project aims to leverage the unique networks, infrastructure, and expertise of UNDP's Climate Action portfolio to support countries to transition toward net zero and climate resilient development pathways - directly in line with the goals of the Paris Agreement and addressing human security for all.

UNDP's Climate Promise provides a uniquely positioned platform to help countries achieve climate targets amidst global challenges while protecting vulnerable and marginalized people from the insecurity of climate impacts and evolving energy and food crises. This project intends to implement priority elements of the Climate Promise and to help governments to obtain the most urgent support to advance climate action while addressing key issues of human security and green transformation – through increasing resilience and adaptation to climate impacts via energy security and driving innovation to urgently advance renewable energy, energy efficiency, and energy access for the most vulnerable in response to the evolving energy crisis. By supporting countries to take ambitious climate actions, the objective is also to generate numerous co-benefits, such as sustainable economic growth and job creation.

The countries have identified activities to advance their Nationally Distributed Contributors (NDCs), supported by Climate Promise and the vast portfolio of climate programming. As part of this, the SIDS have also outlined country level strategies. The multi-country project involves Papua New Guinea, Samoa, Timor Leste and Vanuatu with regional technical and management support to be provided by the UNDP Bangkok Regional Hub.

The overall objective of this project is to contribute to the goal of the Government of Vanuatu to achieve the National Energy Road Map (NERM), i.e., 100% electrification with Renewable Energy by 2030 by the installation of eight (08) Pico hydro projects which is directly linked to the country's NDC target. The project intends to directly benefit 2,366 individuals comprising of 1,260 male and 1,106 females respectively. In addition, the project aims to also indirectly benefit 6,000 individuals comprising of 3,350 males and 2,650 females.

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1.2 Purpose and Scope

The main purpose of this ESIA study is to assess the potential risks and impacts that is envisaged with the proposed project. This ESIA has been developed to meet the requirements of UNDP's SESP as per UNDP Social and Environment Safeguards (SES). This study is thus being undertaken as per the requirements of UNDP's SES to understand the environmental and social risks and impacts associated with the proposed project. The study also suggests appropriate mitigation measures and management plans to prevent and minimize the adverse impacts identified.

Scope of Work

The scope of work and key tasks will include, but will not necessarily be limited to, the services described below and must be fully compliant with the UNDP SES,

- Assessment of compliance of the proposed Project vis-à-vis UNDP SES requirement for development of the ESIA study;
- Review the regulatory and institutional framework that applies to the proposed Project including those on labour and working conditions and workers' health and safety;
- Collection of available additional secondary environment and social data and analysis of the same;
- Review stakeholder engagement activities undertaken by the Company with local communities and institutional stakeholders relating to the proposed Project;
- Review the land procurement and affected population information and based on information available on socio-economic data relating to the affected population analyse and present it in the report;
- Source secondary ecological and biodiversity information and present it in the report;
- Discussion with the Project team on the alternate options considered for the project and rationale of selection of the identified alignment along with review of earlier reports;
- Assessment of potential environmental and social risks and impacts with the proposed activities and develop mitigation measures and plans;
- Preparation of Environment and Social Management and Monitoring Plan (ESMMP) based on the assessment of identified environment and social risks and impacts.

1.3 Applicable Reference Framework

The following list the standards and guidelines that would be used in developing the site specific ESIA,

- Host Country's Regulations;
- International Law including conventions and treaties adopted by the host country and applicable to the Project;
- UNDP Social and Environment Standards, 2021;
- UNDP SES Toolkit;
- UNDP SES Guidance Note;
- World Bank General Environmental Health and Safety (EHS) Guidelines 2007 including sector specific Guidelines;
- UNDP's Construction Works Policy;
- UNDP Guidance Note on Construction Works Policy;
- Good international Industry Practices.

1.4 Approach and Methodology

The approach and methodology applied for the execution of the ESIA study is as provided below,

- The existing comprehensive ESIA, Detailed Design Report and other relevant documents including Free Prior Informed Consent (FPIC) obtained from the affected communities were reviewed to understand the proposed project component;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;

- A detailed social and environmental assessment of the site and surrounding areas was undertaken through the following methods,
    - Review of the Google Imagery of the proposed site to understand site specific issues and associated facilities;
    - Discussions with the beneficiary communities including the project affected communities and identification of key issues;
    - Baseline data collection from various Government Department including affected communities in the study area with respect to ecology and socio-economic conditions;
    - Ecological assessment on flora and fauna of the site and study area through secondary sources.
- Collation of secondary information on socio-economic profile of the area was supplemented by information available in existing reports and institutional stakeholders with regard to the proposed project and its activities. The approach included,
    - Consultations with project affected communities;
    - Data compilation from secondary sources;
    - Consultations with Institutional Stakeholders.
- Assessment of environmental and social impacts based on understanding of the project activities and existing baseline status;
- Preparation of Environment and Social Management and Monitoring Plan.

1.5 Stakeholders Contacted

The following stakeholders were contacted during the course of the study:

- Department of Environment Protection and Conservation
- Community Leader of Nambaranguit Village
- Community of Nambaranguit Village

1.6 Limitation

This report presents the information collected during site visit based on the scope of work, documentation provided, discussions held with team representative and agreed approach and methodology as defined in the Inception Report. The present report has been developed to identify the potential environment and social risks and impacts associated with the proposed project for which the assessment has been carried out. During the course of this assessment, an attempt to independently assess the potential environment and social risks and impacts within the limits of the established scope of work has been undertaken. As with any Environment and Social (E&S) assessment, there is a certain degree of dependence upon verbal information provided during the consultation process conducted with stakeholders, which is not readily verifiable through visual observations or supported by any available written documentation. However, verification of potentially important facts is not always possible, the Consultant shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed at the time this assessment was performed.

The statements, conclusions, and opinions contained in this report are only intended to detail out the key risks and impacts that is envisaged due to the proposed project activities based on the documents made available for review and interviews conducted with the varied stakeholders.

1.7 Report Layout

This report has the following chapters as outlined in the Annexure 1 (ESIA) of the Inception Report which includes,
Chapter 2: describes the applicable Environmental and Social related policies and Regulatory Framework
Chapter 3: outlines the description of the proposed project
Chapter 4: details the Environment and Socio-Economic baseline of the project area
Chapter 5: provides an Analysis of Alternatives
Chapter 6: assess the Environmental and Social Risk and Impacts envisaged due to the project activities
Chapter 7: provides Environmental and Social Management and Monitoring Plan
Chapter 8: provides details on engagement and consultation with stakeholders
Chapter 9: presents the Conclusion and Recommendation of the Report

2.0 Legal and Institutional Framework

This section provides an overview of the administrative framework and identifies relevant Vanuatu legislation, international treaties, and industry standards and guidelines that the Project must follow. Specifically, this chapter provides a summary of the following:

- National environmental and social legislation applicable to the Project;
- International conventions to which Vanuatu is a signatory; and
- International standards and guidelines applicable to the Project.

2.1 Vanuatu Environment and Social Legislations and Policies

The applicable Environmental and Social legislations including Policies of the country applicable to the Project change is presented below,

Table 1: Applicable Regulatory Framework of the Assessment

Regulation/Standard	Description and Provision	Applicability to the Project
Environmental Protection and Conservation Act 2002 and its subsequent amendments	The Act establishes the protection of the environment within Vanuatu and makes provision for the conservation, sustainable development and management of the environment and the regulation of related activities. This includes land, air and water. Specifically, the Act introduces the requirement for environmental assessment and provides for the conservation of biodiversity and the establishment of protected areas in Vanuatu.	This Act is applicable to the project as it covers all environmental aspects including land, air and water. The Act provides reference of the permits, license and approval required for projects including activities which are subject to Environment Impact Assessment (EIA) provisions.
Environment Impact Assessment Regulations 2012[1]	The Regulations (amended in 2012) establishes the procedures for undertaking the environmental assessment of Prescribed Activities. The developer is required to first submit a development consent application following which the DEPC will conduct a preliminary environment assessment (PEA) which determines whether (i) no further assessment is required, (ii) no further assessment is required but an environmental management and monitoring plan is required, or (iii) where major projects are considered such as logging, large agricultural developments, mining and other prescribed activities as noted above, an EIS is required. The DEPC prepares a term of reference for the EIS which would include technical, economic, environmental and social investigations. The EIS also requires public consultation.	The Project will apply for a development consent to the DEPC once the ESIA has been prepared to ensure that all components of environment and social aspects are duly covered within the ESIA study. Once the DEPC provides its approval, the construction activities pertaining to the Project will commence.

[1] The Environment Impact Assessment Regulations (Amendment) Order N° 102 2012 replaced the original Environmental Impact Assessment Regulations Order N° 175 of 2011.

Regulation/Standard	Description and Provision	Applicability to the Project
	A steering committee reviews the EIS and recommends to the Director of the DEPC for approval, refusal or for more information. The Director can approve a prescribed activity with or without conditions. No development can commence without an approval from the DEPC. The Director of the DEPC may issue a notice to stop or restrict the activity if the approval conditions are not being met.	
Pollution (Control) Act No.10 of 2013	The objectives of this Act are to minimize and manage the discharge and emission of pollution and encourage all levels of government to work together to control the discharge and emission of pollution. Clause 8 imposes a requirement on owners and occupiers of premises to comply with prescribed standards for the discharge of pollution, wastewater and the emission of noise, odour or electromagnetic radiation and Clause 9 establishes a permit scheme for the discharge or emission of pollutants and creates offences for the discharge or emission of pollutants without a permit.	This Act is applicable to the Project as the construction activities would generate air and noise emissions including wastewater which will need to be adequately mitigated through appropriate measures.
Waste Management Act No.24 of 2014	An Act to provide for the protection of the environment through encouragement of effective waste services and operations. A designated waste management operator must prepare and submit reports relating to any aspect of waste management under its responsibility to the Department, the Ministry of Health and the Department of Biosecurity.	This Act is applicable to the Project as the construction activities will generate waste. The Contractor involved will be required to engage with a waste management operator to adequately manage the waste generated through the activities undertaken at the site and include a buy back policy to the solar PV vendor to buy back unused, broken and non-working solar panels.
Water Resources Management Act 9 of 2002 (Water use rights)	The Water Resources Management Act (2002) provides for the protection, management and use of water resources in Vanuatu. The act allows for the designation of policies to protect water resources; and provides for water conservation zones to be established. Section 7 of the Act states that 'a person must apply to the Director for the right to construct, operate or maintain works for any purpose that does not comply with Section 4 or 5, including: a) any work in or adjacent to any water or any bore; or b) any work whose purpose is to supply water to any other person	This Act is applicable to the Project as the Project is required to take approval from the Department of Water Resources prior to the development of the Project. In addition, the Project is to comply with the said standards established/prescribed by the Department in terms of maintaining the water quality in the project area.

Regulation/Standard	Description and Provision	Applicability to the Project
	The application of the act mandates for an application to the Director for Water Works and Water Use Permits prior to works commencing.	
Land Leases Act [CAP.163], 1984 and its subsequent amendments	This Act provides for the creation and disposition of leases of land, for their registration and for matters connected therewith. There shall be a Land Leases Register for the registration of each lease required to be registered by this Act. The Act defines various conditions applying to a registered lease and the effects of registration. Other provisions of this Act concern other titles in land such as mortgages and easements, co-ownership, transmission, trusts, and cautions.	This Act is applicable to the Project as the project components including areas to be used by the Contractor during construction phase which might include leased land.
Land Reform Act (Cap. 123)	This Act makes provisions for the alienation of private (custom) land and the use of public land by custom users, the development of public land and various other matters relative to land titles, use and management. The Act consists of 24 sections divided into 13 Parts: Interpretation (1); Encumbrances (2); Alienated Land (3); Negotiations and Agreements Relating to Custom Land (4); Management of Land (5); Public Land (6); Compensation (6a); Registered Leases (7); Rights of Entry (8); Land Corporations (9); Roads (10); Use of Force and Damage (11); Regulations and Offences (12).	This Act is applicable to the Project as land (including existing roads) in the Project Area may be developed/ strengthened to accommodate the project components.
Land Acquisitions Act No.5 of 1992	An Act to make provisions for the acquisition of land and easement in the public interest and to provide for matters connected therewith.	Even though no land is being acquired for the Project, however, there is a possibility that there might be a requirement of land for development of the project features during the course of the Project construction as the project is for public interest. In t209his case, the Act might be applicable to the Project.
Customary Land Tribunal Act No.7 of 2001	The object of this Act is to provide for a system based on custom to resolve disputes about customary land. This Act provides for the establishment of land tribunals to resolve disputes about customary land and prescribes the procedures to be followed by those land tribunals in resolving such disputes and rules of appeal for parties who are dissatisfied with decisions of land tribunals. Part 2 sets out how a village land tribunal is to resolve a customary land dispute. A village land tribunal can be a single or joint village land tribunal	This Act is not applicable to the Project as no customary land is anticipated to be used for any of the project components.

Regulation/Standard	Description and Provision	Applicability to the Project
	depending on where the land in dispute is situated. If all the parties accept the decision, the dispute is resolved, otherwise appeal can be had to custom sub-area land tribunals (see Part 3), custom area land tribunals (see Part 4) and island land tribunals (see Part 5). Parts 6 sets out the procedures to be followed by land tribunals	
Forestry Act [CAP 276] and Regulations	This Act makes provision for the management, conservation and development of forestry resources in Vanuatu, establishes the Forests Board of Vanuatu, provides for the granting of rights relating to forest exploitation, for the declaration of Conservation Areas, for the protection of the environment and the establishment of the Forestry Project Fund for purposes of reforestation and regulates the export of timber. The Act introduces two main requirements for any commercial forestry operations, i.e., an agreement under Part 4 and a licence under Part 5.	This Act is applicable to the Project as the Project is being developed near the river which is within the forest area. Any works undertaken within the forest area including the minimal tree felling that might be required to set up the project component will need to be intimated to the Forest Department.
Employment Act, 1983 and its subsequent amendments	The Act takes into account the labour codes, general labour and employment conditions.	This Act is applicable to the Project as the contractor shall ensure implementation of the rights, wages, occupational health and safety of the labourers in line with the requirement of this regulation.
Minimum Wage and Minimum Wages Board Regulations (Order No. 56 of 1987) and its subsequent amendments	This Act sets the minimum wage rate in Vanuatu for workers in municipalities, agricultural workers and students and young workers.	This Act is applicable to the Project as the workers engaged under the Contractor is be ensured to receive the minimum wages. The Contractor is to comply with the Act and its subsequent amendment and latest Government Notification.
Public Holidays Act [Cap. 114] revised edition 1988 and its subsequent amendments	This Act provides for the days that are to be considered to be a public holiday.	This Act is applicable to the Project as the Contractor is to adhere to the requirements of this Act.
Health and Safety at Work Act (Cap. 195).	This Act deals with various aspects of occupational health and safety. Specifies duties of employers to ensure health, safety and welfare at work of the employees, as well as duties of employees and manufacturers.	This Act is applicable to the Project as the Contractor will need to ensure the health, safety and welfare of the workers engaged.
Convention on the Rights of the Child (Ratification) Act [Cap 219] (Act No. 26 of 1992).	The Act recognize the right of the child to be protected from economic exploitation and from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or	This Act is applicable to the Project as the Contractor is to adhere to its requirement and refrain from engaging any individual below eighteen years of age.

Regulation/Standard	Description and Provision	Applicability to the Project
	physical, mental, spiritual, moral or social development.	
Abolition of Forced Labour Convention (Ratification) Act 2006 (Act No. 5 of 2006)	An Act to provide for the ratification of the Abolition of Forced Labour Convention, 1957.	The Act is applicable to the Project as the Contractor is to ensure that the Contractor complies with the requirements set in the Act.
Convention on the Elimination of All Forms of Discrimination against Women (Ratification) Act No. 3 of 1995	This Act provide for the ratification of the Convention on the Elimination of all Forms of Discrimination Against Women.	This Act is applicable to the Project as the Contractor engaged will be required to comply the requirements set in the Act in terms of engagement of workers including female workers during the construction phase of the Project.
Explosives Act [Cap. 6] (JR 1 of 1917)	This Act controls the use, importation and storage of explosives.	This Act will not be applicable to the Project as the project area does not require any blasting activities to be undertaken.
National Energy Policy Framework 2007	The Vanuatu National Energy Policy Framework is focused in areas such as the promotion of energy efficiency and conservation, promotion of renewable energy sources and the provision of electricity to rural and remote areas. The policy focuses on providing a long-term development plan for the energy sector and the provision of reliable and affordable energy services to all people in Vanuatu	This Project is in line with the requirements of this Policy in terms of promotion of renewable energy sources and provision of electricity to rural and remote areas.
National Energy Road Map (2013-2020) 2013	The Government has developed a National Energy Road Map to put the sector on the path to achieving objectives shared by the Government, members of the public, development partners, and private energy sector operators. The Road Map provides a consistent basis for tracking energy sector challenges, recognizing that streamlining government policy, legislation, and investment is needed to enable Vanuatu to achieve its development objectives. The policy vision for the National Energy Road Map (2012-2020) is to energize Vanuatu's growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an Educated, Healthy, and Wealthy nation.	The Project is in line with the Government's mission on the National Energy Road Map.
National Rural Electrification Policy 2000	The National Rural Electrification Policy of Vanuatu is to provide electricity to all rural people in Vanuatu. Specifically, the National Rural Electrification Policy has the following objectives:	The Project is in line with the National Rural Electrification Policy of the country in providing electricity to all rural people.

Regulation/Standard	Description and Provision	Applicability to the Project
	· To address the electricity needs of the consumers in the rural areas both for social and economic development. · Ensure the provision of electricity to rural consumers while clearly defining the overall level of Government subsidy; · Incorporate the Government Station, medical institutions such as health centre/clinic/aid posts and education institutions such as secondary schools, primary schools and rural training centres within the rural electrification network	
Preservation of Sites and Artefacts (Amendment) Act No. 21 of 2008	To provide for the preservation of sites and objects of historical, ethnological or artistic interest.	In case of Chance find of Cultural Heritage or artifact, this act shall be applicable.
Protection of Traditional Knowledge and Expressions of Culture Act 2019 (Act No. 21 of 2019)	The Act provides for the protection, regulation and management of traditional knowledge and expressions of culture in Vanuatu and for related matters.	It is expected that this Act will not be applicable to the Project as the project footprint and feature is not envisaged to affect the traditional knowledge of the local communities residing in the project area.
Meteorology, Geological Hazards and Climate Change Act 2016 (Act No. 25 of 2016).	The Meteorology, Geological hazards and Climate Change act sets the following objectives: 1) to ensure a high quality services provided in relation to weather, climate, flood forecasting and geological hazards; 2) to promote capacities of governments, communities and organisations to understand and respond to risks arising from weather events, climate change and geological hazards; 3) address the needs of operators of ships and aircrafts and of tourists to access all necessary weather forecasts, bulletins, alerts, warnings and information concerning geological hazards; 4) facilitate the use and application of relevant information, forecasts, bulletins and warnings generated to and by local, regional and international bodies.	This Act will be applicable to the extent that climatic conditions and geological hazards would be communicated to the Project Proponent if any and Emergency Preparedness and Response Plan would be prepared to mitigate the impacts caused by any hazards.

2.2 International Treaties and Agreements

There are several international treaties and agreements related to the environment and social aspects that Vanuatu ratified. The table below provides broader requirements in relation to the project,

Table 2: International Treaties and Agreements

S. No	Multilateral Environment Agreements	Date Ratified, Acceded, Approved or Accepted	Focal Point	Ratification, Accession, Approval or Acceptance Legislation
1.	Convention on Biological Diversity	1993	DEPC	Convention on Biological Diversity (Ratification) Act [CAP 217]
2.	Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity	2014	DEPC	Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity (Ratification) Act No. 7 of 2014
3.	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1989	DEPC VFD DoF	International Trade (Flora and Fauna) Act [CAP 210]
4.	International Plant Protection Convention	-	BV	-
5.	Agreement on the International Dolphin Conservation Program 1998 (AIDCP	2008	VFD	Agreement on The International Dolphin Conservation Program (Ratification) Act No. 35 of 2003
6.	Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats throughout their Range	2010	VFD	n/a
7.	Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region	2006	VFD	n/a
8.	Memorandum of Understanding on the Conservation of Migratory Sharks	2013	VFD	n/a
9.	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification	1999	DEPC	-
10.	Stockholm Convention on Persistent Organic Pollutants	2005	DEPC	Stockholm Convention on Persistent Organic Pollutants (Ratification) Act No. 12 of 2005 Stockholm Convention on Persistent Organic Pollutants Stockholm, 22 May 2001 Adoption of Amendment to Annex A (Ratification) Act No. 5

S. No	Multilateral Environment Agreements	Date Ratified, Acceded, Approved or Accepted	Focal Point	Ratification, Accession, Approval or Acceptance Legislation
				of 2014 Stockholm Convention on Persistent Organic Pollutants Stockholm, 22 May 2001 Adoption of Amendments to Annexes A, B and C (Ratification) Act No. 6 of 2014
11.	Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (Waigani Convention)	2007	DEPC	Waigani Convention (Ratification) Act No. 16 of 2007
12.	International Convention for the Prevention of Pollution from Ships (MARPOL)	1989	DoPM	Maritime (Conventions) Act [CAP 155]
13.	Vienna Convention for the Protection of the Ozone Layer	1994	DEPC	Vienna Convention for the Protection of the Ozone Layer (Ratification) Act No.3 of 1994
14.	Montreal Protocol on Substances that Deplete the Ozone Layer	1994	DEPC	Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act No.4 of 1994 The 1997 Montreal Amendment to the Montreal Protocol on substances that deplete the Ozone Layer (Ratification) Act No. 21 of 2010 The 1999 Beijing Amendment to the Montreal Protocol on substances that deplete the Ozone Layer (Ratification) Act No. 20 of 2010
15.	Agreement Establishing the South Pacific Regional Environment Programme (SPREP)	2006	DEPC and DoFA	The Agreement Establishing the South Pacific Regional Environment Programme (SPREP) (Ratification) Act No. 21 of 2005
16.	United Nations Framework Convention on Climate Change	1993	VMGD and DoFA	Framework Convention on Climate Change (Ratification) Act [CAP 218]
17.	Kyoto Protocol to the United Nations Framework Convention on Climate Change	-	VMGD and DoFA	-
18.	Convention Concerning the Protection of the World	2002	Vanuatu National Commission for UNESCO, MoE	-

S. No	Multilateral Environment Agreements	Date Ratified, Acceded, Approved or Accepted	Focal Point	Ratification, Accession, Approval or Acceptance Legislation
	Cultural and Natural Heritage			
19.	Convention for the Safeguarding of the Intangible Cultural Heritage	2009	Vanuatu National Commission for UNESCO, MoE	Convention For the Safeguarding of the Intangible Cultural Heritage (Ratification) Act No. 26 of 2009

***Source**: Vanuatu National Environment Policy and Implementation Plan 2016–2030*

2.3 Institutional Framework

2.3.1 Institutional Arrangements

The Project Management Team at DoE will provide frequent monitoring and a grievances mechanism for complains procedure. UNDP will monitor and provide guidance in the implementation of the ESMP while PMU besides other functions, are to monitor and supervise the implementation of the ESMP. For this purpose, DoE PMU has established a monitoring mechanism as part of the project's overall management system.

2.3.2 Responsibilities

The DoE PMU is responsible for the implementation of the ESMP as the Project Implementing Agency and is responsible for ensuring that the Implementing Partners (Civil Society Organisation Government productive sectors, Department of Local Authorities (provincial and area secretaries), Area Councils and communities etc) are familiar with the safeguards management measures and requirements for project implementation.

At the project activity level, the Implementing Partners such as the contractors and site supervisors are responsible to assisting the local communities and contractors to implement the mitigation measures.

The PMU will support the Implementing Partners through training on the ESMP processes, standards and checklists, and will review and monitor progress. DoE PMU may also engage the support of the DEPC for the implementation of the ESMP and compliance with national legislation and regulations.

The PMU has allocated the responsibility of safeguards implementation to the Monitoring and Evaluation (M&E) and Implementation Officer. The full time, Port Vila based, M&E officer is responsible for overseeing the screening, assessments and monitoring of the project activities (done either by himself or the implementation partner) and preparing any ESMP and obtaining environmental permits from the DEPC. This officer keeps all records and prepares safeguards reports for the UNDP with the support of the Project Manager. The roles and responsibilities of the various Institutions are detailed in the table below,

Table 3: Roles and Responsibilities of various Institutions

S No	Organization	Roles and Responsibilities
1.	DoE PMU	• Incorporate the ESMP into the Project Operations Manual. Train implementation partners how to implement the ESMP. Ensure the ESMP is put into the contracts of any Contractor/NGO or other third party. • Implement the ESMP for all activities it is directly responsible for. • Supervise and monitor the partner organisation's implementation of the ESMP. • Prepare EMP (regulatory) if required and submit to the UNDP for review and clearance. • Address project-related complaints not resolved by partner stakeholders/ organisations.

S No	Organization	Roles and Responsibilities
		• Review and update the ESMP and Project Operations Manual where necessary in future. • Report on progress and outcomes of the ESMP to UNDP and Government of Vanuatu.
2.	Partner Organizations: Provincial and Area Councils, Civil Society Organizations, Contractors DoE, DEPC etc.	• Use the checklists and screen risks as per the ESMP, for all projects they are responsible for. • Develop and implement mitigation matrices, in partnership with beneficiaries. • Implement ESMP, in partnership with beneficiaries. • Address grievances where possible, and otherwise elevate them to DoE PMU. • Report implementation progress to DoE PMU on a monthly basis.
3.	UNDP	• UNDP will provide support to the PMU DoE through its internal safeguards as required, including supervision of the implementation of the ESMP. The UNDP task team, including safeguards specialists, will make a supervision mission at least once in six months. Opportunities for capacity building, training and other support and mentoring tasks will be created during missions to support the PMU to implement and supervise the ESMP. • The UNDP task team will review safeguards reporting the Project Reports.

2.3.4 Procedure for Environment Clearance and Required Compliance

- **Application Received –** The Environment Impact Assessment (EIA) starts with proponent application to the Department of Environmental Protection and Conservation. Application forms are available from the Department's offices in Port Vila and Luganville and are also available on the Department's website EIA Forms Page. The application must be completed and provided with as much information as possible about the proposed project and how proponent intend to minimise and manage environmental, social and custom impacts. The completed application form and all the required supporting information, including a receipt showing payment of the application fee, must be lodged with the Department.
- **Preliminary Environment Assessment (PEA) Conducted -** PEA is the name given to the Department's initial assessment of application. This assessment is based on the information included in the application and usually includes a site visit. Departmental officers consult with other government agencies and with nearby residents about the project and its potential environmental, social and custom impacts. Department officers may also contact the proponent for further information and may ask to submit EIA report and EMMP (Environment Management and Monitoring Plan). PEA is undertaken by departmental officer. However, the department may require external independent consultant and the cost of those consultant will be borne by the proponent.
- **EIA Report or EMMP required -** The main purpose of PEA is to make an assessment as to whether an Environmental Permit can be issued based on the information in proponent's application. Over 90 percent of all applications received by the Department are approved at this stage and an Environmental Permit is issued. However, for some projects, the Department may require more information about the project and its potential environmental, social and custom impacts. For large projects, or those located in sensitive areas, or those applications where the Department is not convinced by the application and assessment that the environmental, social and custom impacts of the project will be successfully managed, the Department may require further, formal EIA studies to be undertaken before a decision can be made. The results of these studies must be submitted to the Department in the form of an EIA report and EMMP.
- **Environmental Permit granted or refused -** If the Department determines that additional information in the form of an EIA report and EMMP is not required, the Department will decide whether to approve or refuse the application. If the application is approved, an Environmental Permit will be granted. If the application is refused, the Department will provide reasons as to why the project was refused.
- **Terms of Reference Developed -** If the Department determines that additional information in the form of an EIA report and EMMP is required, proponent will be notified and given an opportunity to comment

on the draft TOR for the EIA report. The draft TOR set out the further studies and plans required for an EIA report to be prepared and submitted to the Department to further assess the application. To ensure the quality of EIA reporting, the Department requires EIA reports to be prepared by the registered consultant. To be registered, the consultant must be suitably qualified and experienced. The notification letter accompanying the draft TOR will include a list of registered consultants who the proponent can contract to undertake the EIA studies and prepare the EIA report. There is also an option of finding another consultant.

- **EIA Studies and Consultation Undertaken -** The Consultant will arrange and manage the various studies and documents required for the EIA Report and EMMP. The consultant may also require technical assistance from specialists for some of the EIA studies; for example , coral or fisheries experts. Some project proponents like to be involved in stakeholder consultation while others prefer to have their consultant undertake the consultation on their behalf. The Department has produced separate guidelines on consultation and consultants to assist the proponent.
- **EIA report and EMMP submitted -** Once completed, the EIA report and EMMP, along with any other technical documents must be signed by the consultant and by proponent and delivered to the Department. Proponent must make sure that eight copies are delivered and that an electronic copy is also provided. It is important to note that although the EIA report may be prepared and signed by a consultant, it remains proponent's legal responsibility and forms part of the application for an Environmental Permit.
    - Departmental officers will review the application, including the EIA report and EMMP.
- **Application reviewed by EIA Review Committee -** A Committee is convened by the Department as part of assessing the application. The Committee may include representatives from relevant government departments, local government agencies or non-government organisations and will formally review the application, including the EIA Report and EMMP. As part of this review, each member of the Committee will review the application and the application will be discussed at a committee meeting.
    - It is expected that either proponent or the consultant (or both) will attend the first part of the Committee meeting to present the project and answer questions about the proposed development.
    - The Committee then makes recommendations about the application, including conditions for the Environmental Permit, and these are formally recorded and agreed.
- **Environmental Permit granted or refused -** After the Committee meeting, the Department will decide whether to approve or refuse the application. If the application is approved, proponent will be granted an Environmental Permit. If the application is refused, the Department will provide reasons as to why the application was refused.

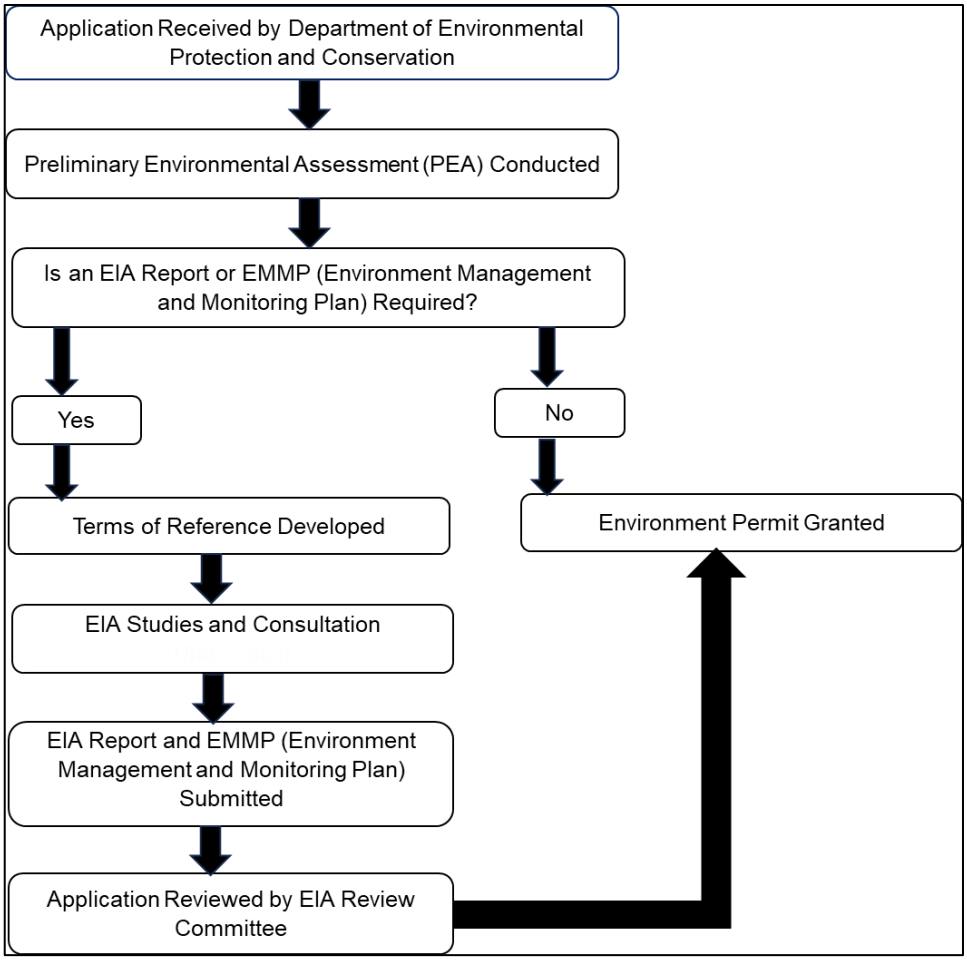


Figure 1: EIA Process Flowchart

2.4 UNDP Social and Environmental Standards (SES)

The following UNDP SES 2021 principles and standards were applied to screen the Project,

- Programming Principles
    - Principle 1: Leave No One Behind
    - Principle 2: Human Rights
    - Principle 3: Gender Equality and Women's Empowerment
    - Principle 4: Sustainability and Resilience
    - Principle 5: Accountability
- Standards
    - Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management
    - Standard 2: Climate Change and Disaster Risks
    - Standard 3: Community Health, Safety and Security
    - Standard 4: Cultural Heritage
    - Standard 5; Displacement and Resettlement
    - Standard 6: Indigenous Peoples
    - Standard 7: Labour and Working Conditions
    - Standard 8: Pollution Prevention and Resource Efficiency

The Screening concluded that the following Programming Principles and Standards were triggered,

- Programming Principles
    - Principle 2: Human Rights
    - Principle 3: Gender Equality and Women's Empowerment

- Principle 5: Accountability

- Standards
  - Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management
  - Standard 2: Climate Change and Disaster Risks
  - Standard 3: Community Health, Safety and Security
  - Standard 6: Indigenous Peoples
  - Standard 7: Labour and Working Conditions
  - Standard 8: Pollution Prevention and Resource Efficiency

2.5 Comparative Analysis between UNDP SES and Regulatory Requirements

A comparative analysis has been undertaken to assess the applicability of UNDP SES, that were triggered during the screening process, and the national regulatory requirements to ensure that the project is environmentally and socially viable as illustrated in the table below,

Table 4: Comparison between UNDP SES and National Regulatory Requirements

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
Principle 2: Human Rights	UNDP recognizes the centrality of human rights to sustainable development, poverty alleviation, sustaining peace and ensuring fair distribution of development opportunities and benefits and is committed to supporting "universal respect for, and observance of, human rights and fundamental freedoms for all.	Constitution of Vanuatu	The Constitution of Vanuatu is supreme law and sets out the legal framework, which deals with the respect of human rights. Vanuatu has ratified core human rights treaties, including: • Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), • Convention on the Rights of Persons with Disabilities (CRPD), • Convention on the Rights of the Child (CRC), • International Convention on Civil and Political Rights (ICCPR), • Convention Against Torture (CAT). In addition, Vanuatu has also ratified a number of International Labor Organization (ILO) conventions that aim to protect and uphold the rights of its workers.	UNDP upholds the principles of accountability and the rule of law, participation and inclusion, and equality and non-discrimination, noting that prohibited grounds of discrimination include race, ethnicity, sex, age, language, disability, sexual orientation, gender identity, religion, political or other opinion, national or social or geographical origin, property, birth, health status or other status including as an indigenous person or as a member of a minority. UNDP also ensures the meaningful, effective and informed participation of stakeholders in the formulation, implementation, monitoring and evaluation of programmes and projects which is limited in reference to the country's regulations on human rights. Through the application of this Principle, inclusivity and accessibility to all vulnerable groups in the project affected and beneficiary communities can be ensured.
Principle 3: Gender Equality and Women's Empowerment	The promotion of gender equality and the empowerment of women are intrinsic to UNDP's human rights-based approach to development programming. This effort includes advocating for women's and girls' human rights, combating discriminatory practices, and challenging the roles and	Constitution of Vanuatu Custom Land Management Act 2013	Vanuatu's 1980 Constitution guarantees the fundamental rights and freedoms of individuals regardless of race, place of origin, religious or traditional beliefs, political opinions, language, or sex. The Act allows for the participation of women in customary institutions	UNDP Principle 3 ensures that projects undertaken by them promote gender equality and empowerment of women. UNDP strengthens interventions tackling structural changes and removes the institutional, societal, political and legal barriers to accelerate gender equality and women's empowerment. They strive to close

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
	stereotypes that create inequalities and exclusion.	Citizenship (Amendment) Act 2013	which are involved in decision-making regarding land matters. The Act guarantees gender equality in citizenship eligibility.	the gender gap by focusing on empowering and creating agency for women and men. UNDP's requirement for Principle 2 provides a broader approach to gender equality and women's empowerment than the Constitution and respective Acts mentioned herein. Thus, the Principle 3 will be adopted for its specific requirement of meaningful participation of women in project decision-making and engagement in paid work during the construction work.
Principle 5: Accountability	UNDP promotes accountability to programme and project stakeholders by (i) enabling active local community engagement and participation in decision-making, particularly those at risk of being left behind; (ii) ensuring transparency of programming interventions through provision of timely, accessible and functional information regarding supported activities, including on potential environmental and social risks and impacts and management measures; (iii) ensuring stakeholders can communicate their concerns and have access to rights-compatible complaints redress processes and mechanisms; and (iv) ensuring effective monitoring—and where appropriate, participatory monitoring with stakeholders—and reporting on implementation of social and environmental risk management measures.	National RTI Policy 2013	The Policy takes into account the guiding principles of social justice, human rights, good governance, transparency and accountability, and public participation. The Government recognizes the importance of information disclosure to good governance, an indicator of which is increased transparency.	UNDP promotes accountability to programme and project stakeholders by actively engaging with them and being participants in the decision-making process. Thus, ensuring transparency of programming interventions through provision of timely, accessible and functional information. The principles also mention about setting up a robust Grievance Redressal Mechanism for the project which is broader in scope as related to the requirements under the RTI Policy.

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management	UNDP is committed to integrating biodiversity and ecosystem management into development planning and production sector activities, strengthening protected areas systems, and managing and rehabilitating ecosystems for adaptation to and mitigation of climate change.	Environmental Protection and Conservation Act 2002 and its subsequent amendments	The Act establishes the protection of the environment within Vanuatu and makes provision for the conservation, sustainable development and management of the environment and the regulation of related activities. This includes land, air and water. Specifically, the Act introduces the requirement for environmental assessment and provides for the conservation of biodiversity and the establishment of protected areas in Vanuatu.	UNDP SES Standard 1 ensures that the assessment of the impacts on the natural resources, biodiversity and ecosystem services should be undertaken as an integral part of ESIA studies so that adequate mitigation measures can be adopted to offset the risks and impacts identified. The Environmental Protection and Conservation Act and Forestry Act [CAP 276] and Regulations is restrictive in ensuring that an assessment of the impacts on the natural resources, biodiversity and ecosystem services should be undertaken as an integral part of ESIA study. Hence, Standard 1 of UNDP SES shall be complied with to ensure that that the risks and impacts related to the project activities are identified so that appropriate mitigation measures are developed.
		Water Resources Management Act 9 of 2002 (Water use rights)	The Water Resources Management Act (2002) provides for the protection, management and use of water resources in Vanuatu. The act allows for the designation of policies to protect water resources; and provides for water conservation zones to be established. Section 7 of the Act states that 'a person must apply to the Director for the right to construct, operate or maintain works for any purpose that does not comply with Section 4 or 5, including: a) any work in or adjacent to any water or any bore; or b) any work whose purpose is to supply water to any other person The application of the act mandates for an application to the Director for	

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
			Water Works and Water Use Permits prior to works commencing. This Act makes provision for the management, conservation and development of forestry resources in Vanuatu, establishes the Forests Board of Vanuatu, provides for the granting of rights relating to forest exploitation, for the declaration of Conservation Areas, for the protection of the environment and the establishment of the Forestry Project Fund for purposes of reforestation and regulates the export of timber. The Act introduces two main requirements for any commercial forestry operations, i.e., an agreement under Part 4 and a licence under Part 5.	
Standard 2: Climate Change and Disaster Risks	This Standard is applicable to projects that (i) have development outcomes that may be threatened by climate change or disaster risks; (ii) may contribute to increased exposure and/or vulnerability to climate change or disaster risks; or (iii) may produce significant GHG emissions.	Meteorology, Geological Hazards and Climate Change Act 2016 (Act No. 25 of 2016).	The Meteorology, Geological hazards and Climate Change act sets the following objectives: 1) to ensure a high quality services provided in relation to weather, climate, flood forecasting and geological hazards; 2) to promote capacities of governments, communities and organizations to understand and respond to risks arising from weather events, climate change and geological hazards; 3) address the needs of operators of ships and aircrafts and of tourists to access all necessary weather forecasts, bulletins, alerts, warnings and information concerning geological hazards; 4) facilitate the	UNDP SES Standard 2 ensures that the projects avoid or minimize the exacerbation of impacts caused by natural or man-made hazards, such as landslides or floods that could result from land use changes due to the project activities which is wider in scope as compared to the Meteorology, Geological Hazards and Climate Change Act 2016. Standard 2 shall be complied with to ensure that the project does not contribute towards disaster risks and that adequate measures are developed and implemented throughout the project cycle.

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
			use and application of relevant information, forecasts, bulletins and warnings generated to and by local, regional and international bodies.	
Standard 3: Community Health, Safety and Security	This Standard addresses the need to avoid or minimize the risks and impacts to community health, safety and security that may arise from project-related activities, with particular attention given to disadvantaged and marginalized groups.	Health and Safety at Work Act (Cap. 195).	This Act deals with various aspects of occupational health and safety. Specifies duties of employers to ensure health, safety and welfare at work of the employees, as well as duties of employees and manufacturers.	UNDP Standard of Community Health, Safety and Security ensures that risks and impacts caused to the community are adequately mitigated which is broader in scope that the national regulations that looks into only the health and safety of workers. Standard 3 shall be complied with to ensure that the community health & safety including workers' health & safety aspects are evaluated and mitigated during the various phases of the project cycle. Structural elements shall be designed and constructed by competent professionals and certified or approved by the competent authorities or professionals. For projects with structural elements or components whose failure or malfunction may threaten the safety of the communities, UNDP ensures that the plans for project supervision, operation, and maintenance are developed and monitored. Independent expertise on the verification of design, construction, and operational procedures is used and periodic safety inspections are carried out. This shall be complied with by the contractor for all

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
				structures that would be constructed as part of the project. UNDP ensures that the projects avoid or minimize transmission of communicable diseases that may be associated with the influx of temporary or permanent project labour. The contractor will adhere to the national regulation while setting up the sanitary facilities for workers at the construction area. In addition, the proponent will also comply with UNDP Standard 3 requirements to ensure appropriate services for the labourers are provided to minimise the impact generated by the facilities on the environment.
Standard 6: Indigenous People	The promotion and protection of the rights of indigenous peoples, especially concerning their lands, territories, resources, traditional livelihoods, tangible and intangible Cultural Heritage, are necessary to achieve UNDP's goals of advancing human rights, respecting indigenous peoples identities and improving their well-being.	Protection of Traditional Knowledge and Expressions of Culture Act 2019 (Act No. 21 of 2019).	The Act provides for the protection, regulation and management of traditional knowledge and expressions of culture in Vanuatu and for related matters.	Standard 6 ensures that projects undertaken by UNDP avoids adverse impacts on the rights of indigenous peoples, their lands, territories, resources, to mitigate and remedy residual impacts, and to ensure provision of just and equitable benefits and opportunities for indigenous peoples in a culturally appropriate manner. While the Act specifically discusses about safeguarding traditional knowledge, the UNDP's Standard 6 is specific as it ensures the full and effective participation of indigenous peoples, with the objective of securing their free, prior, and informed consent (FPIC) where their rights, lands, territories, resources, traditional livelihoods may be affected.

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
Standard 7: Labour and Working Conditions	The pursuit of inclusive and sustainable economic growth, full and productive employment and decent work for all requires the protection of workers' fundamental rights, their fair treatment, and the provision of safe and healthy working conditions.	Employment Act (Cap 160)	The Act takes into account the labour codes, general labour and employment conditions.	UNDP Standard 7 ensures that the projects are gender-sensitive and considers the risks on the health and safety of the women and children. Standard 7 of UNDP shall be complied with by the contractor to ensure that the labourers are provided with safe and healthy working environment, considering the risks inherent to the particular sector (including gender bias) and specific classes of hazards in the work areas as the national regulation is restrictive in terms of encompassing risks inherent to various sectors and classes of hazards in the work areas. Standard 7 of UNDP shall be complied with as it ensures that the steps are taken to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work and ensures the application of preventive and protective measures consistent with the international good practice, as reflected in internationally recognized standards such as the World Bank Group's (WBG) Environmental, Health, and Safety (EHS) Guidelines. The national regulation is restrictive in its scope and fails to adopt measures consistent with the internal good practice and WBG's EHS guidelines.
		Minimum Wage and Minimum Wages Board Regulations (Order No. 56 of 1987) and its subsequent amendments	This Act sets the minimum wage rate in Vanuatu for workers in municipalities, agricultural workers and students and young workers.	
		Health and Safety at Work Act (Cap. 195).	This Act deals with various aspects of occupational health and safety. Specifies duties of employers to ensure health, safety and welfare at work of the employees, as well as duties of employees and manufacturers.	
		Convention on the Rights of the Child (Ratification) Act [Cap 219] (Act No. 26 of 1992).	The Act recognize the right of the child to be protected from economic exploitation and from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.	
		Abolition of Forced Labour Convention (Ratification) Act 2006 (Act No. 5 of 2006)	An Act to provide for the ratification of the Abolition of Forced Labour Convention, 1957.	

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
				UNDP Standard 7 shall be complied with as it ensures compliance with national labour and occupational health and safety laws, with obligations under the international law, and consistency with the principles and standards embodied in the International Labour Organization's (ILO) fundamental conventions. The National Acts are restrictive in its scope as it looks at national aspects while the UNDP's standard is consistent with the international law and principles and standards.
Standard 8: Pollution Prevention and Resource Efficiency	The Pollution Prevention and Resource Efficiency Standard recognizes that increased industrial activity, urbanization, and intensive agricultural development often generate increased levels of pollution1 to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global level. Pollution prevention and resource efficiency are core elements of a sustainable development agenda and UNDP projects must meet good international practice in this regard.	Pollution (Control) Act No.10 of 2013	The objectives of this Act are to minimize and manage the discharge and emission of pollution and encourage all levels of government to work together to control the discharge and emission of pollution. Clause 8 imposes a requirement on owners and occupiers of premises to comply with prescribed standards for the discharge of pollution, wastewater and the emission of noise, odour or electromagnetic radiation and Clause 9 establishes a permit scheme for the discharge or emission of pollutants and creates offences for the discharge or emission of pollutants without a permit.	UNDP's Standard 8 ensures that the projects avoid the release of pollutants, and when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants into the air, water, and land due to routine, non-routine, and accidental circumstances. The Pollution (Control) Act No.10 of 2013 and Waste Management Act No.24 of 2014 are restrictive as it discusses how effluents should be treated. Standard 8 shall be complied with as it considers minimisation and/or control mechanism in terms of controlling the intensity and mass flow of the pollutant's release.
		Waste Management Act No.24 of 2014	An Act to provide for the protection of the environment through	UNDP Standard 8 ensures that pollution prevention and control technologies and practices,

UNDP SES	UNDP SES Requirement	National Regulations	Regulatory Requirement	Comparative Analysis
			encouragement of effective waste services and operations. A designated waste management operator must prepare and submit reports relating to any aspect of waste management under its responsibility to the Department, the Ministry of Health and the Department of Biosecurity.	consistent with international good practice, are applied during the project life cycle. The technologies and practices applied shall be tailored to the hazards and risks associated with the nature of the project. The respective National Acts ensure the respect and recognize international and regional standards and other national standards which are based on international standards. Adopting UNDP's Standard 8 would enhance achieving the standards set down for pollution prevention and resource efficiency.

3.0 Project Description

This chapter provides a summary of the proposed project with a detailed description including project location, project components and its features, distribution network and schedule of the project.

3.1 Project Site Setting

The project area is located in village Nambaranguit in Penama Province situated on the West Coast of Pentecost Island of Vanuatu. The project elevation ranges from 50m to 100m above mean sea level and is located in Nambaranguit. The project lies on geo co-ordinate Lat-15°35'4.63"S and Long-168°7'58.16"E. The indicative location of the project site is provided in the figure below.

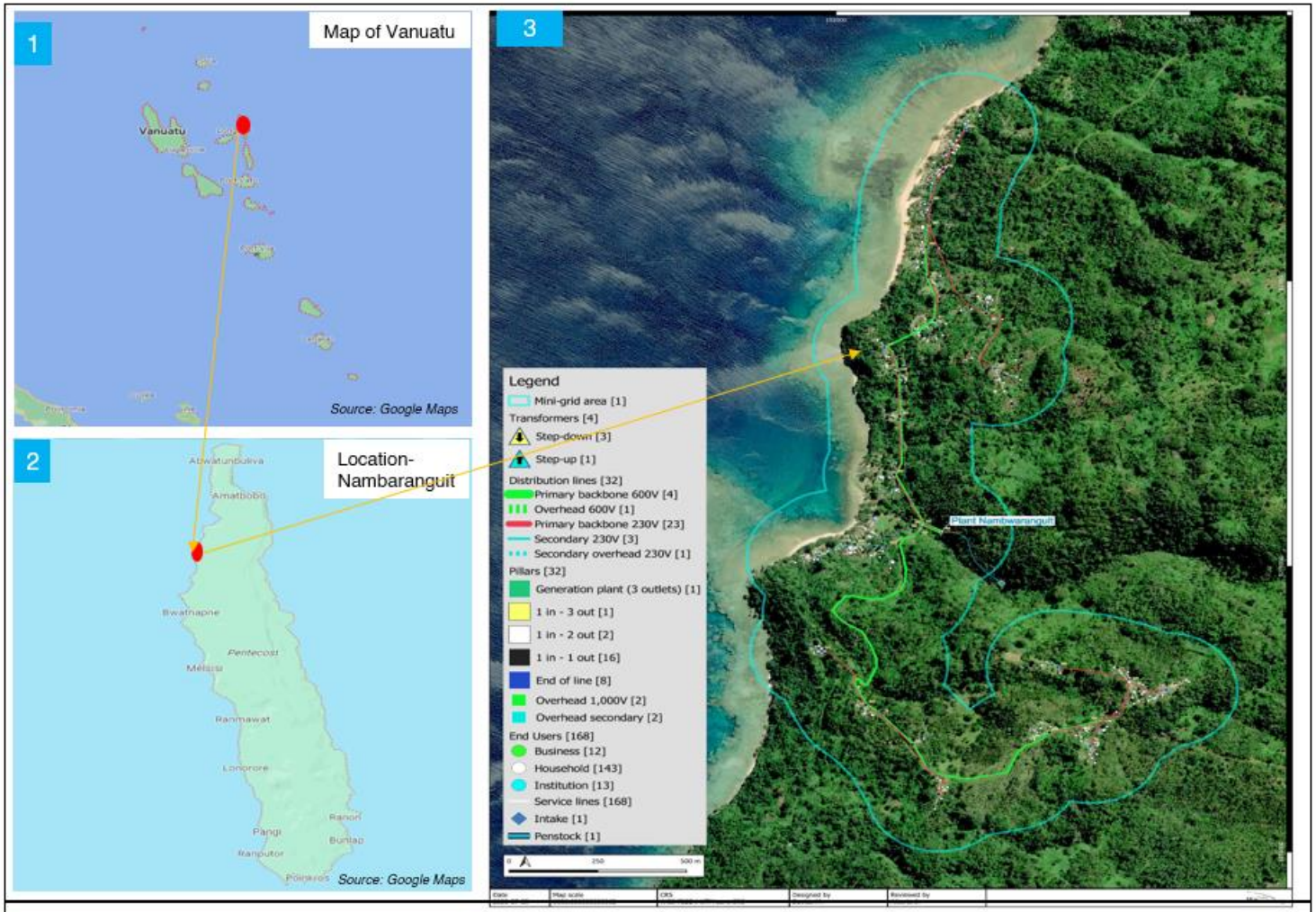
The hydropower potential of the area estimates when the water flow utilization is capped at 20/30% of the recorded waterflow (11 l/s,) utilizing a 144 mm ID, 380m long penstock wherein the combined output of 3 Pelton turbines could reach 3,493W.

For the proposed project, about 03 identical units of 1.75 kW Pelton type turbine (each turbine will have an output of around 1,164 W) will be installed in the Powerhouse. The turbines are required to have a total flow of 10.4 l/s with a combined output of approx. 3,493 W (1,164 W per turbine). The length of the penstock connecting intake and powerhouse is approx. 380m. A 25 kWp PV array on an elevated canopy with SE-NW orientation is expected to be installed as part of the project. It is expected that the PV and hydroelectric systems will deliver a combined generation capacity of up to 28kW.

A total of 6.8 km of single-phase low-voltage distribution network will be installed to connect the 167 potential users currently living in the targeted communities. It will be composed of sections of 600V to achieve cost efficiency while keeping voltage drop within acceptable values. 600V/230V step-up and down transformers will be installed. The remaining sections of the single-phase distribution network will be at 230V with all users being provided with a 230V single-phase connection.

Accessibility to the Project Site

The project is accessible by road. There is a possibility that the road from the Powerhouse to the Catchment Area might be stregthened during the implementation phase as it is currently undulating and unpaved. The project site is about 15km from the airport. There is a barge landing available. The water catchment to the public road is about 800m.



Location Map for Pico hydro and Hybrid system (Pico and Solar PV backup) in Nambaranguit

Description of the map – (1) Map of Vanuatu, indicating project location in Pentecost Island; (2) Indicating project location on Pentecost Island of Vanuatu; (3) Google Earth Imagery of the Project location representing various project features

Figure 2: Indicative Location Map for Hybrid System (Pico and Solar PV Backup) in Nambaranguit

A Detailed Designed Report (DDR) was prepared in June 2023 for the identified site in line with the requirement of the DoE under the MoCC with support from UNDP and as part of the Barrier Removal for Achieving National Energy Road Map Target of Vanuatu (BRANTV) Project for the Vanuatu Government.

The DDR provided a summary of the socio-economic and demand data resulting from the feasibility study as well as the hydropower potential assessment details, an overview of the technical system setup from the conceptual design phase, description of the key components of the system and estimated bill of quantities. As per the DDR, it was understood that a total of 167 users (households – 141, businesses – 12 and institutions – 14) that would be benefitted from the project with a total demand of 109.175 kWh/day.

3.2 Project Salient Features

The salient features of the proposed project have been provided in the following table,

Table 5: Salient Features of the Project

S. No	Component	Description/Requirement
1.	Head	47M
2.	Penstock Length	290m
3.	Water Flow	8 l/s (Intake 1) 5 l/s (Intake 2)
ii	***Hydro Potential Simulations***	
1.	Flow	11.0 lps
2.	Used Flow	10.4lps
3.	Pipe Head	65.0m
4.	Pipe Length	380m
5.	Pipe Efficiency	90%
6.	Pipe Diameter	144mm
7.	Number of Power sprouts	3
8.	Nozzles	2
9.	Jet Diameter	8.7mm
10.	Actual Pipe Efficiency	98%
11.	Speed	1322 rpm
12.	Output	1164W
13.	Total Output	3493W
III.	***Variables Measured to Calculate the Water Flow Rate for Nambwaranguit***	
1.	Bucket	21L (Intake 1) 21L (Intake 2)
2.	Trials	20 (Intake 1) 10 (Intake 2)
3.	Average Time (T)	2.6s (Intake 1) 4.2s (Intake 2)
4.	Flow (Q)	8 l/s (Intake 1) 5 l/s (Intake 2)
IV.	***Pelton type turbine specifications***	
1.	Generator (PMA)	3-phase Smart Drive permanent magnet generator (PMG)
2.	Generator efficiency	> 70%
3.	Wattage single turbine	Up to 1750W
4.	Running speed	Up to 2000 rpm
5.	Watt/rpm	Up to 1.0 W/rpm
6.	Case	UV resistant LDPE plastic case with minimum 6mm thickness
7.	Drive shaft	Stainless steel
8.	All fasteners and fixings	Stainless steel

S. No	Component	Description/Requirement
9.	Turgo rotor material	GF30 Nylon
10.	Runner	Pelton wheel (Impulse turbine)
11.	Jets	1-2 jets. Diameter can be adjusted in size on-site to fine-tune the turbine output during the commissioning.
12.	Static head range	Up to 160m
13.	Maximum Dynamic head	Up to 130m
14.	Jets supplied	1 set cut to calculated size + 2 spare uncut set
15.	Rectification	100 amp rated air-cooled rectifier
16.	Greasing	Equipped with spring-loaded re-usable cans
17.	Warranty	2 years product warranty
18.	Spare parts	The turbines need to be provided with a set of tools and spare parts according to manufacturer recommendations to ensure spare parts are on-site for fast repairs. I grease canister fully compliant with manufacturer recommendations needs to be supplied for each turbine.
V.	***Specifications of Solar PV Modules***	
1.	Product Standards	IEC-61215, IEC 61730-1, IEC 61730-2, IEC 61701, IEC TS 62804
2.	Manufacturer Certificates	ISO 9001 , ISO 14001
3.	Years that the manufacturer will be present in the market	≥ 10 years
4.	PV Cell Technology	Poly-crystalline or mono-crystalline Silicon.
5.	Number of Cells	60, 72, 120 or 144
6.	Power Tolerance	> 0 %
7.	Efficiency under STC Conditions	≥ 19 %
8.	Frame Material	Anodized aluminium
9.	Front Glass Material and Thickness	low-iron tempered glass, ≥ 3 mm.
10.	System Voltage	≥ 1000 Vdc
11.	Connectors Type	MC4 or equivalent
12.	Junction Box Ingress Protection rating	≥ IP65
13.	Number of Bypass Diodes	≥ 3
14.	PV Conductors cross-section	≥ 4 mm2
15.	Front load	≥ 5400 Pa uplift.
16.	Performance Warranty	Maximum STC power degradation of 10% during the first 10 years and 20% during a period of 25 year
17.	Product Warranty	≥ 10 years
VI.	***Specifications of PV Support Structure***	
1.	Tilt from the horizontal	10 ^{o}
2.	Profiles material for ground mounted structures	Hot-dip galvanized steel with a minimum Zinc coating thickness of 85µm or anodized aluminium with a minimum coating thickness of 20µm (AA20).
3.	Profiles material for canopy structures	Hot-dip galvanized steel with a minimum Zinc coating of 85µm.
4.	Bolts and fastenings material	Stainless steel SS316.
5.	Racking Connections	Bolt-locked. Self-tapping screws are not allowed.
6.	Profiles	Profiles should be pre-cut to the final measurement before performing the anodizing process, to avoid having uncoated sharp edges

S. No	Component	Description/Requirement
7.	Foundations type	Concrete pads or ground screws. If ground screws are used, they should be made of hot-dip galvanized steel with a minimum coating thickness of 100 µm.
8.	Height between the ground level and the lower most point of the PV modules	Canopy: ≥ 3 m
9.	Product Warranty	≥ 10 years
10.	Desing Windspeed	70m/s
VII.	***Specifications of Grid Tied Inverter for Hydro Turbines***	
1.	Recommended max. power	2660 W
2.	Max input voltage	600 V
3.	Rated voltage	330 V
4.	Start-up voltage	90 V
5.	MPPT voltage range	80-500 V
6.	Max. input current	11A
7.	Max short circuit current	17.2A
8.	MPPT number / Max. input strings number	1/1
	Output AC	
9.	Rated output power	2000 W
10.	Max. apparent output power	2200 VA
11.	Max. ouput power	2200 W
12.	Rated grid voltage	1/N/PE, 230V
13.	Rated grid frequency	50 Hz
14.	Rated grid output current	8.7A
15.	Max. output current	10.5A
16.	Power Factor	>0.99 (0.8 leading - 0.8 lagging)
17.	THDi	<3%
	Minimum efficiency requirements	
18.	Max. efficiency	97.20%
19.	EU efficiency	96.50%
	Integrated protections	
20.	DC reverse-polarity protection	Yes
21.	Short circuit protection	Yes
22.	Output over current protection	Yes
23.	Surge protection	Yes
24.	Grid monitoring	Yes
25.	Anti-islanding protection	Yes
26.	Temperature protection	Yes
27.	Integrated AFCI (DC arc-fault circuit protection)	Yes
28.	Integrated DC switch	Yes (PV2 Switch)
29.	**General data**	
30.	Topology	Transformerless
31.	Self consumption (night)	<1 W
32.	Operating ambient temperature range	-25C to 60C
33.	Relative humidity	0-100%
34.	Ingress protection	IP65

S. No	Component	Description/Requirement
35.	Cooling concept	Natural convection
36.	Max. operation altitude	4000m
37.	Grid connection standard	AS/NZS 4777.2, IEC 62116, IEC 61727, IEC 60068, IEC 61683, EN 50530
38.	Safety/EMC standard	IEC 62109-1/-2, IEC 61000-6-1/-2/-3/-4
	Additional features	
39.	DC connection	MC4 connector
40.	Display	LCD
41.	Communication	RS485, and WiFi/GPRS
42.	Warranty	5 years product warranty provided by manufacturer
VIII.	***Specifications of Grid Tied Inverter for PV Array***	
	Input DC	
1.	Recommended max. power	9000 W
2.	Max input voltage	1,000 V
3.	Start-up voltage	80 V
4.	MPPT voltage range	80-800 V
5.	Max. input current	18A
6.	Max short circuit current	36A
7.	MPPT number / Max. input strings number	2/2
	Output AC	
8.	Rated output power	6000 W
9.	Max. apparent output power	6000 VA
10.	Rated grid voltage	1/N/PE, 230V
11.	Rated grid frequency	50 Hz
12.	Rated grid output current	8.7A
13.	Max. output current	26.1A
14.	Power Factor	0.85 to 1
15.	THDi	<3%
	Minimum efficiency requirements	
16.	Max. efficiency	98.10%
17.	EU efficiency	97.30%
	Integrated protections	
18.	DC reverse-polarity protection	Yes
19.	Output over current protection	Yes
20.	Surge protection	Yes
21.	Grid monitoring	Yes
22.	Anti-islanding protection	Yes
23.	Temperature protection	Yes
24.	Integrated DC switch	Yes (PV2 Switch)
	General data	
25.	Topology	Transformerless
26.	Self consumption (night)	<1 W
27.	Operating ambient temperature range	-40C to 50C
28.	Relative humidity	0-100%
29.	Ingress protection	IP65
30.	Cooling concept	Regulated air cooling

S. No	Component	Description/Requirement
31.	Max. operation altitude	4000m
32.	Standards	DIN V VDE 0126-1-1/A1, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 4777-2, AS 4777-3, G98, G99, CEI 0-21,
	Additional features	
33.	DC connection	MC4 connector
34.	Display	LCD
35.	Communication	RS485 and WiFi
36.	Warranty	5 years product warranty provided by manufacturer
IX.	***Charge controller specifications for turbine***	
1.	Battery voltage	48V
2.	Rated charge current	60A
3.	Nominal input power at 48V	2440W
4.	Max. PV short circuit current	35A
5.	Maximum PV open circuit voltage	250V
6.	Maximum efficiency	99%
7.	Self-consumption	Less than 20mA @ 48V
8.	Charge algorithm	multi-stage adaptive or user defined algorithm
9.	Protection	PV reverse polarity/Output short circuit/Over temperature
10.	Operating temperature	-30 to +60°C
11.	Humidity	95%
12.	Maximum altitude	5000m
13.	Pollution degree	PD3
14.	Data communication port	Via direct communication cable and Bluetooth
15.	Remote on/off capabilities	Yes
16.	Programmable relay	Yes
	Enclosure	
17.	Protection category	IP43 (electronic components), IP22 (connection area)
	Standard	
18.	Safety	EN/IEC 62109-1. UL 1741. CSA C22.2
19.	Warranty	At least 5 years product warranty
X.	***Charge controller specifications for PV array***	
1.	Battery voltage	48V
2.	Rated charge current	200A
3.	Number of MPPT trackers	4
4.	Max. DC output charging power	11520 W
5.	Max. PV short circuit current	20A per tracker
6.	Maximum PV open circuit voltage	450V
7.	Maximum efficiency	96%
8.	Self-consumption	15mA
9.	Charge algorithm	multi-stage adaptive
10.	Protection	PV reverse polarity/Output short circuit/Over temperature
11.	Operating temperature	-40 to +60°C
12.	Humidity	95%
13.	Remote on/off capabilities	Yes
14.	Programmable relay	Yes
	Enclosure	

S. No	Component	Description/Requirement
15.	Protection category	IP21
	Standard	
16.	Safety	EN-IEC 62109-1, EN-IEC 62109-2
17.	Warranty	At least 5 years product warranty
XI.	***Battery Inverter Specifications***	
1.	Integrated Transfer switch	Yes
2.	AC inputs (grid and generator)	Input voltage range: 187-265 VAC Input frequency: 45 - 65 Hz Power factor: 1
3.	Maximum feed through current (A)	2x100
	Inverter	
4.	Input voltage range (VDC) @48VDC	38 - 66V
5.	Output	Output voltage: 230 VAC ±2% Frequency: 50Hz ±0.1%
6.	Cont. output power at 25°C (VA)	15000
7.	Cont. output power at 25°C (W)	123000
8.	Peak power (W)	25000
9.	Maximum efficiency (%)	96
10.	Zero load power (W)	110
	Charger	
11.	Charge voltage 'absorption' (VDC)	57.6
12.	Charge voltage 'float' (VDC)	55.2
13.	Storage mode (VDC)	52.8
14.	Battery charge current @25C	200
15.	Battery temperature sensor	Yes
	General	
16.	Auxiliary output (A)	50
17.	Programmable relay	3x
18.	Protection	• output short circuit • overload • battery voltage too high • battery voltage too low • temperature too high • 230 VAC on inverter output • input voltage ripple too high
19.	Remote on-off capabilities	• Yes
20.	Operating temperature	• -40 to +65 °C
21.	Humidity	• max. 95%
22.	Protection category	• IP21
	Standard	
23.	Safety	• EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1
24.	Emission, Immunity	• EN 55014-1, EN 55014-2, EN-IEC 61000-3-2, EN-IEC 61000-3-3, IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-3
25.	Warranty	• At least 5 years product warranty provided by the manufacturer
XII.	***Battery Specifications***	
1.	Nominal voltage (V)	48
2.	Nominal capacity (kWh)	At least 3.5
3.	Usable Capacity (kWh)	At least 3.3

S. No	Component	Description/Requirement
4.	Discharge Voltage (V)	44.5-53.5
5.	Charge Voltage (V)	52.5-53.5
6.	Charge/Discharge Current (A)	37 (continuous operation 74 (@60s) 90(@15s)
7.	Communication Port	RS323, RS485, CAN
8.	Single string quantity(pcs)	16
9.	Working Temperature/C	0-50
10.	Humidity	5%~95%
11.	Design life	15 Years
12.	Cycle Life	At least 6000
13.	Transport certificate	UN 3090
14.	EMC	IEC62619, IEC63056, IEC62040, IEC62477-1, UL1973,U1642,UL9540A, VDE2510-50, IEC61000-6-2, IEC61000-6-3, UN38.3
XIII.	***Distribution Line***	
1.	Primary backbone 600V	2* 1C 95mm^2 XLPE 1/06kV aluminum
2.	Primary backbone 230V	2* 1C 95mm^2 XLPE 1/06kV aluminum
3.	Overhead 600V	2* 1C 70mm^2 XLPE 1/06kV ABC aluminum
4.	Secondary 230V	2* 1C 70mm^2 XLPE 1/06kV aluminum
5.	Secondary overhead 230V	2* 1C 70mm^2 XLPE 1/06kV ABC aluminum
XIV.	***Specifications of 15Kva step up transformer to be installed inside the powerhouse***	
1.	Rated Power	15 KVA
2.	Transformer type	Dry
3.	Mounting	PAD
4.	Input Voltage	230V
5.	Input Frequency	50Hz
6.	Output Voltage	600V
7.	Output Frequency	50Hz
8.	Impedance Voltage	<4% i.e. low loss.
9.	Efficiency	≥98%
10.	Duty Cycle	100% Continuous
11.	Winding Conductor Material	Copper
12.	No Load Current	<4%
13.	Display	Analog or Digital Voltmeter
14.	Insulation Class	H
15.	Cooling Method	Natural or forced ventilation
16.	Working Environment	Ambient Temperature: -10℃ to +45℃ Relative Humidity: ≤95% (non-condensing) Altitude: ≤1000m
17.	Protection Degree	IP33 or superior
18.	Standards	In Accordance with IEC and EN including but not limited to IEC 61558-2, IEC 60076
XV.	***Specifications of 10Kva step up transformer to be installed next to the distribution pillars***	
1.	Rated Power	10 KVA
1.	Transformer type	Dry
2.	Mounting	PAD
3.	Input Voltage	600V

S. No	Component	Description/Requirement
4.	Input Frequency	50Hz
5.	Output Voltage	230V
6.	Output Frequency	50Hz
1.	Impedance Voltage	<4% i.e. low loss.
2.	Efficiency	≥98%
3.	Duty Cycle	100% Continuous
4.	Winding Conductor Material	Copper
5.	No Load Current	<4%
6.	Display	Analog or Digital Voltmeter
7.	Insulation Class	H
8.	Cooling Method	Natural or forced ventilation
9.	Working Environment	Ambient Temperature: -10℃ to +45℃ Relative Humidity: ≤95% (non-condensing) Altitude: ≤1000m
10.	Protection Degree	IP33 or superior
11.	Standards	In Accordance with IEC and EN including but not limited to IEC 61558-2, IEC 60076
XVI	***Specifications for Single-Phase Meter***	
	Voltage	
1.	Nominal voltage Un	230V
2.	Limited voltage	70%~120% Un
	Frequency	
3.	Nominal frequency fn	50-60Hz
4.	Tolerance	5%
	Current	
5.	Basic current(Ib)	5A
6.	Maximum current(Imax)	60A
7.	Starting current(Ist)	20mA
	Measurement accuracy	
8.	Active energy to IEC62053 - 21	Class1.0
	Burden	
9.	Voltage circuit	<2W <8VA
10.	Current circuit	<1VA
	Temperature range	
11.	Operation meter	-25°C to +70°C
12.	Storage	-40°C to +85°C
	Insulation	
13.	Insulation level	4kV rms 1min
14.	Voltage impulse withstand	8kV 1.2/50 μs
15.	Insulation System Classification	Protective Class II
	Electro Magnetic Compatibility	
	Electrostatic discharges	
16.	Contact discharge	8kV
17.	Air discharge	16kV
	Mechanical	
18.	Meter shell Protection Rate	IP54
19.	Insulation System Classification	Protective Class II

S. No	Component	Description/Requirement
	Display and functionalities	
20.	LCD display parameters	Credit balance, daily energy consumption, total energy consumption, alarms.
21.	Automatic disconnection.	If overload, if no payment, if tamper event.
22.	Interface.	LCD screen and LED indicators.
23.	Product warranty	≥ 1 year

***Source**: Nambaranguit Detailed Designed Report*

Project Components

Intake

To capture the required water flow for the turbines' operation, the height of both existing intakes would need to be supplemented. The supplement of the intake may be made of masonry taking special measures to join the supplement with the existing intake by means of small anchors. Intake 1 will have to be supplemented by 15cm for the entire perimeter of the intake (approximately 9m). Section 2 will have to be supplemented by 30cm for the entire perimeter of the intake (approximately 8m). Additionally, both intakes will have to be emptied and cleaned from algae and vegetation growing on them.

The interconnection of Intake 2 to Intake 1 will be made by a 3m long 110m OD UV-resistant PVC pipe. Intake 1 will be fitted with a Coanda-type screen intake to protect the ingress of fine debris into the penstock. Big debris like boulders and tree logs are not expected to be present due as the source is an underground spring. The figure below provides an approximate layout with dimensions for Intake 1.

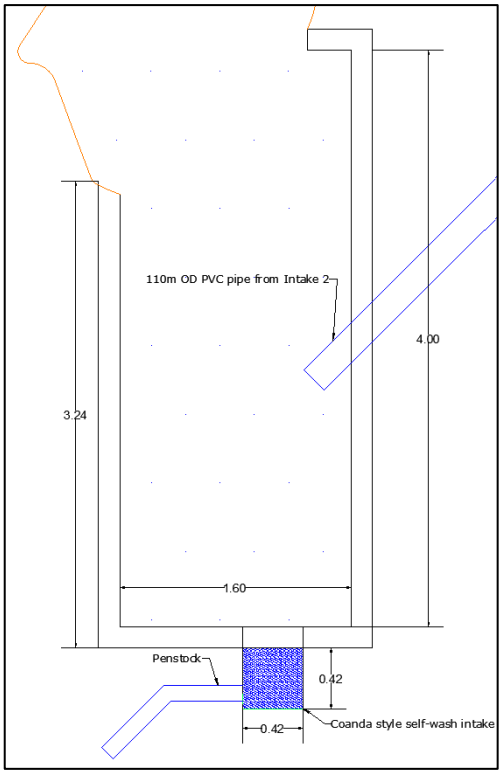


Figure 3: Approximate Layout with dimensions (in meters) for Intake 1

The figure below provides a front view of Intake 1 with details on the intake screen and existing pipes connected to the Intake.

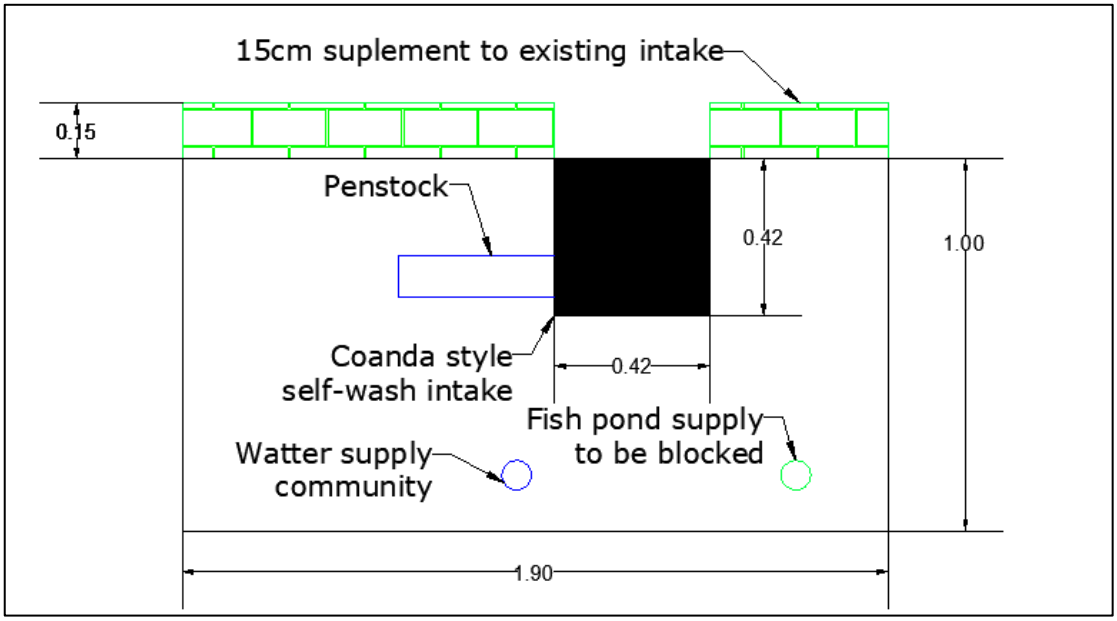


Figure 4: Front View with details of Intake 1

The figure below provides an approximate layout with dimensions of Intake 2.

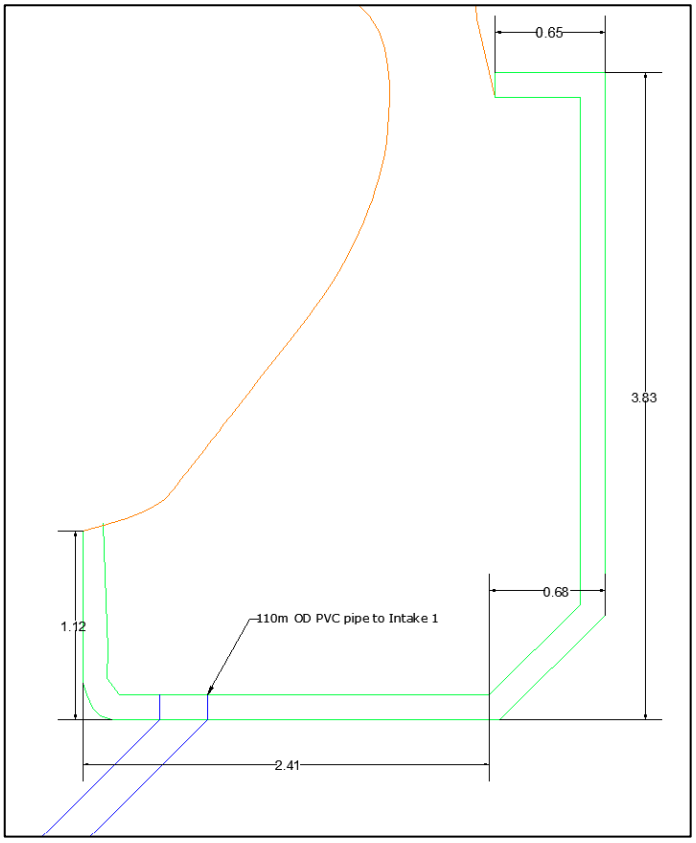


Figure 5: Approximate Layout with dimensions (in meters) for Intake 2

The figure below presents a front view of Intake 2,

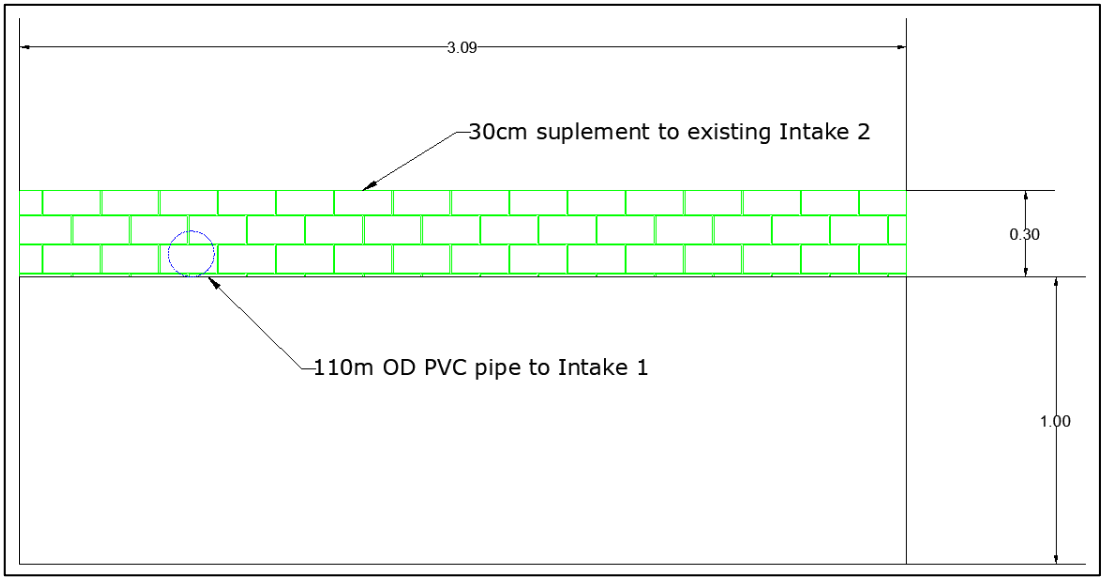


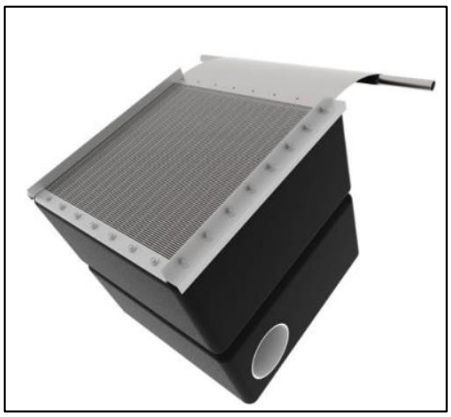
Figure 6: Front view with details of Intake 2

The top of the screen box to be included in Intake 1 is to be formed by a Coanda-type screen made of stainless-steel mesh at the top which should not allow to pass particles bigger than 2mm in any dimension while permitting to pass a flow of at least 30l/s without vortex formation as per manufacturer recommendations. The screen is to meet the following specs:

- Material: 304 stainless steel
- Wedge wire tilt angle: 5 degrees
- Wedge wire width: 2mm
- Wedge wire depth: 3mm
- Screen gap: 1.5mm

The screen box is to be mounted at an optimum angle at a horizontal level to allow self-cleaning of debris while allowing sufficient flow to pass as per manufacturer recommendations (normally between 25 and 35 degrees). The screen box casing is to be made of moulded LDPE material which allows for interconnection of the penstock on the left side. The base where the screen mounts should be made of solid masonry construction (concrete blocks or bricks) anchored to the wier and bottom, allowing the screen box to sit on it and be anchored to it.

The figure below displays an example of a typical Coanda type screen intake,



Photograph 1: Example of typical Coanda type screen intake

The figure in the following displays details on the intake screen installation,

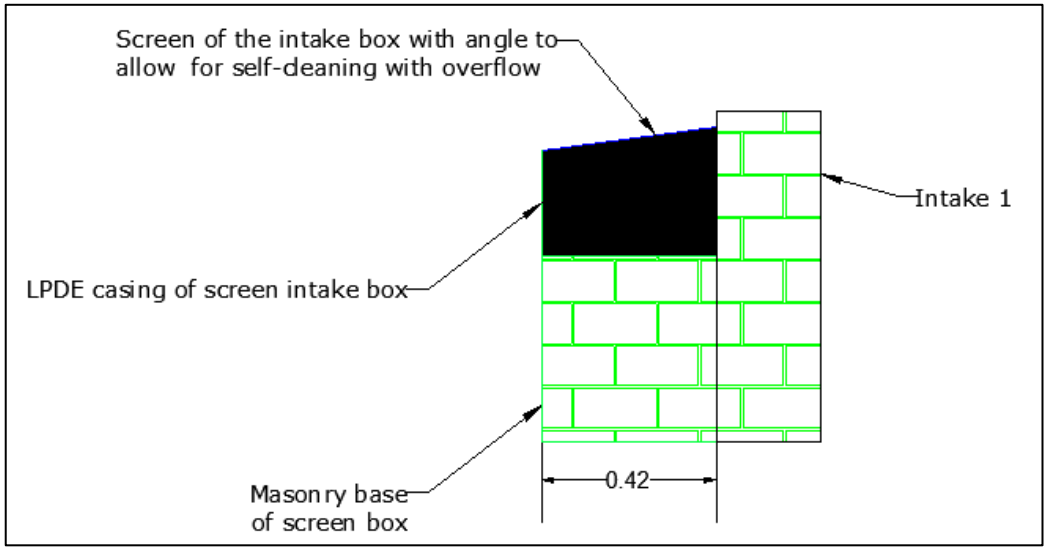


Figure 7: Indicative side view of Intake 1 with the Coanda-type screen intake and its base

Penstock and Valves

A 290m long 160mm OD PN8 PE penstock is to be installed between the intake and the powerhouse. All the joins between different sections and fittings will be electro fused. Particularly on the steep parts of the path, the penstock will be kept in place with reinforced concrete footings with the location of each footing to be agreed onsite between the contractor and the PMU. The support to be used should not allow the penstock to move to prevent wear and tear of the penstock against any surface it might be in contact with, like concrete, rock, and steel.

The penstock will be fitted with the required accessories to connect it to the left side of the Coanda-type screen intake. It will come out suspended with supports following a gently slopped and curved route to the Powerhouse.

Approximately 5 meters from Intake 1, the penstock will be fitted with a 2m long vertical air vent going 1m above the top of the Intake 1. The vertical vent is to be made of the same pipe as the penstock using a T fitting. It is to be fixed with steel supports fixing it to the nearby rocks and protected against the potential impact of debris during flooding and/or high wind conditions, both conditions likely to happen simultaneously during a cyclone. The vent is to be fitted with a screen on the top to prevent the entrance and/or nesting of animals and the ingress of any type of flying debris.

Before entering the Powerhouse, the penstock will be switched into a 160 mm OD UPVC PN 8 8m long pipe feeding the group of turbines. The 160 mm OD pipe will be fitted with two gate valves, one at the beginning to control the flow into the pipe and one at the end to be able to flush the penstock out. It will also be fitted with two pressure readers and fixed with anchors and thrust blocks to guarantee long terms stability of the piping.

Turbines and Elements

03 identical units of 1.75 kW Pelton-type turbines will be installed in the powerhouse. Each turbine should output around 1,164 W with a total combined output of 3,492 W. The turbines will be equipped with jets whose diameter can be adjusted on-site to fine-tune the turbine output during the commissioning.

The turbines should be equipped with a spring-loaded auto greaser to keep grease flowing into the bearings – which is the most common source of mechanical failure in turbines.

Each turbine will be mounted on top of a U-section, 400 mm high tail race constructed with concrete blocks anchored to the slab and a timber frame where the water can fall through. The base of the turbine should be at least 100 mm above the water level in the tail race. The dimensions of the tail race should comply with the manufacturer's recommendations. The figure below provides a reference for the main outside dimensions of a 1.75kW Pelton turbine and its footprint.

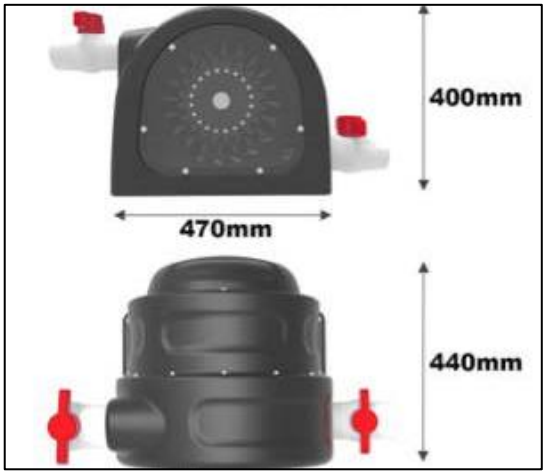


Figure 8: Reference dimensions of a 1.75 kW Pelton type turbine

The turbines will be connected to the penstock after the gate valve by means of a reduction and 63mm OD PN 8 UPVC pipe. Each turbine will count with a 50mm brass gate valve. Two pressure gauges in total will be installed on the penstock. The gauges will be installed just before two of the 50mm brass gate valve connect to the turbines. The gauges will be used to read the correct working pressure and fine-tune the turbine performance if required. The gauges are also used to troubleshoot any potential issue like an obstructed jet.

The operational output of the turbines should be limited to $200V_{DC}$ to be within the input voltage range of standard charge controllers for this range of powers – up to 250 V_{DC}. Each turbine will be equipped with a Power Clamp (PC) device which by means of a PWM control is able to divert a variable current to a set of resistors to dispose of exactly enough energy to keep the turbine speed and voltage (200Vdc) stable despite conditions of changing user load and battery charging demand.

Each turbine will be connected to its respective grid-tied inverter or charge controller by means of a $4mm^2$ PV cable equipped with a 20 Amp HRC fuse in both poles. Four of the turbines will be AC coupled and one will be DC coupled. This setup has been selected to obtain continuous black-start capability.

PV Solar Array

The PV array is to be of installed capacity of at least 25kWp. The array is to be composed of PV modules installed on portrait forming rows. A potential configuration of the PV array could be 48 x 540 Wp modules installed in 4 rows of 12 modules, 2 rows facing NW and 2 rows facing SE.

A customized hot-dip galvanized steel ground-mounted canopy structure with aluminium racking and a tilt of 10 degrees should be used. All bolts to be used will be of stainless-steel type with wedge-lock washers. The design wind speed for the PV array and its foundations and all elements should be 70m/s.

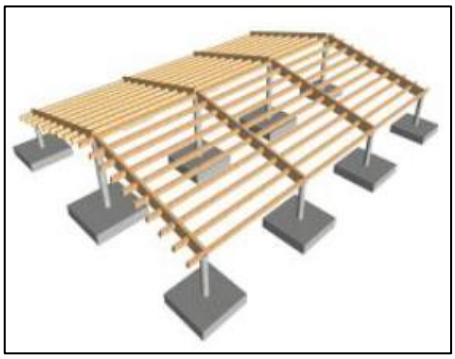


Figure 9: Example of a canopy PV support structure

Part of the array will be AC-coupled and part will be DC-coupled:

- The DC-coupled strings should be connected to a PV string combiner box including DC fuses, a Surge Protection Device (SPD), and a DC switch, which is attached to the mounting structure. The output of the combiner box is connected to a 1 x 450V/200A MPPT charge controller installed in the powerhouse. The output of the charge controller is connected to the main DC busbar at 48 Vdc.
- The AC-coupled strings should be connected to 2 PV string combiner boxes including DC fuses and a DC switch. The SPC can be integrated withing the PV inverters. The output of the combiner box is connected to 2x 6kVA grid-tied MPPT inverters installed in the powerhouse. The output of the PV inverter is connected to the AC marshalling box at 230V.
- The amount of PV capacity to be DC and AA coupled should be defined by the bidder attending to the following requirements:
    - PV input power into the charge controller at least 8% of the max-rated PV input power.
    - DC/AC ratio for the PV inverters ≥ 1
    - Only strings with the same azimuth and number of panels can be connected in a MPPT input.

The cables between the combiner boxes and the grid-tied inverters and charge controllers is expected to have an estimated distance of 250m and should be installed underground inside of adequately sized conduit following the route of the distribution network. For a 20m long section, the cables will have to be installed overhead together with the distribution networks. A maximum 5% voltage drop at max Wp output should be experienced in the run of DC cable between the combiner boxes and the inverter and charge controller.

Grid-tied Inverter

The two AC-coupled turbines and part of the PV array will be connected to a single-phase grid-tied inverter.

For the turbines:

- The model and brand of grid-tied inverters used with the turbines need to be fully compatible with the characteristics of the hydro generator and approved for use by both the turbine and inverter manufacturer.
- The inverters should be rated to 2 kVA AC output, be equipped with one MPPT input and a built-in DC surge protection and DC-PV2 Switch (AS/NZS 5033 compliant), minimum EU efficiency of 96.5% and come with a standard 5-year warranty.

For the PV array:

- An inverter configuration with two 6kVA AC-rated inverters should be used. The inverters should be equipped with at least 2 MPPT input and a built-in DC surge protection and DC-PV2 Switch (AS/NZS 5033 compliant), minimum EU efficiency of 96.5%, and come with a standard 5-year warranty.
- The inverter should be fully compatible with the monitoring system of the grid-forming inverter. It must be possible to display operational parameters in the grid-forming inverter monitoring platform.

The inverters will be wall mounted on the Powerhouse. The output of each of the 2kVA inverters will be connected to a 2p+ E 4 mm2 cable and an MCB 2P 10A circuit breaker installed in the AC marshalling box. The output of each of the 6kVA inverters will be connected to a 2p+ E 6 mm2 cable and an MCB 2P 32A circuit breaker installed in the AC marshalling box.

The output of the AC marshalling box will be connected to the AC busbar in the main distribution panel by means of a 2 x 16mm2 cable and an MCB 2p 80A circuit breaker installed in the main distribution panel.

Charge Controller

The charge controller to be used for the DC-coupled turbine is to be fully compatible with the turbines and approved for its use by the turbine manufacturer. The output of the charge controller will be connected to the 48V DC busbar with a 2 x 1C 25 mm2 CU DC conductor and protected with an 80A 48V DC fuse.

Grid-forming Inverter and Accessories

A 48V_{DC} 15,000VA grid-forming inverters would be used to generate a single-phase, 50Hz providing a rated output of 15 kVA and capable of providing a peak power up to 25,000 W. The inverters will be wall-mounted inside of the Powerhouse together with a monitoring and control device recommended by the Manufacturer to provide full

monitoring and control capabilities for the entire system and including controlling a productive use diversion load to be installed in the future. The rated output of the inverter and the AC coupled generation would be approximately 16.3 kVA which is well above the forecasted peak demand from the community which is in the range of 8 kVA.

The inverter and the control and monitoring device will communicate via an ethernet cable. The AC output of the inverter will be connected to an adequately sized AC busbar in the main AC switchboard with a 2x1C CU XLPE 16mm2 AC circuit protected with a 2P 80A MCB circuit breaker or as per manufacturer and relevant standards recommendations. Inverters will also be connected to the $48V_{DC}$ busbar (where the batteries will be connected) by means of a 2x1C CU 90 mm^2 DC circuit protected with a 1P $60V_{DC}$ 400Amp fuse disconnect (on the positive pole) together with an adequately rated 48Vdc switch (on the positive pole).

Battery Bank

The system will be equipped with a $48V_{DC}$ LiFePo battery bank. The battery bank should be fully compatible with the selected battery inverter. The compatibility should have been tested and certified by both the battery and inverter manufacturer and key battery parameters need to be visualized in the remote monitoring platform from the battery inverter.

The battery bank will be formed by at least 10 modules with a nominal capacity per module of 3.5 kWh and a usable capacity of at least 3.3 kWh with a total combined usable capacity of 33 kWh or more. Each module should provide at least 37 A of nominal continuous operation discharge current and 90 A peak discharge for at least 15 seconds as per manufacturer specifications.

The batteries will be divided into two stacks of battery modules connected in parallel forming a battery string which will be connected to the 48VDC busbar with a 2 x 1C CU 70mm2 DC circuit protected by a set of 2P 300A 60VDC fuse disconnect or as per manufacturer recommendations.

Powerhouse

The turbines, pipes, power clamps, grid-tied inverters, charge controller, battery bank, grid-forming inverter, monitoring system and electrical protections required for the system to operate properly will be installed at the Powerhouse. Located approximately 200m from Nambaranguit village, the Powerhouse will have internal dimensions of 6.28 x4.32m (27.12m2) with 2.5 meters height. It will be constructed with a 250mm high reinforced concrete slab and walls made of concrete hollow blocks. A shed-type roof will be built with a timber structure treated for termites and a Colourbond steel roofing sheet with thermal insulation. To prevent high temperatures inside of the Powerhouse, both the roof and the exterior walls will be of bright white colour and the building will include openings in the walls to create natural cross-ventilation. All openings in the building will need to be fitted with metallic mesh to prevent the entrance of insects, rodents, and birds.

The Powerhouse will be partitioned into 2 areas. The turbines and piping work will be installed in the wet area and the electric equipment will be installed in the other area. Both areas will be separated by a parapet wall going up to the ceiling to avoid the potential spray of water on the inverters and other electronics from the highly pressurized piping to be installed next to the turbines. The resistive elements of the power clamps will be installed in a touch and rainproof enclosure in one of the Powerhouse´s walls.

The building will count with an outdoor-rated lockable hardwood door with the outward opening. The building will be equipped with four (2 for each area) 18W LED lighting points and 6 power points in the dry zone. The lighting and power points circuits should be separated and protected with a common 230V 1p 20Amp 30mA RCD and two separate (one per circuit) 230V 1p 10Amp circuit breakers.

All cables will be installed on a hot dip galvanized steel cable tray which provides good resistance against corrosion.

The runoff water from the 3 turbines (coming from the tail race) together with the penstock flush will be conducted by gravity into a 5m long 160mm OD PVC to the river. The pipe will be supported on concrete thrust blocks. The figure below provides a plan view of the Powerhouse Layout.

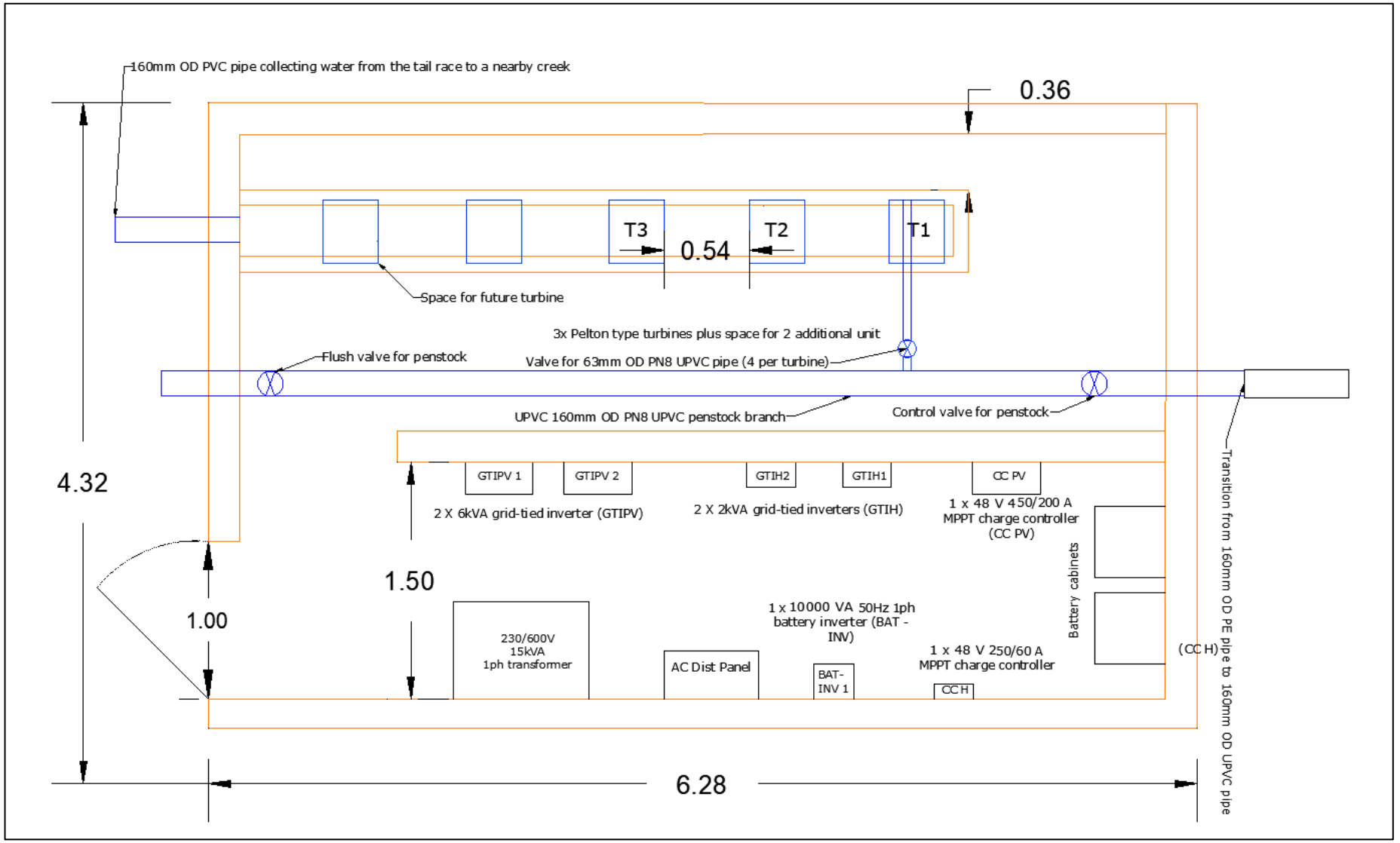


Figure 10: Plan view of the Powerhouse Layout

Communication and Monitoring

The system would be equipped with full cloud-based remote monitoring capabilities visualizing in the battery inverter manufacturer monitoring portal the operational parameters of the charge controller, battery inverter, and batteries together with key operational parameters of the ac-coupled generation. The grid-tied inverters would also be equipped on a cloud-based monitoring platform. Both monitoring systems would be provided with internet access with the installation of a satellite internet connection provided by an authorized service provider in Vanuatu. The remote monitoring system would be equipped with a memory card to prevent loss of operational information in the event of loss of internet connectivity.

3.3 Power Evacuation System

Distribution Network

A total of 6.8 km of single-phase low-voltage underground distribution network will be installed to connect the 167 users currently living in the targeted communities. The distribution network will be composed of sections of 600V to achieve cost efficiency while keeping voltage drop within acceptable values. A 15kVA 230V/600V step-up transformer will be installed inside of the powerhouse to step-up voltage. Three (3) 10 kVA 600V/230V step-down transformers will need to be installed inside a dedicated transformer house to be built next to the distribution pillar at the entrance of the villages at the north and south of Nambaranguit. The remaining sections of the single-phase distribution network will be at 230V 50 Hz.

The distribution network will change to aerial in 1 section for a distance of 30 meters where there is need to cross a creek. The aerial section will be installed utilizing two at least 5m high steel poles rated for withstand highly humid and corrosive environments. The poles will be installed using 1-meter-deep reinforced concrete footings and will be equipped with post covers to protect the cables to a height of at least 2 meters. The aerial crossings (poles and accessories) need to be rated to withstand to CAT5 wind speeds.

The sizing of each section has been estimated to minimise the cost of the cable while guaranteeing a maximum voltage drop of 10% between the main switchboard and each meter centralisation taking into consideration the potential demand growth.

The cables will be installed directly buried at a minimum depth of 50cm with the first 20 cm filled with fine sand free of rocks to avoid potential cable punctures. A warning tape will be installed at a depth of 30cm to indicate the presence of a live conductor. In sections where the distribution line crosses the existing road, cables will be installed under protective 50mm conduit.

Transformer

A 15kVA 230V/600V step-up transformer will be installed inside of the powerhouse to step-up voltage. Two (02) 10kVA 600V/230V step-down transformers will be installed.

The transformer shed will be constructed with a 250mm high reinforced concrete slab and walls made of concrete hollow blocks. A shed-type roof will be built with a timber structure treated for termites and Colour-bond steel roofing sheet with thermal insulation. The transformers will be of dry type and pad mounted with the base of the transformer elevated at least 30cm over the ground. The transformers will be of low loss type with impedance values below 4%. They need to be suitable for operation in very humid and close to the sea corrosive environments. The transformer enclosure needs to have a minimum IP33 rating and be lockable with a key.

Metering System

The metering infrastructure will be implemented using Single Phase meters. The meters should be equipped with a user-friendly prepayment keypad system that allows users to insert a code provided by the vendor to top up credit. The meters should be equipped with remote monitoring functionalities but to keep the metering system simple and robust it will not be implemented for the time being. Therefore, meters will only be accessed locally.

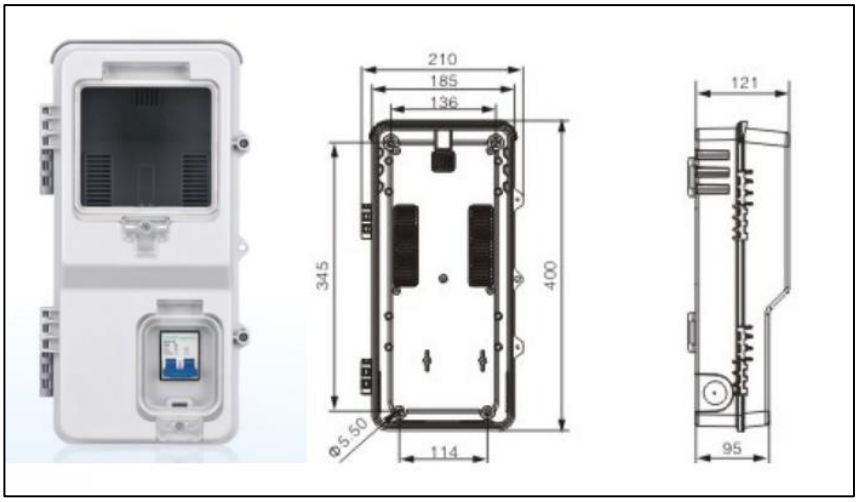
The meters will be equipped with advanced load control and disconnection features including:

- Antitamper alarm

- Overload disconnection
- Credit limit disconnection

In addition, the meters will support service-based and energy-based tariffs both on pre-paid and post-paid basis.

Depending on the distribution of users and their location different groups of meters will be centralized in the distribution pillars to optimize the service line distance. Each group of meters will be connected in daisy chain with 2C 6mm2 CU cable. Each meter will be installed on a IP65 rated UV stable enclosures housing a 2P 30mA 20A RCD which the service line will be connected to. The figure below presents an indicative front view and dimensions of a meter enclosure.



Photograph 2: Indicative front view and dimensions of a meter enclosure

Several meters can be installed together in a centralised support structure. This structure should be made using welded galvanised steel C profiles rated for marine environments and it should be electrically grounded. The structure foundations should be made of concrete and should be enough to withstand a design wind speed of 70m/s.

Each meter should be installed inside a sealable, IP65-rated enclosure. The meter centralisation will be installed next to the distribution pillar where the meters are connected to.

Earthing

The system will be equipped with a TN-S grounding system where grounding conductors and the neutral are separate. The figure below resents an example of TN-S grounding system.

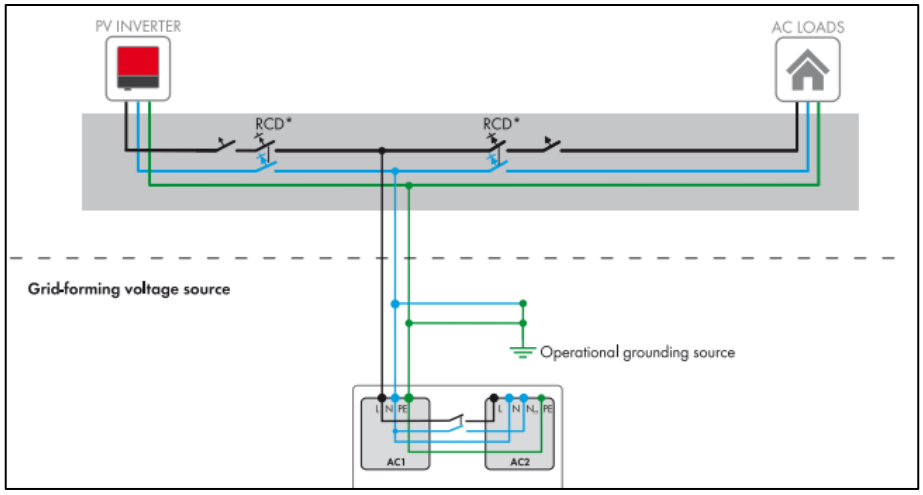


Figure 11: Example of TN-S system

The Powerhouse will be equipped with a grounding system composed by a set of copper ground rods. The number of rods and layout to be used will be sufficient to achieve a resistance to ground of less than 1 ohms. In the Powerhouse the items which will be grounded includes - turbines, inverters, resistors, power points, all communications and monitoring devices, cable trays, grid-forming inverters, battery bank and charge controller.

Service Line

Each end user will be connected to their respective meter by means of a 1 x 2C 6mm ^{2} CU 600/750V cable. The cables will be installed directly buried at a minimum depth of 50cm with the first 20 cm filled with fine sand, free of rocks to avoid potential cable punctures. A warning tape will be installed at a depth of 30cm to indicate the presence of a live conductor.

Customer Protection Line

Each end user will be equipped with 1 x indoor rated wall mounted enclosure to house 1 x MCB 2P 15A 230VAC + 1 x 2P 30mA 20A RCD and 1 copper rod and required accessories to provide grounding to the end user installation. Each protection box would be connected to the respective service line. The enclosure is expected to include 1x MCB 2P 230 V 1P 15A circuit breaker. Each customer protection box will be installed inside the main building of each of the 167 end users.

3.4 Land Requirement

As noted from the Detailed Design Report, it is reported that the Powerhouse and the Catchment area would require less than 50m ^{2} of land. Right of Way for the transmission and distribution line would also be attained. No historical sites and no 'tabu' sites were identified in the proximity of the water source. A site with up to 160m2 (8 x 20m) is available for installation of solar PV which has been allocated by the community next to the church. The area is flat and not prone to flooding and free from shading and it is located about 250m distance from the Powerhouse where the energy produced by the array will have to be injected. The below figure provides an indicative distance of the Powerhouse from the identified solar site,

Figure 12: Indicative location of PV site and Powerhouse

3.5 Resource Requirement

Workforce Requirement

The workforce will be sourced from the local community. It is anticipated that a total of four (04) workers would be engaged in the project. The skilled workers would be sourced from outside the local community, but the numbers are expected to be low.

Worker Accommodation/Camps

Considering that the workforce would be sourced from the local communities. The skilled workforce would be arranged from outside the project area and will be residing in hotel/rented accommodation within the community. No worker accommodation camps are expected to be set up for the construction phase of the project.

Water Requirement

Water would be sourced from the stream directly for any civil construction related work.

Construction Material

Reportedly, the construction material for civil works will be sourced locally and for electrical materials it will be sourced internationally. The mode of transportation would be through shipping vessels, boat and through land transport. Also, it was informed that the storage area is already available in the community, however, no information on land details and technical aspects were shared.

The details of the construction material to be used are provided in table below,

Table 6: Construction Material

S. No	Item	Qty
1	Intake	1 set
2	Penstock 1	1 set
3	Penstock 2	1 set
4	Manifold	3 sets
5	Run-off pipe	1 set
6	Turbine	3 sets
7	Solar PV	1 set

S. No	Item	Qty
8	Grid-tied inverter for the turbines	2 sets
9	Grid-tied inverter for the PV	2 sets
10	Charge controller for turbines	1 set
11	Charge controller for PV	1 set
12	Grid-forming inverter	1 set
13	PV support structure	1 set
14	AC marshalling box	1 set
15	DC fuse box	1 set
16	Battery bank	1 set
17	Control and monitoring of battery inverter	1 set
18	Monitoring grid-tied inverter	1 set
19	DC busbar box	1 set
20	Main distribution panel	1 set
21	Powerhouse	1 set
22	Cable trays	1 set
23	Control and monitoring of battery inverter	1 set
24	Distribution 1	3043 m
25	Distribution 2	3409 m
26	Distribution 3	345 m
27	Distribution 4	30 m
28	Distribution 5	30 m
29	Distribution 6	1 set
30	Distribution 7	32 set
31	Setp-up transformer	1 unit
32	Setp-down transformer	3 units
33	Meter	167 set
34	Service line	6284 m
35	Costumer proteccion box	167 set
36	Training	1 set

***Source**: BOQ, Nambaranguit*

3.6 Project Schedule

The Project Schedule for the pre-construction and construction phases would be one (01) year and the project is expected to operate for twenty (20) years.

4.0 Environment and Social Economic Baseline

This section provides information on the baseline gathered for environmental and socio-economic conditions in and near the project area, based on secondary data (accessible reports and scientific literature) available in the public domain.

4.1 Introduction

The objective of the environmental baseline was to assess the environmental and social conditions in the project area, and to provide a basis for evaluating environmental and social impacts and issues related to project design and construction, operations and maintenance, and decommissioning phase. The description of the environment and social components is based on secondary data sources. The parameters which are covered in this baseline chapter as part of ESIA is provided below:

- Physiography
- Geology and Soil
- Drainage
- Water Quality
- Climate and Micro-meteorology
- Natural Hazards
- Ambient Air Quality
- Ambient Noise Quality
- Ecology and Biodiversity
- Socio-economic

4.2 Physiography

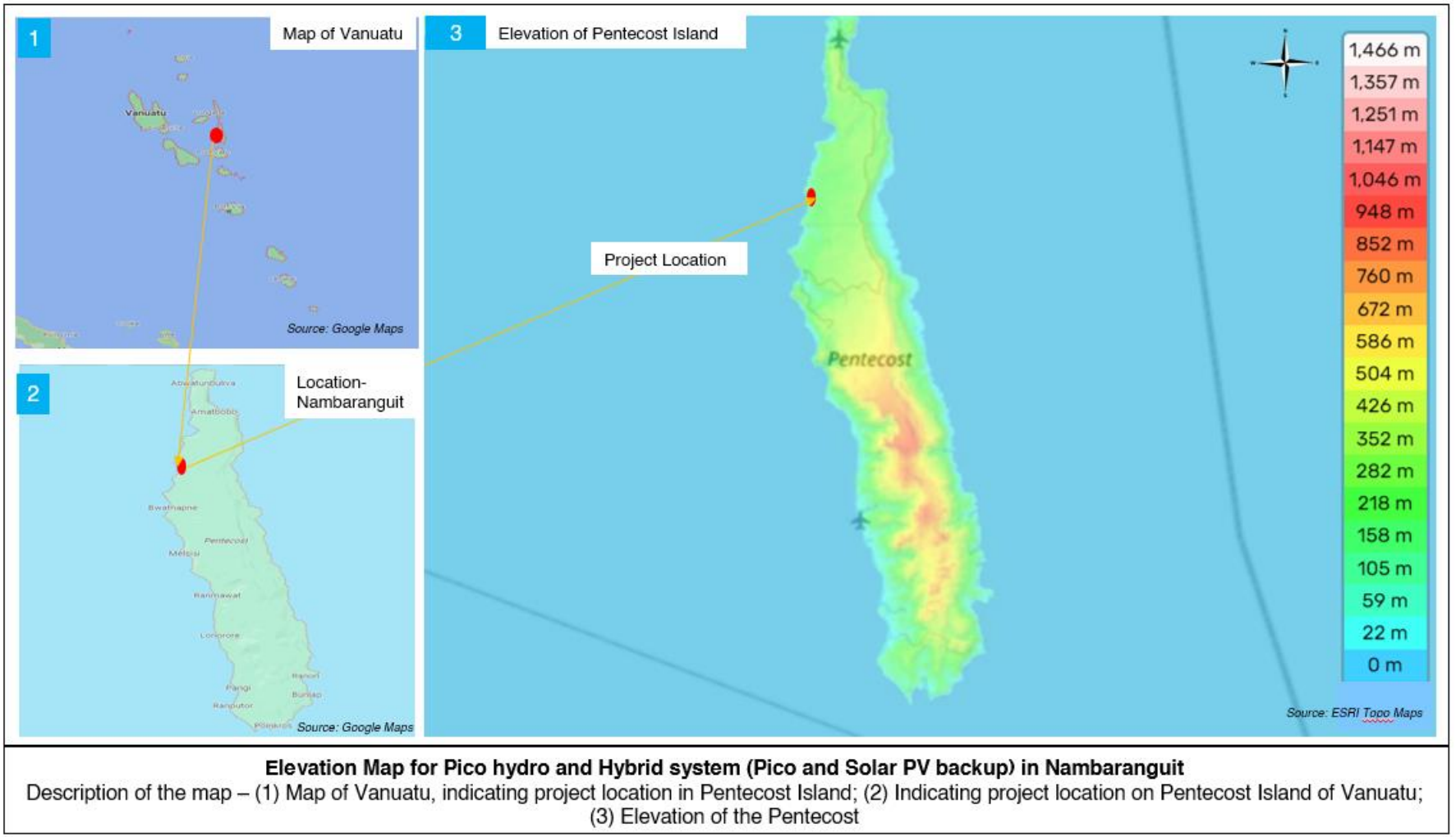
4.2.1 Site Settings

The project area is located in village Nambaranguit in Penama Province situated on the West Coast of North Pentecost Island of Vanuatu. The project elevation ranges from 50m to 100m above mean sea level and is located in Nambaranguit. The project lies on geo co-ordinate Lat-15°35'4.63"S and Long-168°7'58.16"E. The local language of the area is the Apma Language.

The project is accessible by road. The project site is about 15km from the airport. There is a barge landing available. The water catchment to the public road is about 800m.

4.2.2 Topography

Nambaranguit is situated on the west coast of North Pentecost Island of Vanuatu. Pentecost is an island 60 kilometers long by 12 kilometers Vide, located at 15° 30' to 16° S and 168° 30' E. The landmass is predominantly basaltic, with a few limestone ridges formed by the uplifting of coral reefs. The eastern coast is precipitous, fringed by extensive coral reefs, and windward, with few safe anchorages. The western coast is flat and leeward, with coral reefs, extensive sandy beaches, and good anchorages. The central part of the island is mountainous and covered with dense primary rain forest. The elevation of the Pentecost Island ranges from 100m to 950 m.



Elevation Map for Pico hydro and Hybrid system (Pico and Solar PV backup) in Nambaranguit

Description of the map – (1) Map of Vanuatu, indicating project location in Pentecost Island; (2) Indicating project location on Pentecost Island of Vanuatu; (3) Elevation of the Pentecost

Figure 13: Elevation Map of Pentecost Island

4.2.3 Land Use

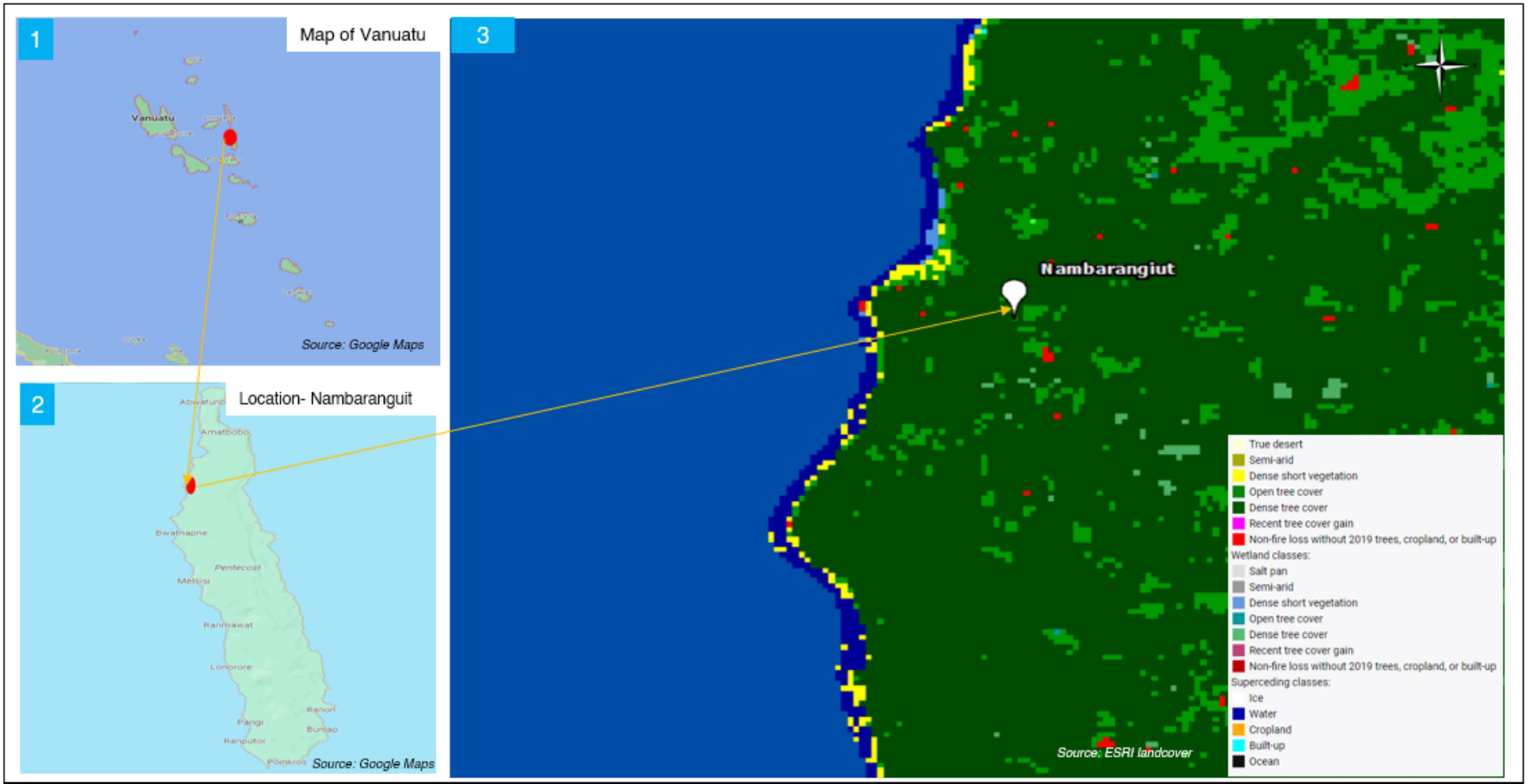
Vanuatu's land area totals approximately 12,336 km^2. Almost 74 percent of that area is covered by natural vegetation, with more than 36.1 percent (440,000 hectares) covered by tropical forest. The land use map of the Nambaranguit and nearby area is provided in the figure below. As per Vanuatu's enhanced nationally determined contributions (NDC) 2020-2030, the following are the key points,

- Vanuatu does not classify land by function or land capability classes, nor does it have a legally defined permanent forest estate (PFE).
- All lands, including forest lands, are customarily owned; that is, by individuals or communities (clans or families). Government-owned land with forest does not exist. However, the forests are important to rural communities as they are one of the communities' main sources of cash income.
- The quality of natural forests in terms of commercial forestry is low.
- The forests provide a wide range of products for the subsistence lifestyle of most ni-Vanuatu.
- The 1990-1993 National Forest Inventory found that around 74 percent of Vanuatu was covered by woody vegetation, half of which was closed forests and the remainder, discontinuous scrub and thicket. Of that, only 10 percent was primary forest.
- The estimated commercially exploitable forest was determined to be approximately 35 percent of forest cover.
- Vanuatu is using more forests than are being planted and some of the customary landowners are developing their logged forest 14 areas for other activities, such as cattle rearing or real estate in coastland lowland areas of Efate and east Santo.
- By 2006, some 4,800 hectares were covered with planted forests; approximately 3 percent of the high to mid forest (about 6,000 ha) and 0.7 percent of the low forest (about 1,400 ha) are in protected areas.

Table 7: Vegetation Cover of Vanuatu

S. No	Vegetation Type	Area (ha.)	Percentage of land area
1.	Midweight Forest (20-30m)	205,307	16.73
2.	Low Forest (10-20m)	234,089	19.08
3.	Woodland (<10m)	386	0.03
4.	Thickets (3-8mm)	433,941	35.37
5.	Scrub (<3m)	45,018	3.67
6.	Grassland	51,128	4.17
7.	Swamp Communities	2,261	0.18
8.	Mangroves	2,519	0.21
9.	Bare ground/Human made	252,256	20.56
Total land area		**1,226,905**	**100**

Source: *Vanuatu National Resource Inventory System (VANRIS)*



Landuse Map for Pico hydro and Hybrid system (Pico and Solar PV backup) in Nambaranguit

Description of the map – (1) Map of Vanuatu, indicating project location in Pentecost Island; (2) Indicating project location on Pentecost Island of Vanuatu; (3) Landuse and Landcover of the Nambaranguit village in Pentecost Island

Figure 14: Land Use and Land Cover Map of Nambaranguit Village in Pentecost Island

4.3 Geology and Soil

4.3.1 Geology of the Study Area

On Pentecost, there is an occurrence of ultrabasic rocks older than Late Miocene. The oldest rocks of Vanuatu (Early Oligocene) are exposed on southern Pentecost. These are ultramafic serpentinites and peridotites, and gabbros, norites, schists and basalts. Young Pliocene-Pleistocene coralline and related sedimentary rocks locally overlie most of Pentecost containing large expanses of coralline limestone rock.

4.3.2 Soil Classification

Soil in Pentecost have been derived from coral colluvial parent materials. These are young soils with limited development of a shallow dark coloured organic which overlies weathered coral detritus. On the lower slopes of the hills, older soils have formed which vary from shallow skeletal soils to slightly deeper soils which have formed at the base of hill where soils have accumulated. These soils have progressively more development but are limited by massive inclusions of coralline rock either as emergent boulders or as inclusions of loose coral rock evident throughout the profile.

Coral derived soils tend to have a neutral to alkaline reaction and with a high base saturation have excellent characteristics for plant growth. The soils are well structured, friable and are inherently reasonably stable. Water holding capacity is limited by the coarse texture, shallow profiles and inclusions of rock. However, with the well distributed rainfall pattern there are few periods where water will severely limit plant growth. With the removal of topsoil, these areas can erode but similarly with their good soil and plant establishment characteristics they also revegetate quickly. Production of large volumes of sediment from these areas is rare unless the area has been highly disturbed.

The weakly matured soils formed by erosion occupy large areas on the old volcanic mountains of Pentecost islands. They are located on steep slopes. At low altitude, the soils are saturated with bases: they are mostly eutric rhegosols or rarely lithosols.

Eutrophic brown soils subtype dusky brown soils with montmorillonitic clays are found in Pentecost. These appear on steep slopes of basic eruptive rocks where they are rejuvenated by erosion. These soils are very fertile.

Unsaturated brown soils are formed, like the eutrophic ones, on steep reliefs of basic eruptive rocks that are rejuvenated strongly by erosion; however, they appear at higher altitudes, usually above 500 m. These soils are of low fertility and are rarely cultivated.

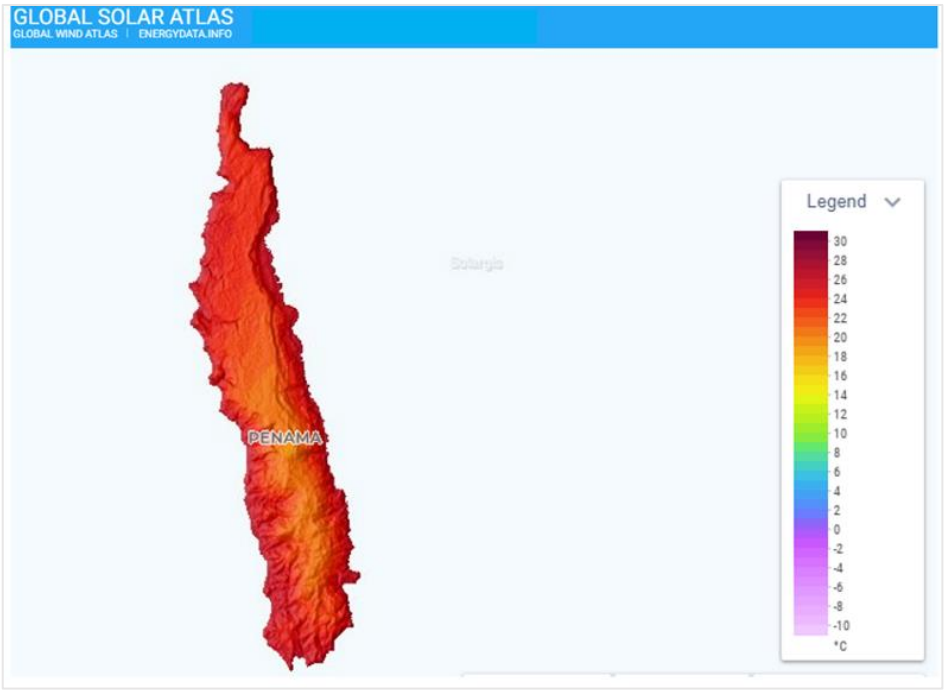
Humic and weakly desaturated ferrallitic cover mainly the low limestone-plateaus of old high islands, where they are located in the wet climatic zone with a southeast aspect. These soils are very clayey and fertile.

Andic ferrallitic soils are very rich in aluminium and iron hydroxides, especially in gibbsite and fine goethite minerals, but they are poor in silica and particularly in clay minerals. The andic ferrallitic soils are of low fertility. They are rarely cultivated and mostly covered with nephelophytic closed canopy thicket, with Metrosideros and epiphytic species.

4.4 Climate and Meteorology

4.4.1 Temperature

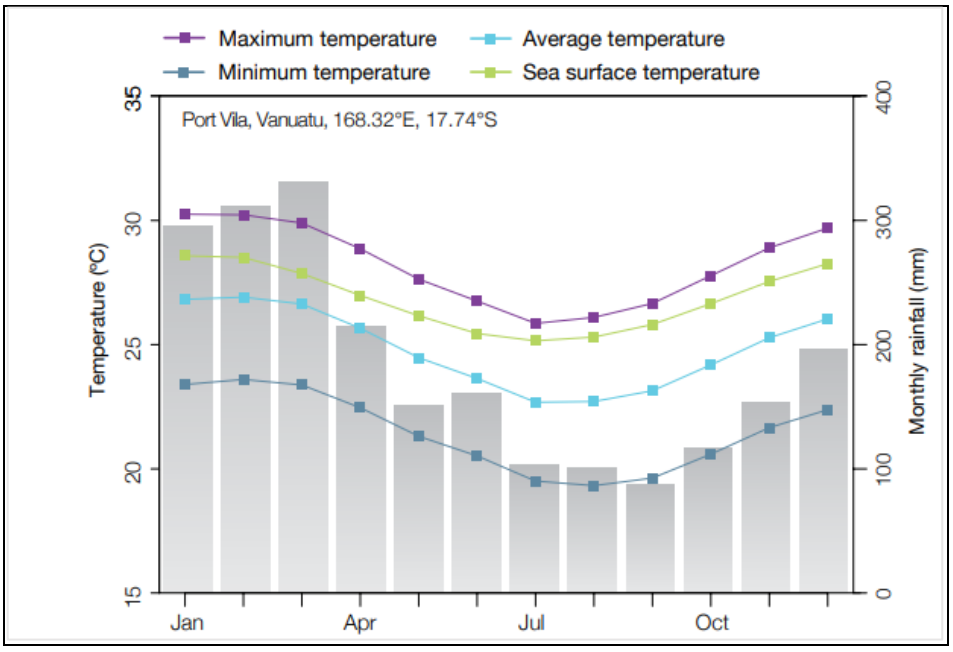
Across Vanuatu the annual average temperatures are between 23.5–27.5°C. Changes in the temperature from season to season are strongly tied to changes in the surrounding ocean temperature. The country has two distinct seasons – a warm wet season from November to April and a cooler dry season from May to October. The air temperature in the project area as provided in the Global Solar Atlas (portal developed by World Bank in collaboration with Energy Sector Management Assistance Program (ESMAP) is presented in figure below,



Source: *Global Solar Atlas, World Bank, Energy Sector Management Assistance Program (ESMAP)*

Figure 15: Air temperature (in oC) of Penama Province

The annual maximum and minimum temperatures have increased in both Port Vila (Capital of Vanuatu) and Aneityum (Southmost Island of Vanuatu) since 1950. At Bauerfield Airport in Port Vila, maximum temperatures have increased at a rate of 0.17°C per decade and at Aneityum the rate of increase has been 0.18°C per decade[2]. These temperature increases are consistent with the global pattern of warming.



Source*: Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative*

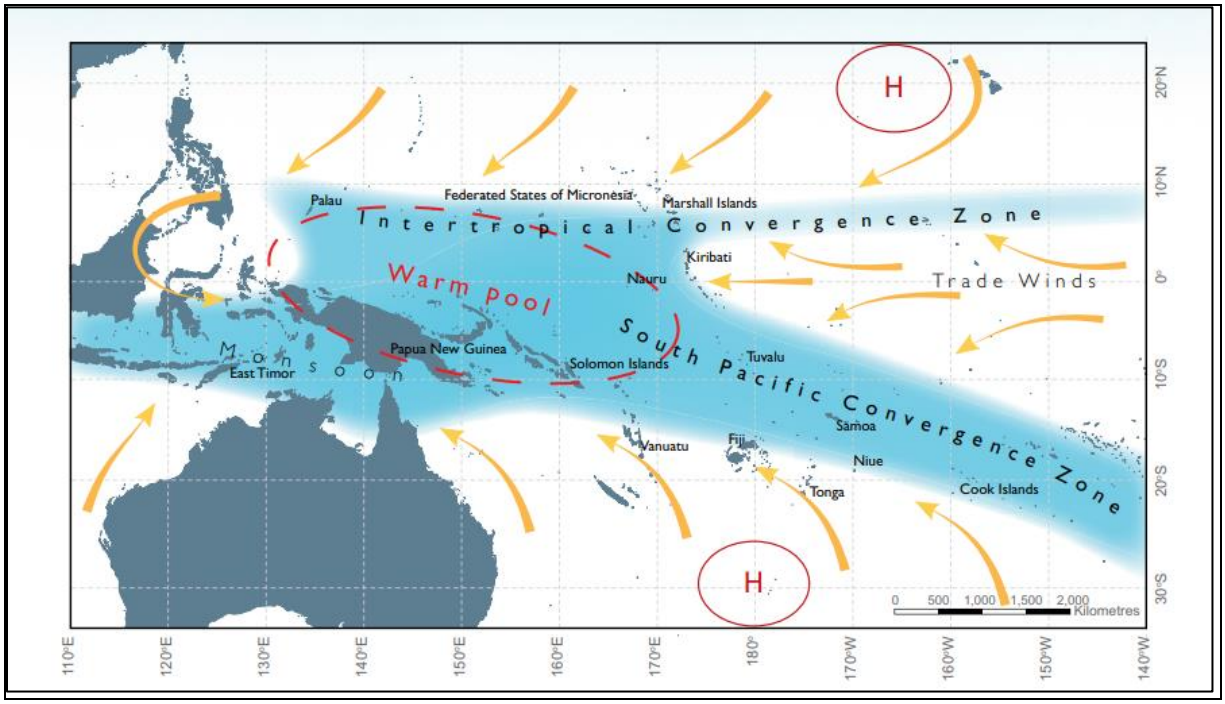
Figure 16: Seasonal rainfall and temperature at Port Villa

[2] Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative

4.4.2 Rainfall

Rainfall in Vanuatu is affected by the South Pacific Convergence Zone. This band of heavy rainfall is caused by air rising over warm waters where winds converge, resulting in thunderstorm activity. It extends across the South Pacific Ocean from the Solomon Islands to east of the Cook Islands. During the wet season, the South Pacific Convergence Zone intensifies and moves further south, bringing higher rainfall to Vanuatu. Low pressure systems embedded in this band of heavy rainfall often become tropical cyclones during the cyclone season. Mountains also play a role in the variations in rainfall across some islands.

During the wet season, rainfall is particularly high on the windward (south-east (SE)) side of the mountain ranges of the bigger islands, and scarce on the leeward (north-west) sides, especially during the dry season. Vanuatu is located within the tropical climate range with two distinct seasons. November to April is the wet season when temperature and humidity levels are higher and cyclonic events may occur. The dryer season starts in May and lasts to about October. At the beginning of the dry season SE trade winds establish and produce cooler temperatures and mainly sunny periods. Vanuatu has abundant rainfall with higher rainfall recorded in the northern part of the archipelago (4,136 mm recorded in Banks Island) compared to 1,597 mm recorded in Tanna Island in the south of the archipelago.



Source: : *Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative*

*Please note that the arrow in the figure above shows near surface winds, the blue shading represents the bands of rainfall convergence zones, the dashed oval shows the West pacific Warm Pool and H represents typical positions of moving high pressure system.

Figure 17: Average positions of the climate features in Nov to Apr month

Vanuatu's climate varies considerably from year to year due to the El Niño Southern Oscillation. This is a climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño-Southern Oscillation: El Niño and La Niña. There is also a neutral phase. In both, Port Vila and Aneityum El Niño events tend to bring drier conditions as well as a late start to the wet season and cooler than normal dry seasons. The opposite occurs during La Niña events.

4.5 Natural Hazards

The Republic of Vanuatu is located in the Melanesia region of Oceania, consisting of over 80 islands. The population of Vanuatu is around 300,000 (2019) and around 80% of the population reside in rural areas[3]. Vanuatu is vulnerable to natural hazards including floods, droughts and tropical cyclones as well as earthquakes, tsunamis, and volcanic eruptions[4]. A large percentage of the population is exposed to natural disasters and climate risk due to their proximity to the coastline. Climate change has sparked internal migration in Vanuatu. Six villages on four of Vanuatu's islands have been relocated because rising sea levels have made water supplies too salty for drinking[5]. Citizens on smaller islands are also moving to the capital, Port Vila. This recent wave of urbanization is occurring as mostly younger people on the outer islands are moving to Port Vila for economic as well as environmental reasons[6].

According to the World Risk Report, Vanuatu has the highest World Risk Index score. It ranks number 1 of 171 countries, because it has very high exposure, vulnerability and susceptibility to natural hazards and limited institutional capacity to respond and adapt. Part of the country's vulnerability relates to the 1.2 per cent of the total population who, in 2010, lived in the 0.8 per cent of the total land area below 5 metres above sea level. According to the Emergency Events Database (2018), there was a notable decline in natural disasters,12 which then remained steady from 1990 to 2018. The natural disasters in that time were mostly storms, landslides and floods. Damage costs were highest between 2010 and 2018. Developing preventative measures to limit infrastructure and property damage and increase institutional capacity to respond to climate events, particularly for small businesses, can be a source of decent job creation while building resilience.

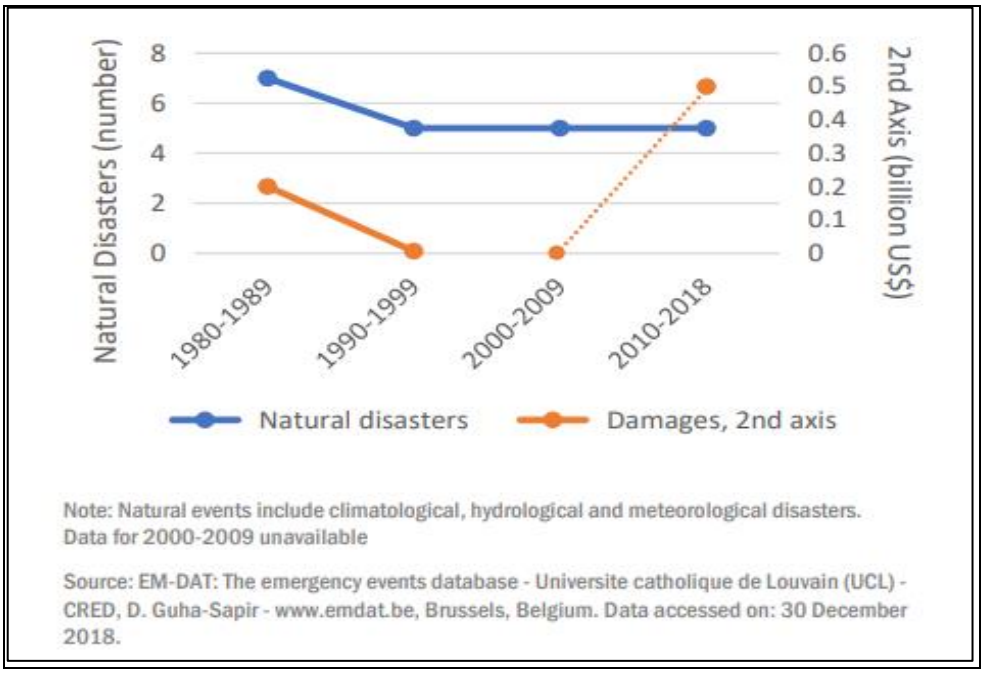


Figure 18: Natural Disaster occurrence and damage costs in Vanuatu

The Vanuatu Climate Change and Disaster Risk Reduction Policy 2016—2030 convenes partners across the government, private sector, civil society and international agencies to direct the country's climate-change and risk-reduction efforts. In partnership with programs such as the Coping with Climate Change in the Pacific Island Region, Vanuatu has activated sustainable practices to meet food production needs, all while encouraging efficient energy use to protect the country's land and marine environments. Vanuatu is one of 43 nations on the Climate Vulnerable Forum and has been a vocal proponent in limiting temperature rise from global warming to

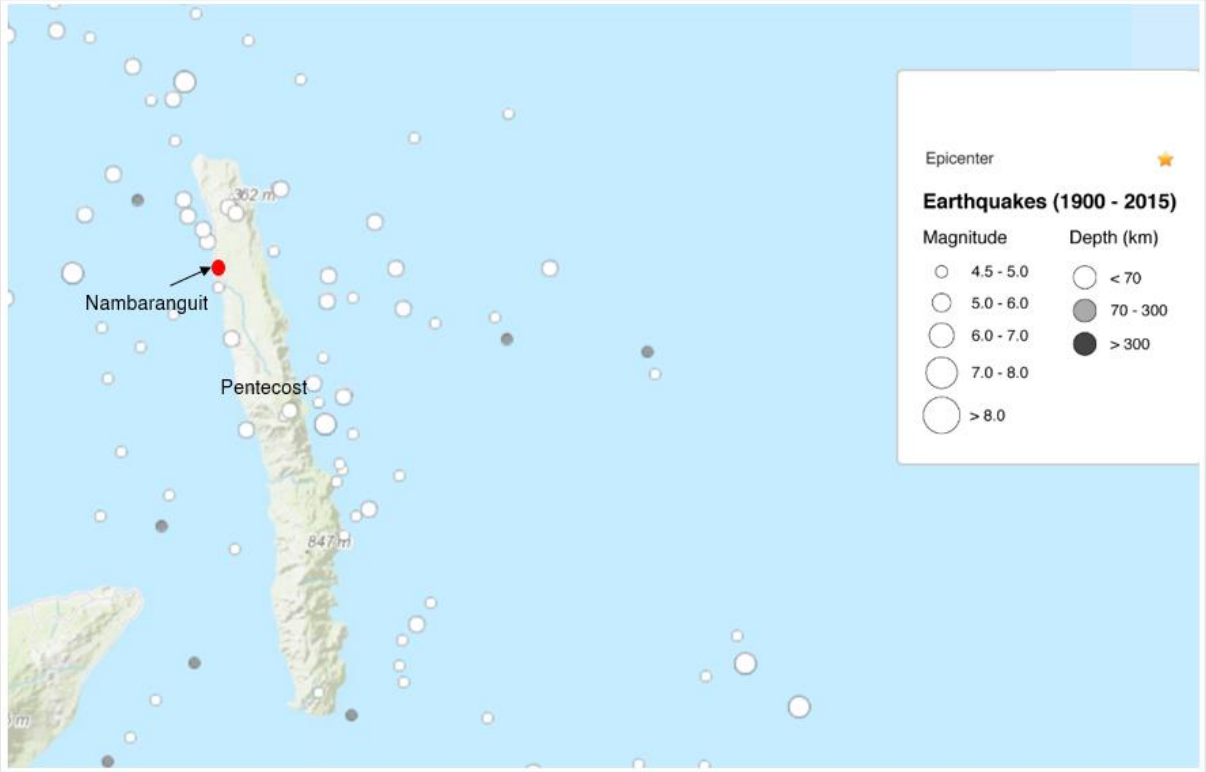
[3] Chapman et al., 2021
[4] Government of Vanuatu [GoV] & International Organization for Migration [IOM], 2018
[5] Sengupta, 2023
[6] Henson et al., 2020

1.5° Celsius. The Paris Agreement on Climate Change seeks to limit temperature rise to 2° Celsius. Vanuatu ratified the Paris Agreement in April 2016.

4.5.1 Seismicity

Vanuatu is located about 100-200 km east of New Hebrides trench which runs parallel to and has formed the archipelago where the Australia-India plate collides with and is being subducted by the Pacific Plate. The location of the archipelago relevant to this feature means that Vanuatu is located in an area of active seismic and volcanic activity. Earthquakes are frequent in Vanuatu and the United States Geological Survey (USGS) recorded about 4,000 earthquakes with a magnitude greater than 4 between 1961 and 1982. Earthquakes often originate at considerable depth and are therefore not particularly destructive being of large magnitude but low intensity.

The last major earthquake that affected the area occurred in south Pentecost close to Matelli Bay on 26 November 1999 with a magnitude of 7.5 on the Richter scale. The 1999 earthquake also triggered a tsunami with a maximum height of 5.6 m which killed 5 people in south Pentecost in Mateli Bay. The low number of people killed was attributed to increased community awareness of tsunamis warnings.



Source: *Earthquake-USGS*

Figure 19: Earthquakes visualization in and near Pentecost Island

4.5.3 Flood, Cyclones, and Storm Surge

Vanuatu has very high exposure and vulnerability to the impact of flood, tropical cyclones, and storm surge which can strike in combination or isolation. Cyclones bring coastal and flash flooding even when only passing in the vicinity of the island. According to the Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), around 20–30 cyclones pass over Vanuatu every decade, around 3–5 of which will cause severe damage. In 2015 Cyclone Pam, a Category 5 tropical cyclone struck Vanuatu killing 11 people, destroying or damaging over 17,000 buildings and displacing 65,000 people. The economic damages associated with the incident were estimated to be equivalent to around 64% of Gross Domestic Product (GDP).

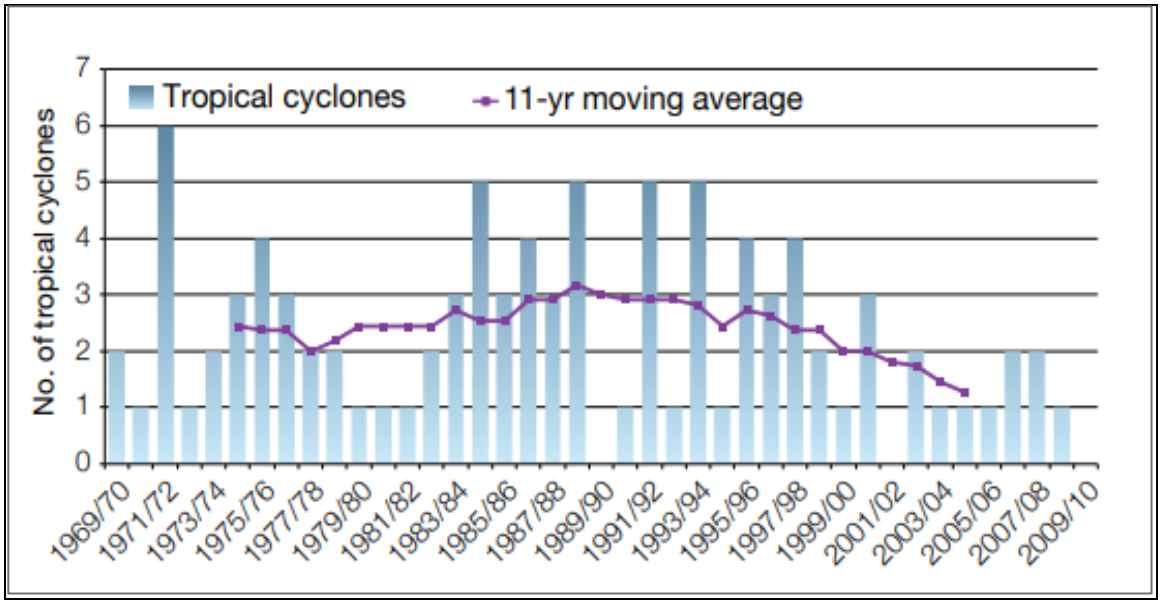
4.5.4 Cyclone

Cyclones occur in the hotter months of the year and the cyclone season extends from December to April though cyclones have also been recorded in the shoulder months of October and November and again in May and June. Cyclones are generally more frequent during El Nino Southern Oscillation (ENSO) occurrences when the climate is drier than usual. The below table shows an analysis of the frequencies of cyclones and strong winds which states that out of 137 events recorded between 1939-2007 on average, Vanuatu records 2.01 cyclonic events every year of which 0.7 are severe hurricanes (winds > 64 knots). Of these 60% of the cyclonic events were recorded in January, of which 22.1% were hurricanes. However, the greatest proportion of hurricanes (23.5%) is experienced in February. One hurricane was recorded in October but none in May or June. Cyclones tend to affect all of Vanuatu and may arrive from several directions. The largest and one of the most destructive cyclones to hit Vanuatu was Cyclone Uma which was recorded from 3rd to 8th February 1987. During cyclones, waves are driven onto the upper beach terrace areas and can intrude for several metres inland.

Table 8: Months Experiencing a Cyclone or Hurricane in Vanuatu (1939-2007)

Season	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	no/yr
Cyclones	1.5%	8.8%	16.2%	60.3%	57.4%	38.2%	16.2%	1.5%	1.5%	2.0
Hurricanes	1.5%	2.9%	7.4%	22.1%	23.5%	10.3%	2.9%	0.0%	0.0%	0.7

Source: *Vanuatu Met Services, Cyclones <64kts, hurricanes>64kts*



Source: *Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative*

Figure 20: Number of Tropical Cyclone passing within 400km of Port Vila

*Eleven year moving average in purple

Tropical cyclones affect Vanuatu between November and April. In the 41-year period between 1969 and 2010, 94 tropical cyclones passed within 400 km of Port Vila, an average of two to three cyclones per season. The number of cyclones varies widely from year to year, with none in some seasons but up to six in others.

4.5.5 Volcano

Volcanoes are present on nearly all of the islands of the archipelago of which nine volcanoes are still active. The most dangerous is Mount Garet (797 m) located on Gaua (Banks Island), and also on the islands of Lopevi and

Tanna where Mt Yasur is one of the world's most accessible volcanoes for tourists. There are no active volcanoes on Pentecost.

4.5.6 Sea level Rising (Climate Change)

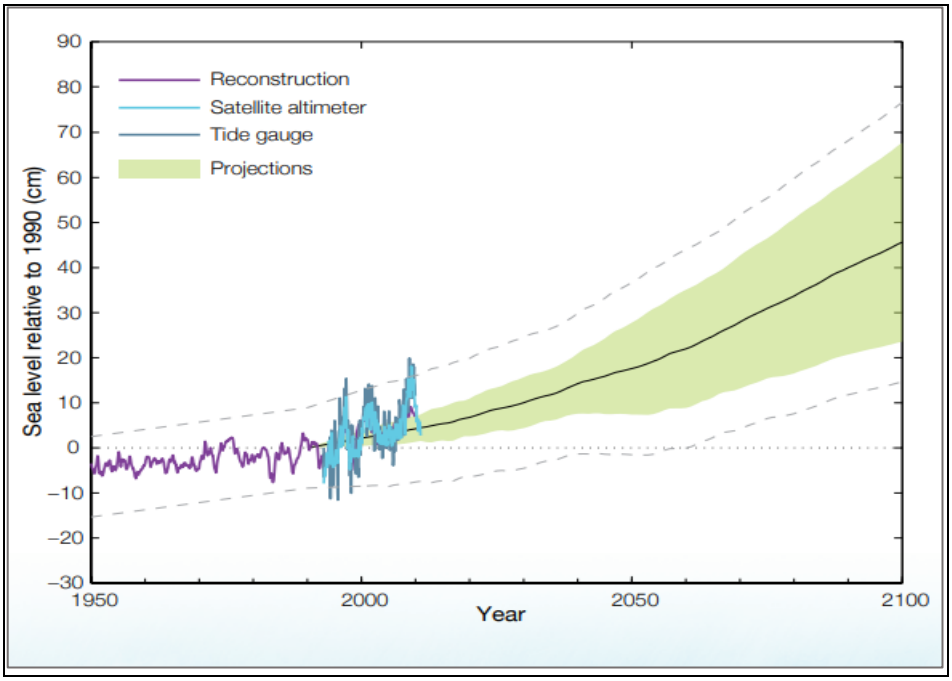
As the ocean water warms it expands causing the sea level to rise. The melting of glaciers and ice sheets also contributes to sea-level rise. As per the Pacific Climate Change Science program, study on current and future climate of Vanuatu, instruments mounted on satellites and tide gauges are used to measure sea level, wherein for satellite data it indicates that the sea level has risen near Vanuatu by about 6 mm per year since 1993. This is larger than the global average of 2.8–3.6 mm per year. This higher rate of rise may be partly related to natural fluctuations that take place year to year or decade to decade caused by phenomena such as the El Niño - Southern Oscillation. This variation in sea level can be seen in the figure below which includes the tide gauge record and the satellite data since 1993.

Table 9: Sea Level rise projections for Vanuatu for three emissions scenarios and three time periods

	2030 (cm)	2055 (cm)	2090 (cm)
Low emissions scenario	5-16	10-27	17-47
Medium emissions scenario	5-16	8-31	20-59
High emissions scenario	3-17	7-31	21-63

***Source**: Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative*

* Values represents 90% of the range of the models and changes are relative to the average of the period 1980-1999.



***Source:** Pacific Climate Change Science Program, Current and future climate of Vanuatu, International Climate Change Adaptation Initiative*

Figure 21: Observed and projected relative sea level change near Vanuatu

The observed sea level records are indicated in dark blue (relative tide gauge observations) and light blue (the satellite record since 1993). Reconstructed estimates of sea level near Vanuatu since 1950 are shown in purple. The projections for the medium emissions scenario representing 90% of the range of the model is shown by the shaded green region from 1990 to 2100. The dashed lines are an estimate of 90% of the range of natural year to year variability in sea level.

Sea level is expected to continue to rise in Vanuatu. By 2030, under a high emissions scenario, the rise in sea level is projected to be in the range of 3-17 cm. The sea-level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding. As there is still much to learn, particularly how large ice sheets such as Antarctica and Greenland contribute to sea-level rise, scientists warn larger rise than currently predicted could be possible.

For Vanuatu, the impact of climate change comes in many forms. By 2030, temperatures will increase in Vanuatu by up to 1° Celsius (33.8° Fahrenheit) per year. The sea level has risen by 6 millimeters (0.2 inches) per year since 1993 and will continue to rise to reach up to 18 centimeters (7 inches). At the same time, extreme rainfall events will grow in frequency and intensity, increasing the resulting damages spurred by cyclones, storm surges, landslides, flooding and droughts. Cyclones will be less frequent, but more severe, endangering the country's economy and the population's livelihood. Root crops, such as sweet potatoes and plantains, provide food and income for more than 70 percent of Vanuatu's majority-rural population. But changing rainfall patterns cause damage to seedlings and soil which in turn causes contamination of the environment in which the crops grow.

4.5.7 Heat waves (Climate Change)

Vanuatu regularly experiences high maximum temperatures, with an average monthly maximum of around 27.2°C and an average February with maximum of 28.8°C. Research has identified the Western Tropical Pacific as a global hotspot for climate change impacts on marine heat waves. Marine heat waves are projected to extend their spatial footprint and to grow in duration and intensity. The consequences of this trend may be serious for marine ecosystems in the region (and the livelihoods dependent on them), which are adapted to survive under very stable temperature regimes.

4.6 Drainage Pattern

4.6.1 Surface Water Bodies

Pentecost island includes large areas of deeply fractured and fissured coralline deposits that intercept surface runoff and accordingly Pentecost has large inflow areas and subsurface water resources. However, apart from emergent springs, accessing these resources is often difficult without drilling equipment.

Pentecost has the following rivers – Green River, Bwatnapne River, Melsisi River, Holnensouban River, Baravet River, Oubouen River, Walap River, Lonpoa River, Warbot River.

The first water source close to the community is a river (known as Waterfall) with a water flow that fluctuates considerably, maintaining a flow of above 50 l/s that tends to dry up during the dry season, as reported by the community. The second source is adjacent to the first source, only 30 meters apart, and it is a natural spring with a smaller but more stable water flow that never dries up, even during a long dry season. The spring comes from under a rock and flows naturally into two different paths ending in two small water intakes built by the community.

As part of the Detailed Designed Report, the water flow rate was measured using the bucket method. The flow rate was measured and calculated to be approximately 8l/s in the first intake and 5l/s in the second intake. It is important to note that currently, the intakes capture approximately 80% of the available water coming from the spring. Therefore, it is determined that the total amount of usable water could be increased by 20/30%. Taking this into consideration, the design water flow is estimated to be 11l/s.

Photograph 3: Potential Intake area in Nambaranguit

The land where the potential intakes and powerhouse are located is owned by two (02) tribe. This area was used by the community for farming and gardening purposes earlier which has been discontinued. No historical sites and no 'tabu' sites were identified in the proximity of the water source.

The community reported that the water source slightly drops during the dry season. The Department of Water was consulted to check if they have historical water flow records, but no records of this source are undertaken.

The route is accessible, and the terrain is compact and stable but given the slope, the penstock will have to be installed with thrust blocks to prevent any movement. The length of the proposed penstock route (from intake to powerhouse) was measured to be 380 m. This location is free from flooding and landslide even during the rainy season, as reported by the community. No signs of flooding or landslide were found at the site.

4.7 Water Quality

No existing data on freshwater runoff and groundwater quality was available in the public domain for the study area and no new data was collected as part of the ESIA. As per the ESIA prepared for the BRANTV project, it was mentioned that the water flow exceeds demand. There is a low intensity of water use and the potential water use and its conflict also appears to be low. Further, there is no potential water quality issues at the project area as well.

4.8 Ambient Air Quality

No existing data on air quality was available in the public domain for the study area. However, as part of this ESIA study information was sourced from the Environment Officer at Department Environment Protection and Conservation (DEPC) on 23 October 2023 wherein it was understood that the Department has not set up any environmental monitoring station at the project area to monitor the ambient air in the country. The ambient air quality is good as no other development or industry is present in the project area. Annexure F refers to the details of information sourced from DEPC.

Vanuatu ranks at number 144 of 180 countries in the Environmental Performance Index (EPI), with a score of 44.55 (with 0 being furthest from the high-performance benchmark target of 100). Vanuatu outperforms the average score for Asia and the Pacific in some of the EPI categories, including air quality, forests, air pollution and water resources.

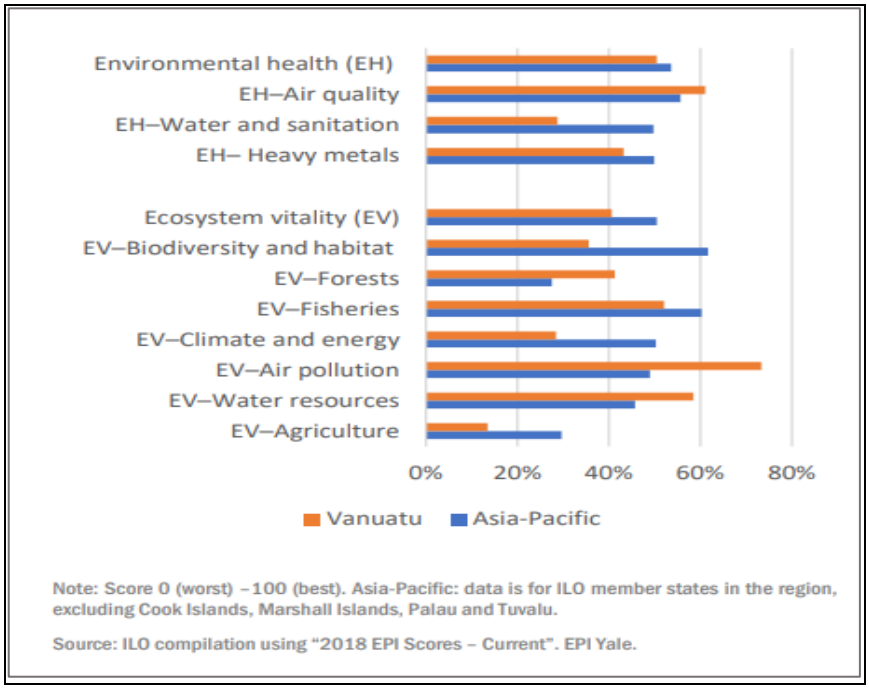


Figure 22: Environmental Performance Index for Vanuatu, 2018

As per information sourced from ILO (2018), carbon dioxide (CO_2) emission levels for Vanuatu increased slightly by an average of 4 per cent from 1990 to 2014. The increase was due primarily to one major source, which is the energy sector, due mainly to the combustion of fossil fuel. The level of emissions is significantly lower than both the Asia-Pacific and ASEAN averages. The $PM_{2.5}$ (atmospheric particulate matter with a diameter of less than 2.5 micrometres) emission levels for Vanuatu were highest in 2005. Overall $PM_{2.5}$ emission levels exceeded the World Health Organization's Air Quality Guideline threshold level, thus indicating high emissions. Vanuatu shows a significantly lower level of emissions than the ASEAN and Asia-Pacific averages.

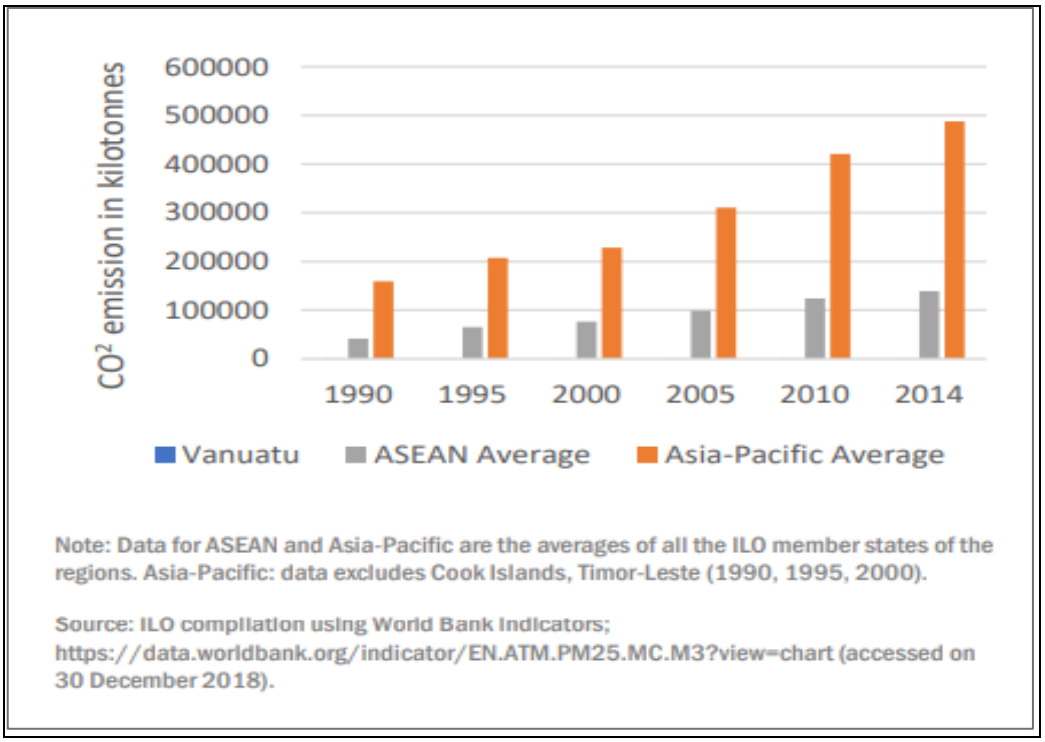


Figure 23: CO_2 emission for Vanuatu, 1990-2014

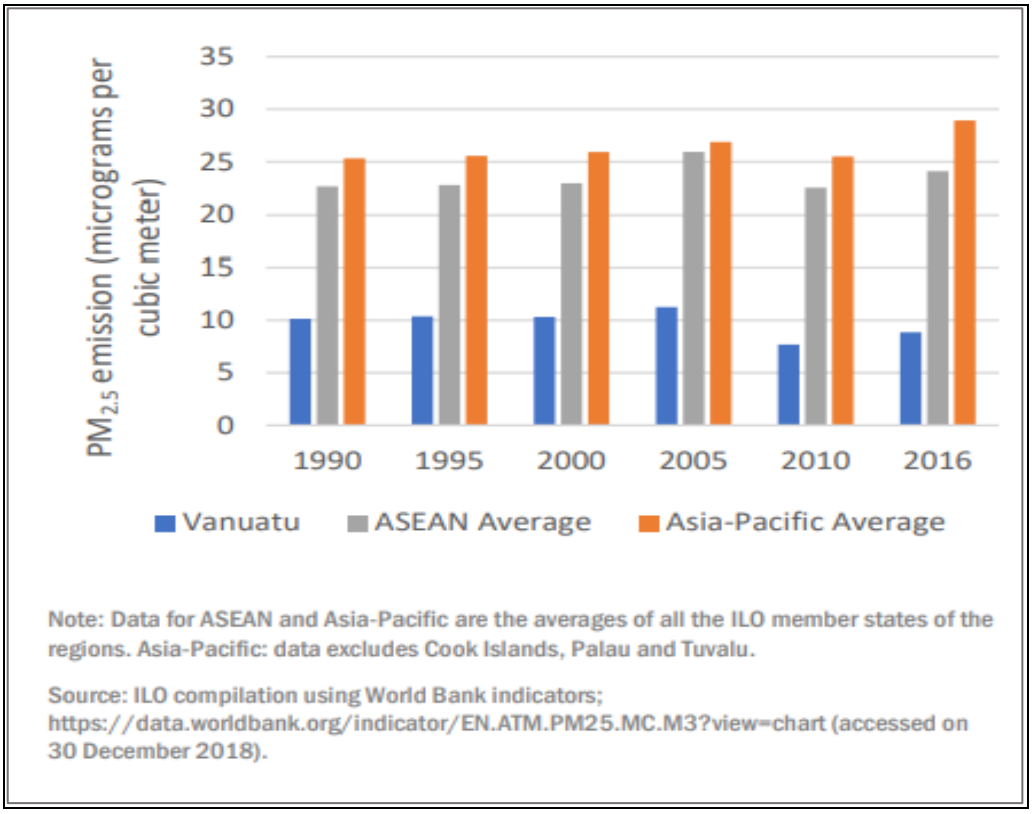


Figure 24: $PM_{2.5}$ emission for Vanuatu, 1990-2014

4.9 Ambient Noise Quality

No existing data on noise quality was available in the public domain for the study area. However, as part of this ESIA study information was sourced from the Environment Officer at DEPC on 23 October 2023 wherein it was understood that the Department has not set up any environmental monitoring station at the Project Area to monitor ambient noise in the country. The ambient noise as understood based on responses received mentions that the noise quality is good as no other development or industry is present in the project area. Annexure F refers to the details of information sourced from DEPC.

4.10 Ecology

The Republic of Vanuatu is an island nation located in the western Pacific Ocean. This archipelago of over 80 islands, which extends 1,300 kilometers from north to south, is of volcanic origin. It is some 1,750 km east of northern Australia, 500 km northeast of New Caledonia, west of Fiji and southeast of the Solomon Islands. Vanuatu is located between latitudes 12º to 23º south and longitudes 166º to 173º east. Vanuatu's terrain is mostly mountainous, with narrow coastal plains. It comprises 83 islands, of which 65 are inhabited, with total land area of 12,336 km^2 and a maritime exclusive economic zone of 680,000 km^2. The largest island is Espiritu Santo. Efate Island is home to the capital, Port Vila and Vanuatu's national government. From largest to smallest, the islands are Espiritu Santo, Malekula, Efate, Erromango, Ambrym, Tanna, Pentecost, Epi, Ambae (or Aoba), Vanua Lava, Gaua, Maewo, Malo, and Anatom (or Aneityum). The two largest islands, Espiritu Santo and Malekula, make up nearly 50 percent of the total land mass. Larger islands are characterized by rugged volcanic peaks and tropical rainforests. The highest peak, Mount Tabwemasana on Espiritu Santo, is 1877 m above mean sea level and the total coastline is about 2,528 km long.

Vanuatu is located immediately adjacent to the global epicentre of marine biodiversity known as the 'Coral Triangle', focused on Indonesia, the Philippines and Papua Guinea, and hosts an extremely high level of marine species diversity comparable to the World Heritage listed Great Barrier Reef in Australia. Along with land, marine resources are the lifeblood of Vanuatu, with subsistence fishing providing a significant proportion of national dietary protein and commercial fisheries making a major contribution to the national economy.

Vanuatu has some 108 known species of amphibians, birds, mammals and reptiles. Of those, 21.3 percent are endemic (they exist in no other country) and 13 percent are threatened. Vanuatu is also home to at least 870 species of vascular plants, of which 17.2 percent are endemic. There are around 1,000 vascular plants, of which 150 are endemic, and 700 species of bryophytes, including many invertebrate species (including butterfly, bees, flies, ants and termites). The coconut crab is one of Vanuatu's best-known invertebrates. Vanuatu hosts 121 bird species, some of which are rare or vulnerable, and around 30 species of reptiles and amphibians. The region is rich in sea life, with more than 4,000 species of marine molluscs. The giant East African land snail arri ved only in the 1970s but has already spread from the Port Vila region to much of the rest of the country. There are three or, possibly, four adult saltwater crocodiles living in Vanuatu's mangroves with no current breeding population. Coral reef systems fringe most islands in Vanuatu. The Reef Islands, also called Rowa, are a cluster of coral cays between Mota Lave and Ureparapara, in northern Vanuatu. They are important sources of economic and subsistence resources and a drawing card for the important tourism sector, while they also protect adjacent coastlines from extreme sea events. Mangroves are also an important part of the Vanuatu's ecosystem, with sea grass beds and other near-shore marine ecosystems. Mangrove ecosystem services include subsistence/ commercial and recreational fishing, wood, tourism, bioremediation, sediment trap, protection against waves, and carbon sequestration.

Pentecost is an island 60 km long by 12 km wide, located at Vanuatu Island. The landmass is predominantly basaltic, with a few limestone ridges formed by the uplifting of coral reefs. The eastern coast is precipitous, fringed by extensive coral reefs, and windward, with few safe anchorages. The western coast is flat and leeward, with coral reefs, extensive sandy beaches and good anchorages. The central part of the island is mountainous and covered with dense primary rain forest. The mountain range, of which the highest is Mount Vulmat (947 metres, (3,107 ft)), marks the dividing line between the humid, rainy eastern coast and the more temperate western coast. The coastal plains crosscut by small torrents, are generally very green and ideally suited for plantations and livestock.

The vegetation structure has been extensively influenced by volcanic activity, cyclones and centuries of human interaction with the environment, and by rainfall, altitude and soils. High forests are restricted on Pentecost and is affected by anthropogenic influence.

The ratio of dense to open forest is 2.6 in Pentecost. Open forest is more often affected by humans, such as through agriculture, fallows, grasslands. Many rivers and streams flow from the mountains to the coast, especially on the western side, and they are the primary sources of fresh water.

Pentecost has following rivers – Green River, Bwatnapne River, Melsisi River, Holnensouban River, Baravet River, Oubouen River, Walap River, Lonpoa River, Warbot River.

4.10.2 Methodology

Literature review and desk-based research has been done in order to enlist floral and faunal species found at the country level wherein species noted in the IUCN Red List have been enlisted thereby mentioning their status. The following data has been referred to while detailing this section,

- Forest Genetic Resources - Country Report, Vanuatu
- Vegetation of the Tropical Pacific Islands
- Vanuatu Environment Science Society - Threatened species factsheet
- Republic of Vanuatu's fifth country report
- Dupuyoo, 2006.Two palms with surprising qualities;50(4).
- Butterflies of Vanuatu, with biogeography document.
- Traditional Tree farming in Vanuatu
- Grant et al, 2023; Geographical variation in *Canarium indicum* across Vanuatu, Research square
- Country report on the forestry invasive species situation in Vanuatu
- Global Forest Resource Assessment Report, 2020- Vanuatu
- Protected Area Assessment and Establishment in Vanuatu
- Checklist of the Vascular Flora of Vanuatu
- ESIA Report of BRANTV Project

4.10.3 Species Profile

Species profile from the data collected was assessed to understand the type of species present in the study area and to understand whether they are native, endemic or invasive. Besides species profile can be used for understanding which species are facing population loss or are in threat of extinction to help mitigate with appropriate conservation methods.

4.10.3.1 Floristic Species

The data collected of floral species at the country level was segregated as per their habits (trees, shrubs, herbs). Analysis of floral species reveal that there is total 51 floral species out of which 39 are trees, 04 are shrubs, 06 are herbs and 02 are climbers. 02 tree species are found to be Critically Endangered (CR) and 01 tree species to be Endangered (EN) that is enlisted in checklist, while amongst the shrubs, herbs and climbers no species fall in category CR or EN.

There is very little diversification in the agricultural produce developed on Pentecost. Vegetables and fruits are not sold commercially and are consumed on a seasonal and limited basis. Taro is the main crop grown for local consumption on Central Pentecost. The list of trees, shrubs, climbers present in Pentecost island are mentioned in Annexure G of the report.

4.10.3.2 Faunal Species

The data collected through the desk-based method of faunal species was segregated as Mammals, Reptiles, Avifauna and Butterflies. Pentecost forest and freshwater systems contain some endemic species animals. One such is the freshwater gobby species, *Akihito vanuatu*, which is only found on the island. As per the ESIA Report prepared for BRANTV, it has been mentioned that there is no natural forest or threatened species near the Project site.

Analysis of faunal species reveal that there are a total 106 faunal species out of which there are 05 mammals, 18 reptiles, 62 aves and 21 butterflies. Critically Endangered (CR) and Endangered Species (EN) are not found in the study area of Pentecost island. The list of mammals, reptile, avifaunal and butterfly's species present in Pentecost is detailed as part of Annexure G.

4.10.3.3 Aquatic Species

There are few freshwater fishes present on the island of Pentecost. Some coral reef areas are also found in some parts of the islands. The fish species present at the island have been listed in Annexure G. Based on discussion held with the local community of Nambaranguit village in November 2023, it was understood that there are no individuals whose livelihood is depended on fishing activities on the river.

4.10.4 Habitat Profile

4.10.4.1 Natural Habitats

According to Global Forest Resource Assessment Report 2020, Vanuatu, the forest type of Pentecost includes the following forests,

Terrestrial Habitats

Mid height forest with emergent: These forests occur in the altitudes from about 3,000 feet (900 meters) to more than 5,000 feet (1,500 meters) above sea level. Most rainforests are structured in four distinct layers: emergent, canopy, understory, and forest floor. Each layer has unique characteristics based on how much water, sunlight and air circulation it experiences. Although the animal and plant species differ in each layer, they are all dependent on each other and influence each other every day. The upmost layer of the rainforest is known as the emergent layer wherein there are tall trees standing above the canopy from the other trees. These trees can reach up to 60 metres in height and dominate like skyscrapers. These trees have access to an abundance of sunlight to photosynthesise, though it is hard to pull water all the way from the forest floor (especially during droughts and dry seasons) so the leaves are small and waxy to retain water.

Low forest with metrosideros: Low forests is type of quality tropical rainforest that are within heights ranging from 80 to 400 meters above sea level. Low forest covers 19.08% of land area of Vanuatu. The low forests are 10-20 meters in height. Forests for timber production are concentrated in the Mid-height and Low forests. The non-timber forest products could also be harvested from the Mid height forests and Low forests.

As per the ESIA Report prepared for the BRANTV project, it was mentioned that the project site does not have any natural habitat, mangroves and wetlands. The project area however, does have minimal tree and shrubs cover wherein clearance would be required for the construction of the Powerhouse, penstock, solar PV installation and transmission line.

4.10.4.2 Modified Habitats

Nambaranguit is situated on the west coast of North Pentecost Island of Vanuatu. From 2001 to 2022, North Pentecost lost approx. 50 hectares of tree cover, equivalent to a 0.55% decrease in tree cover since 2000. In 2020, North Pentecost had more than 30% tree cover with 95% of forest (7.95 kha), 0.64% of grassland (54 ha), 3.3% in settlement (279 ha), wetland of less than 0.1% (7ha), and 1.1% of other categories (92ha).

4.10.4.3 Critical habitats

There are no critical habitats present in study area however, the existing conservation areas in North Pentecost is provided below,

Table 10: Existing Conservation Areas in North Pentecost

S. No	Existing Areas	Location	Importance to Community	National Priority
Marine Areas				
1.	Laone	North Pentecost	Beach and Good fishing ground	
Forest and Inland Water Conservation Areas				
2.	Lini Memorial College (LMC)	North Pentecost	Cultural Site-Father Walter Hadye Lini Grave Site	Culture site
3.	Anvisilingi Lagatava	North Pentecost	Historical Site/Tabu Site	
4.	Hingon Bwagi	North Pentecost		
5.	Aviriana	North Pentecost		
6.	Langatava	North Pentecost		

***Source**: Vanuatu National Biodiversity Strategy and Action Plan (NSAP), 2018-2030*

4.10.5 Ecosystem Service

Provisioning Services: The main crops are taro and yams, although these are complemented by sweet potatoes, manioc, arrowroot, sago, and breadfruit. Some leafy green vegetables, sugarcane, squashes, melons, and tomatoes are grown on the island. The local population fish extensively in the coastal waters off the fringing reefs and in freshwater streams for fish, lobsters, shrimps, crabs, eels, and octopuses. The communities have extensive groves of fruit and nut trees and also forage for wild greens, ferns, algae, and mushrooms in the forest, where hunting of birds, flying foxes, snakes, and stick insects are undertaken. The communities also herd pigs, which are consumed on ritual occasions only. Kava is cultivated wherein only men drink kava in the traditionalist villages.

Regulating services: The environment regulating services provided by the prevalent forest cover in the island include air quality maintenance, prevention of soil erosion, carbon sequestration and controlling the greenhouse gases.

Supporting Services: Forest areas provide habitats for different life forms, retain biodiversity, nutrient cycling and other services for supporting life on earth.

Cultural services: Pentecost Island has become famous throughout the world for the land diving ritual called Nagol or N'gol. Land divers jump headfirst from towers up to 80 feet (24 metres) tall that are made of bush timber and vines. The divers are suspended only by vines, short and springy enough to break their fall, attached to the tower and to their ankles. Careful planning allows them to just brush the ground and survive these plunges, which are said to have inspired the modern sport of bungee jumping. In the project area, there are however, no cultural use of the land area by the local community of Nambaranguit site.

4.11 Socio Economic Environment

Penama Province, Vanuatu is comprised of the three islands of Pentecost, Ambae and Maewo. It has a total population of 30,819 people based on the latest Census by the Vanuatu Statistics Office (VSO) and a total land mass surface area of 1,193 km². The provincial capital is located on the island of Ambae at Seratamata. Pentecost Island is the largest and most populated island in Penama Province with an area of 490 km² and a total population of 16,843 people according to the 2009 Census with an annual population growth rate of 1.8%. The island stretches north to south at a distance of around 60 kilometres with an average width of less than 10 kilometres.

4.11.1 Administrative Arrangement in Pentecost

There are four Area Councils on Pentecost: (from North to South) North Pentecost, Central Pentecost 1 (CP1), Central Pentecost 2 (CP2) and South Pentecost, which collectively contain over 50 villages with populations exceeding 100 people. The VSO recorded over 250 communities in total living in Pentecost, with populations ranging from a single household up to 307 villagers.

Below the four Area Councils on Pentecost, there are 23 Ward Councils, which are collections of “nakamals” or chiefly associations. There are 190 “nakamals” on Pentecost as reported by the Penama Provincial Government Council. North Pentecost is relatively more developed than other parts of the island and has the largest population with over 5,800 residents, although there are significant infrastructure challenges present there as well. Central Pentecost 1 has just over 2,500 inhabitants who are primarily located on the western coast and middle portion of the island. Central Pentecost 2 has nearly 4,000 inhabitants with a quarter of the population living along the remote and inaccessible eastern coast. South Pentecost is home to over 4,500 residents and is where the island’s thriving tourism “land-diving” or “Nangol” activities take place.

There are 4 Area Secretaries employed by the Penama Provincial Government Council, each working within their respective 4 Area Councils.

Traditional System

The traditional Ni-Vanuatu chiefly system is the prominent village-level governance system in Pentecost. The traditional chiefly councils in the target area appear to be generally quite cohesive without reported disputes over chiefly parties or land ownership. Typically, the larger villages contain a paramount chief who is responsible for various tribal chiefs reporting below the authority of a “nakamal”. Some villages form larger, chiefly associations collectively which are commonly referred to as “nakamals”. However, some villages in Central Pentecost are independent, meaning that no other villages are linked to their “nakamal”. Chiefly titles on Pentecost are not hereditary, but rather earned through a series of custom rituals, payments and ceremonies. Chiefly status in Pentecost is typically judged by the number of pigs that have been sacrificed at community ceremonies, with paramount chiefly titles bestowed by the community upon those who have sacrificed the highest number of pigs. Normally, family and community members must donate pigs to support aspiring chiefs attempting to gain a chiefly status or those seeking to improve their chiefly rank. Only males serve as chiefs on Pentecost. A Chairman, either of a Village Development Committee or of the Chiefly Council is often elected by the Chief or the village committee on merit in order to help organize the community to work. Many times, a Chief will simultaneously hold the position of Chairman on Pentecost. The Village Chiefly Councils on Pentecost oversees dispute resolution and the enforcement of customized rules and regulations within their respective areas. They regularly impose fines and collect penalties from villagers for disciplinary matters and violations of their rules.

Ward System

The Ward system is unique to Penama Province and links together the various “nakamals” or chiefly councils within Pentecost, Ambae and Maewo. Ward councils typically consist of chiefly representatives from around 6 -10 villages in their respective areas, linked by factors including geographic proximity and tribal association.

There are 11 Ward Councils inside the CP2 Area Council and residents from these councils will be targeted during the project implementation phase along with 2 Wards from CP1 Area Council, which contain villages sharing water catchment areas with the target site in CP2. During community consultations with the VCAP design team, there were mixed reports on the functionality of the Ward system in Central Pentecost. Some villagers reported that the Ward system was not operational in their given area, due to a lack of organizational planning or an operational budget. However, some Ward council representatives reported that they occasionally held meetings, especially to resolve minor land disputes or to hold disciplinary hearings.

Area Council

The Penama Provincial Government has recently established its Area Councils within the target area, Central Pentecost 2 (CP2) and Central Pentecost 1 (CP1). The Area Councils include Area Councillors consisting of village representatives who live within the respective “area” consisting of Chiefly reps, Women reps, Youth Reps, Disabled Persons reps, Church reps and Business House reps. The basic duties of the Area Council are to: tax collection, voter registration, government information dissemination, Statistics enumeration duties and assisting development projects within their respective Area Councils.

4.11.2 Profile of the Project Area

The project area is located in village Nambaranguit in Penama Province situated on the West Coast of Pentecost Island of Vanuatu. The project elevation ranges from 50m to 100m above mean sea level and is located in Nambaranguit. The project lies on geo co-ordinate Lat-15°35'4.63"S and Long-168°7'58.16"E. The local language of the area is the Apma Language.

4.11.3 Approach and Methodology

The socio-economic profile has been attempted based on the information provided in the Nambaranguit Hydro Mini-grid Detailed Design Report prepared by Ministry of Climate Change and Adaptation, Department of Energy, BRANTV project, June 2023 including information derived from consultations undertaken with the local communities in November 2023 by UNDP Fiji CO representative and DoE representative. In addition, information from various secondary sources including information available on the public domain has been referenced in the section below.

4.11.4 Demographic Profile

The total number of potential end-users mapped in Nambaranguit, and the two nearby communities is 167. The table and figure below provide the number of Household (HH), Business (BB), and Institutions (II) in Nambaranguit.

Table 11: Summary of the number of HH, BB, and II at Nambaranguit

Type of end-user	End-users in Nambaranguit	End-users from nearby communities	Total end-users
Household (HH)	27	114	141
Business (BB)	3	9	12
Institution (II)	7	7	14
Total	**37**	**130**	**167**

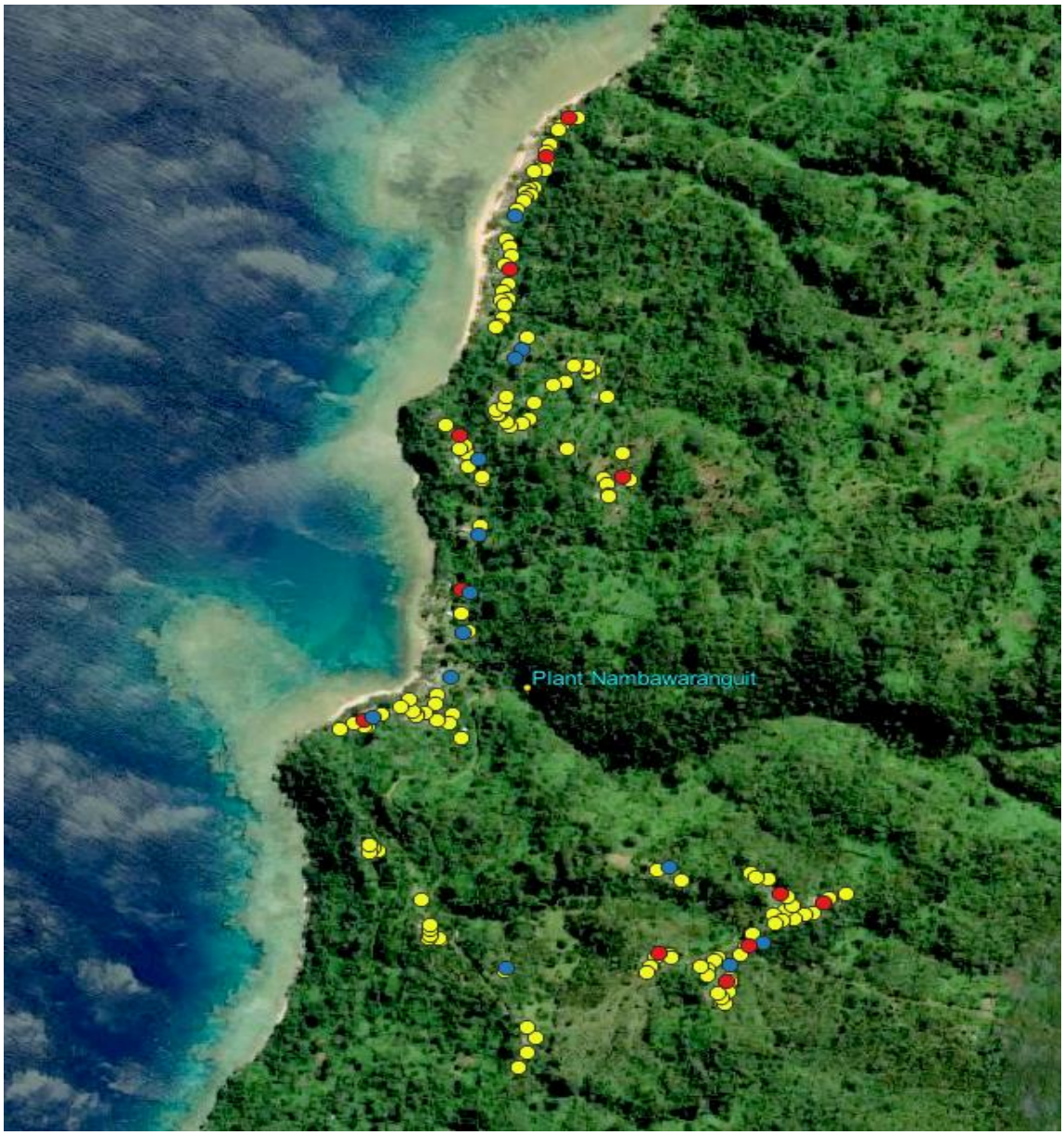


Figure 25: Geolocation of different current and potential users in Nambaranguit Community

4.11.4 Occupation and Income level

The main source of income for the community in Nambaranguit is predominantly farming and selling of kava and other root crops. Private businesses are another important source of income and mainly consist of retail shops (located inside the HH) selling frozen goods and other food products. Public workers also represent an important source of income in the community. The target communities generate majority of their income through agricultural activity, especially the sale of kava.

The reported average cash income across all the communities is approximately 22,000 VUV/month , details of average values has been presented in the table below. The average income of approximately 9,700 VUV/month ranks considerably lower than other communities in Pentecost Island, as illustrated in the figure below,

Table 12: HH average income for all the communities in Nambaranguit

Indicators	VT/Month
Average Income (VT)	9700
Daily Demand (kWh/Day)	109.175
Average Monthly Electricity Expense	1298.06

***Source**: Detailed Designed Report, June 2023*

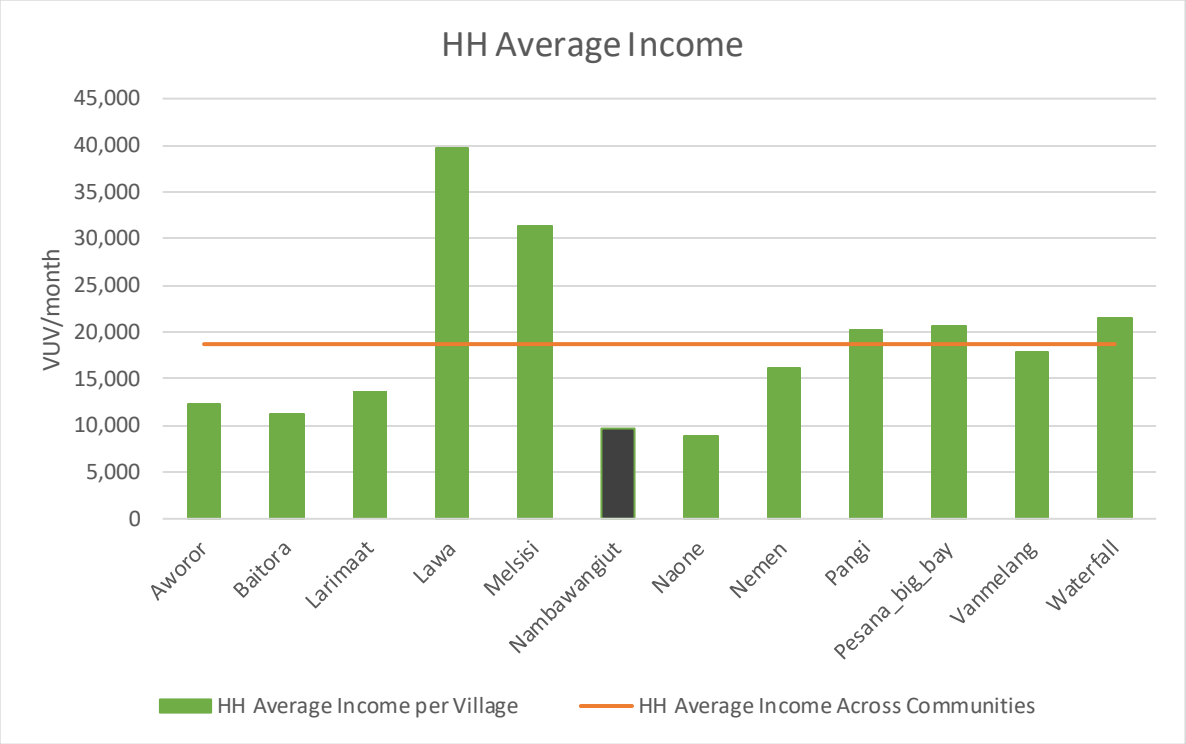


Figure 26: HH Average Income for all the communities In Pentecost

4.11.5 Energy Demand

The total number of end-users identified in the community is 167. The service packages that have been assigned to the users are summarized in the Table below. At the design year, which is the year when 100% of the end-users would be connected (year 4), the total demand would be 109.175 kWh/day.

Table 13: Total End Users Package Distribution

User type	Package	#	EDA (Wh/day)	Total Demand (kWh/day)
Household	Package 1	89	275	24.475
Household	Package 2	45	550	24.75
Household	Package 3	7	2200	15.4
Household	Package 4	0	3850	0
Business	Shop (P2)	4	550	2.2
Business	Shops freezer (P4)	8	3850	30.8
Institution	Primary school (P3)	2	2200	4.4

User type	Package	#	EDA (Wh/day)	Total Demand (kWh/day)
Institution	Church (P1)	6	275	1.65
Institution	Clinic (P3)	2	2200	4.4
Institution	Community building (P1)	4	275	1.1
Total (kWh/day)				**109.175**

Source: *Detailed Designed Report, June 2023*

4.11.6 Basic Amenities

Educational Facilities

There is a primary school and a kindy (Kindergarten) located in Nambaranguit.

Health Care Facilities

There is a clinic/health center including a dispensary in Nambaranguit.

Other Facilities

There is a Church and Community Building located in the area.

Water supply

Communities within the target site have a variety of means for providing water supply. These range from:

- Gravity feeds from ”water sources”, typically small springs, where the water has been contained and is then piped often over a number of kilometres to the village where there are typically shared taps to provide water to a number of households. Often sedimentation occurs after heavy rains and a lack of a filter makes these supply systems frequently unsafe for drinking purposes.
- Tank supply from metal roofs: There is a significant number of rainwater tanks (both cement and poly tanks) along the western coast of CP2. Rain tanks are used by smaller communities in the highlands in CP2 as there are often no gravity feed supply options in communities located at higher elevations. The east coast of CP2 has a shortage of water tanks due to the area’s inaccessibility and a decreased number of buildings with metal roofs.
- Open containers: Plastic containers, buckets, drums and other various containers regularly used by villagers to collect rainwater for later use.
- Pumps & wells: Pumps and well are not used by communities within the target site.
- Rivers and streams: Water collected straight from rivers and streams by many households.

Banking Services

No information on the existence of banking facility in Nambaranguit is available in the public domain.

5.0 Social and Environment Risk and Impacts

5.1 Introduction

This section presents a summary of the environmental, socio- economic, demographic and cultural context in which the proposed project activities is to be implemented and made operational. While identifying the above key features, the section also discusses the type and range of impacts likely to result from the different project activities, measuring its extent and severity. The specific purpose of this section is to,

- Identify and assess the range of potential impacts and extent of their severity;
- Explain the ways in which the proposed project activities might affect environment, ecology, socio-economic resources, demographics, livelihoods, cultural patterns, as well as access and infrastructure issues;
- Suggest viable mitigation measures for the identified impacts;
- Develop a management plan based on the proposed mitigation measures.

These impacts have been identified through secondary information, reports and stakeholder records undertaken in 2019.

5.2 Impact Evaluation Criteria

The criterion that has been used to evaluate impacts on various environmental and social components is as following:

Extent (Context)

The extent refers to spatial or geographical extent of impact due to proposed project activities. In this study, the impacts were classified as per the following context:

- Very Local (*very low spread*), when an impact is restricted within the footprints of the Project components (except for ecology);
- Local (*low spread*), when an impact is restricted within the footprints of the Project components and extends up to 2 km from the boundary of the Project components (except for ecology);
- Medium (*medium spread*) when an impact is spread from up to 2 km to 5 km from the footprint boundary of the Project component (except for ecology); and
- Regional (*high spread*) when impact is spread beyond 5 km from footprint boundary of each of the Project component (except for ecology).

The above extent has been selected based on the understanding of the Project and prevailing environmental and social baseline conditions. The Project relates to development of hybrid system (Pico Hydro and PV Solar System) project located in the elevation ranging from 50m to 100m above mean sea level and is located in Nambaranguit village. As understood no other hydro power projects are located upstream and downstream of the project location.

Duration

The duration of impact indicates whether the impact would be short-term, medium-term or long-term. The impacts have been assessed considering the time taken by an environmental component to recover back to its best achievable pre-project state. For the proposed project component, impacts were classified based on their existence in temporal scale as follows:

- Short term (*low duration*), when impact is likely to be restricted for duration of less than one (01) year; this is based on the understanding that there will be recovery of the affected environmental component within two (02) years;
- Medium term (*medium duration*), when impacting up to three (03) years; this will result in the recovery of the affected environmental component within ten (10) years; and

- Long term (*high duration*) when impacting beyond three (03) years; and will result in recovery of prevailing conditions in ten (10) years or beyond or upon decommissioning after completion of the Project life.

Magnitude (Intensity)

Indicators of the magnitude (intensity) of an impact, whether it is insignificant, minor, moderate, or major, was based on the following criteria adopted for the proposed Project activities,

- Insignificant intensity, when resulting in changes in the environmental baseline conditions up to 20% in regional context or 20 to 30% in medium context or up to 30% in local context but for short duration of less than 1 year;
- Low intensity, when resulting in changes in the baseline conditions up to 20% in regional context or up to 30% in medium context or more than 30% in local context. While for ecology low intensity refers to minimal changes in the existing ecological baseline conditions in terms of their reproductive capacity, survival or habitat suitability;
- Moderate intensity, when resulting in changes in the baseline conditions for up to 30% in regional context or more than 30% in medium context. While for ecology, moderate intensity refers to changes that are expected to be recoverable in terms of medium duration of three years; and
- High intensity when change resulting in the baseline conditions beyond 30% in regional context. While for ecology, high intensity refers to changes that result in serious impairment to species, productivity or their habitat.

Type

The type of impact refers to whether the effect is considered beneficial or adverse. Beneficial impacts would improve resource conditions. Adverse impacts would deplete or negatively alter resources.

5.3 Impact Significance Criteria

Details regarding application of the above-mentioned impact evaluation criteria are presented for each of the identified impacts in this section of the report considering the risk significance assessment matrix as provided in the table below,

Table 14: Impact Significance Matrix

Significance	Context	Duration	Intensity
Insignificant	Local	Short	Low
Minor	Local	Short	Moderate
	Local	Medium	Low
	Local	Medium	Moderate
	Medium	Short	Low
	Local	Long	Low
Moderate	Local	Medium	High
	Local	Long	Moderate
	Medium	Short	Moderate
	Medium	Medium	Low
	Medium	Medium	Moderate
	Medium	Long	Low

Significance	Context	Duration	Intensity
	Medium	Long	Moderate
	Regional	Short	Low
	Regional	Short	Moderate
	Regional	Medium	Low
	Regional	Medium	Moderate
High	Local	Long	High
	Medium	Short	High
	Medium	Medium	High
	Medium	Long	High
	Regional	Short	High
	Regional	Medium	High
	Regional	Long	Low
	Regional	Long	Moderate
	Regional	Long	High

***Note**: Positive impacts are termed is beneficial while negative ones are adverse*

5.4 Impact Assessment for Construction Phase

The assessment process is based on current information shared by the UNDP Fiji CO team, including the ESIA Report prepared by BRANTV Project, Detailed Design Report and Stakeholder Consultation records undertaken in 2023 and in 2019. The assessment considers all relevant social and environmental impact/risks, including issues identified in UNDP SES, and those who will be affected by such risks and impacts.

Considering that no alternate options were evaluated as the option considered for the project activities has been selected to minimize social or environmental impacts, there will, nevertheless, be some impact in the project area due to construction activities associated with the project features.

This section presents a summary of the environmental and social impacts from the activities related to construction of the project. The impacts are based on the scoping exercise, documentation review and information provided by UNDP Fiji CO.

5.4.1 Land Use

Potential Impacts

The proposed project will have an impact on land use marginally with the development of powerhouse, penstock including associated works and installation of Solar PV panels.

The proposed project will marginally affect the land voluntarily transferred to the project. The land parcels wherein the project components are going to be constructed and installed will undergo a slight change in land use due to the proposed construction/installation activities to be undertaken. In addition, few parcels of land to be used for temporary usages within the community might be used however, there would be temporary impact and it is envisaged that this would not be of long term in nature.

Mitigation Measures

The following mitigation measures are to be implemented to minimise impact on land use,

- The usage of land to be restricted to areas identified/voluntary consented by the local community.

- The land parcels wherein temporary usage is expected are to be returned to the landowners/community after proper treatment and rehabilitation.
- Area to be cleared for the project activities are to be undertaken post receiving consent of the local community.
- Information on work to be initiated onsite is to be shared with the stakeholders prior to start of the construction/installation works.
- Monthly meetings to be held with the Chief council of the area to update on the works on ground to create sense of ownership amongst the community members and provide a platform to raise any concerns directly.
- Chance Find Procedure developed is to be implemented onsite by the Contractor.

Impact Significance

Due to temporary, localised and minimal land parcels being used for the proposed project activities, the nature of impacts on land use from the project activities together with implementation of proposed mitigation measure recommended is predicted to be minor.

5.4.2 Topography and Drainage

Potential Impacts

The proposed project would involve marginal potential impacts on topography due to excavation works for the penstock and transmission lines including physical structures for the Powerhouse and installation of solar PV system.

The construction activities would require excavation and earthworks, which can result in the minimal alteration of the existing topography within the project area. The few slight slopes within the project area may need to be cut or flattened, leading to changes in the shape and contours of the land. This might disrupt the natural drainage patterns of the area which might lead to the risk of soil erosion. In addition, the construction may loosen the topsoil in the project area resulting in loss of soil and accelerated soil erosion especially during rainy season. Erosion of soil can also occur from the runoff of unprotected excavated areas and muck generation. Excavations on slopes would also decrease its stability to certain extent.

Mitigation Measures

- All unstable zones are to be avoided.
- Drainage pattern areas are not to be disturbed during construction activities.
- Identification of possible and active erosion areas to be undertaken within the project area.
- To prevent soil erosion, measures such as soil stabilization, slope protection, vegetation restoration, and proper management of the construction process, including proper disposal of construction waste are to be implemented as and where required.
- Muck and debris to be backfilled to the extent possible. Excess muck if generated, is to be disposed off at a pre-identified site in consultation with the local authority/community.
- Sand trap to be provided onsite by the Contractor wherein all run offs and other water sources are to be directed to for pretreatment before discharge in natural water bodies.

Impact Significance

The geographical extent of impact on topography and drainage is expected to be local. The impact duration is perceived to be short and intensity to be low. The intensity will be reduced to negligible with the implementation of the mitigation measures. The overall impact significance is expected to be negligible with the implementation of mitigation measures.

5.4.3 Water Resources and Quality

Potential Impacts

The proposed construction activities would result in potential impacts on water sources.

The water resources requirement for domestic and construction purposes is expected to be quite minimal. The requirement will be met through the nearby water stream. Considering the availability of water resources in the area, it is anticipated that there would not be any conflict with the local communities dependent upon the water stream in the area.

Wastewater would be generated through construction activities only as no worker accommodation camps are anticipated to be set up. Sediment run off from the construction activities might also be exacerbated due to the improper storage of construction materials and excavated debris. Inadequate storage of fuel, lubricating oil, grease etc. including accidental fuel and oil spills could lead to hydrocarbon release in the soil leading to soil contamination with eventual run offs to the water bodies.

Mitigation Measures

- Sand trap to be provided onsite by the Contractor wherein all run offs and other water sources are to be directed to for pretreatment before discharge in natural water bodies.
- All muck and debris generated to be used for back filling to the extent possible and excess muck to be disposed of at pre-identified muck dumping site.
- Ensure that the muck dumping site (if required) is provided adequate protection so that it does not flow into the water stream. The muck disposal site will be treated with indigenous plant species once the construction works gets completed.
- Storage area to be kept away from the water bodies to prevent any runoff into water bodies.
- Regular collection of used oil and lubricants into drums/barrels to be done and stored in designated places within the project site with provisions of secondary containment, depending on the quantity onsite.
- Waste Management Plan developed to be implemented on site by the Contractor for the use, storage and disposal of general, battery, solar panels and hazardous waste materials.
- Provision of safe drinking water to be provided to all workers onsite for drinking water purposes.
- Conduct water quality monitoring once during construction and once post construction of the river to assess the impact on the water quality of the river.

Impact Significance

The geographical extent of impact on water resources and quality is expected to be medium. The impact duration is perceived to be short and intensity to be moderate. The intensity will be reduced to low with the implementation of the mitigation measures. The overall impact significance is expected to be minor with the implementation of mitigation measures.

5.4.4 Ambient Air Quality

Potential Impacts

The proposed construction activities would lead to dust emissions and exhaust emissions from vehicles resulting in potential impacts on air quality of the project area.

The preparatory works pertaining to strengthening of access roads and construction related activities would lead to dust emissions in the active work area. In addition, transport emissions from vehicles moving on roads and from their exhausts, would also lead to dust (PM10 and PM2.5) emissions and exhaust emissions. Further, operation of diesel generators might also affect the air quality in the area.

Mitigation Measures

- Regular use of dust suppression systems such as water sprinklers to reduce dust emissions during transportation, handling of construction materials and movement of vehicles.
- Conduct air quality monitoring at the construction work areas against international standards once during construction and once post construction to assess the effectiveness of mitigation measures and take corrective actions if necessary.
- Trucks to be covered during transportation of construction materials.

- Review the maintenance of construction equipment prior to construction to minimize smoke in the exhaust emissions. An equipment maintenance register to be kept ensuring that construction equipment are maintained in order to minimize smoke and particulates in the exhaust emissions.
- Diesel Generator (DG) set to be met through power supply. The DG set to be optimally operated and regularly maintained. Ensure adequate stack height is provided to the diesel generator as per regulatory requirements.
- Reduce traffic speed on all unpaved surfaces to 15 km/hr or less to avoid dust emissions from vehicular movement.
- Sprinkle water on the area where excavation is done to settle down the particulate matter emissions.

Impact Significance

The potential for impact on air quality will be limited to the project area for short duration with moderate intensity which with the implementation of mitigation measures will get reduced to low intensity. The overall impact on air quality is expected to be minor.

5.4.5 Ambient Noise Quality

Potential Impacts

The primary sources of noise generated would be generated through the few vehicular traffic, construction equipment such as generator, pump, compressor etc. including activities related to excavation. The operation of these equipment is expected to generate noise. These disturbances can have detrimental effects on human and animals causing stress.

The noise generated by the construction activities is likely to be attenuated within a distance of 500 meters from the project site. However, this may cause discomfort to the workers working at the construction site, who will be provided with personal protective equipment such as ear plugs or muffs. In addition, work schedules to include only day shifts. The construction activity is expected to be short-term in nature, and the overall scale of the impact on noise is expected to be low.

Mitigation Measures

- Operation hours of construction activities to be restricted during nighttime.
- Proper maintenance of construction equipment such as generator, compressor etc. to be undertaken to reduce noise emissions.
- The Contractor to consider using low-noise construction equipment where feasible to minimize the noise generated during project activities.
- Workers on the construction site to be provided with appropriate personal protective equipment such as ear plugs or muffs to protect their hearing.
- Monitoring of noise levels to be undertaken once during construction work to ensure compliance with applicable noise standards and regulations.
- PMU in collaboration with DoE to conduct public awareness campaigns to inform nearby residents about the construction schedule and the potential noise impacts.

Impact Significance

The geographical extent of potential impact on noise due to the construction phase is expected to be local, duration is expected to be medium and intensity low with the implementation of the mitigation measures. The overall impact on noise is expected to be minor.

5.4.6 Traffic and Transport

Potential Impacts

The project is accessible by road, wherein the access road ends at around 800m from the Catchment area. The last section will be accessed by foot using a path used by the locals. The area around the water source is mainly covered with tree growth and shrubs which will need to be cleared to provide access to the powerhouse. The existing access road might be strengthened as part of preparatory work for the main construction. With the onset

of construction activities, the number of vehicles and machineries movement would increase thus leading to disruption of traffic and increased cases of road related hazards.

In addition, the existing road if not properly maintained may lead to damage with the increase of vehicles and heavy equipment to site. Vehicle breakdown on the road can also create disruption to the flow of traffic. Additionally, the parking space for construction vehicles can be an area of concern, resulting in vehicles being parked in unplanned areas, which could lead to safety issues to the local communities using the same roads.

Mitigation Measures

- Contractor to prepare a Traffic Management Plan outlining the construction schedule, transportation routes, and times when heavy vehicles can operate to minimize disruption and congestion on local roads.
- Ensure that the existing road is maintained and repaired regularly to withstand heavy loads during construction. If necessary, upgradation of the roads to accommodate construction traffic might also be considered.
- Designated parking areas to be assigned for construction vehicles to prevent vehicles from parking in unplanned areas and causing safety issues.
- Skilled local drivers to be engaged for driving and all drivers to be provided with regular training.
- Adequate signages to be placed at various locations along the road specifying the speed limits, active road crossing areas used by the local communities and at the road turnings. Speed of vehicles to be controlled in densely habited areas.

Impact Significance

The geographical extent of potential for impact on traffic due to the construction phase of the project is expected to be local, duration expected to be medium and intensity low with the implementation of the mitigation measures. The overall impact on traffic is expected to be insignificant.

5.4.7 Ecological Environment

Potential Impacts

The site has marginal vegetation cover which might lead to clearing of trees and shrubs in the specified construction areas which might not lead to significant loss to vegetation. Release of construction wastewater and soil run off can cause contamination to adjoining water bodies, besides an increase in turbidity.

Mitigation Measures

- Complete ban on use of fuel wood by workers during the construction period.
- Water quality control measures as provided in the above section to be implemented.
- All construction areas to ensure mechanism for trapping silt and other construction waste from being disposed into the river.
- Adequate permission/intimation of tree clearance/felling to be taken by Contractor from the Local Authority/Community and records of communication on the same to be maintained.

Impact Significance

The potential for impact on ecology will be local for short term with low intensity. The overall impact on ecology with the implementation of mitigation measures is expected to be insignificant.

5.4.8 Occupational Health and Safety

Potential Impacts

Potential impacts on health and safety during the project construction phase include the following:

- Use of electrical equipment entail the risks of potential electrical hazards such as,

a. Shocks: These can occur upon contact of human body part with an electricity source which is not properly insulated such as wires, cables, switches etc. The potential impact/injury depends on current/voltage magnitude and contact period. The possible injuries include first and second degree burns among the minor physical ones. Major injuries include third degree burns, ventricular fibrillation, cardiac arrest, central nervous system damage, paralysis and electrocution.
b. Burns: These can occur either due to shocks or electrical fires due to short circuiting of power lines/equipment failure. The possible injuries include various degrees of burns and death in lethal cases.

- Welding activities pose the following possible risks to workers engaged in them:
  a. Eye/Retina Damage: Workers engaged in welding activities are susceptible to retina damage due to sparks or flashes emanating from the welding arc if they have not properly protected their eyes.
  b. Photo keratitis: It is caused due to prolonged exposure of insufficiently protected eyes to UV radiation from welding arcs. Photo keratitis is akin to sunburn of the cornea and conjunctiva and is not usually noticed until several hours after exposure.
- Ergonomic injuries: These injuries are also known as Musculoskeletal Disorders (MSD) and they can occur due to awkward or sustained postures, forceful exertion or strain, exposure to vibration and sudden shocks during equipment or material loading and unloading processes. Improper ergonomics can affect the muscles, nerves, tendons, ligaments, joints, cartilage and spinal discs. The possible injuries include muscle strains, sprain, ligament tear, fracture, paralysis and slip disc.
- Working at height (≥ 2m): This kind of work typically involves assembling components and setting up of scaffolding for Powerhouse structure. The workers engaged in such activities can slip or fall from the scaffolding or ladders which may result in minor injuries such as muscle sprain or major ones such as ligament tear, fractures, haemorrhage depending on the height at which they are working.
- Respiratory diseases: Construction activities e.g., excavation, concrete mixing, cutting, welding etc. involve significant amount of particulate emissions in the form of dust, silica, fibres etc. as well as gaseous emissions such as fumes, smoke, acetylene etc. Hence, construction activities entail the risk of acute or chronic health hazards such as bronchitis, asthma, silicosis, asbestosis, cancer etc. to workers who are constantly exposed to such emissions.
- Hearing damage: Workers involved in activities like metal cutting etc. are exposed to sudden as well as continuous loud noise in excess of 80 dB(A). Consequently, they are at the risk of hearing impairment, ear damage, and irreversible hearing loss if proper protective measures are not taken.
- Other Occupational Hazards: These include the following:
  a. Road accidents can occur during material/equipment transportation due to vehicle movement on uneven terrains, overturning due to carriage of loads in excess of safe limits, over-speeding etc. Such incidents can lead to physical injuries to drivers, death etc.; and
  b. Workers at times are not accustomed to use of Personal Protection Equipment (PPE) such as safety helmets or hard hats, safety shoes, harness etc. Their negligence may result in accident/hazard such as head injuries, haemorrhage, fracture etc.;

Thus, occupational health and safety (OHS) risks entailed in various construction activities necessitate the requirement of adequate mitigation measures to be implemented.

Mitigation Measures

- The construction contractor and workers involved in the construction activities are to be trained /informed on the mandatory precaution and safety practices as defined in the Construction Safety Management Plan prior to commencement of construction activity.
- Contractor to ensure that the Construction Safety Management Plan is implemented onsite.
- Construction contractor is required to ensure necessary safety measures to be taken up before and during the construction activities for all electrically driven machinery.
- Vehicle movements to follow the traffic norms and maintain a safe speed while moving through the hilly tracts.
- Personal Protective Equipment (PPEs) e.g., helmets, safety belts, welding masks, shock resistant rubber gloves, shoes, other necessary protective gear etc.to be provided to workers handling welding, electricity and related components.
- Safety harness and other fall protection measures are to be ensured for workers while working at height.
- Periodic inspection of PPE to be done to ensure that they are in proper condition. A register for keeping records of such inspection shall be maintained.

- Loading and unloading operation of equipment to be done under the supervision of a trained professional.
- All excavation activities are to be conducted under the supervision of the Safety officer.
- Proper signage to be provided in places of excavated areas.
- Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks. Regular monitoring of the Fire extinguisher is to be done through inspection checklist.
- An accident reporting and monitoring record should be maintained. The objective is to minimize such occurrences in the future and attain zero accidents.
- Conducting a thorough risk assessment and providing training on handling hazardous materials and assigning necessary PPE to the workers.
- Provide training on proper lifting techniques.
- Provisions of first aid kits will be made in all active construction work areas with inventory of medicines available, expired medicines and medicines used is to be developed and recorded. In addition, emergency numbers to be displayed at all active work areas.
- An ambulance/vehicle shall be kept standby to take the workers to the medical facility.
- Ensure sign boards, safety signages and information on boards are also displayed in regional language.
- Ensure hard barricading is installed at all active work sites.
- Ensure all gas-cutting sets are provided with flashback arrestors at the torch and the cylinder ends.
- Emergency Preparedness and Response Plan developed to be implemented at site by the Contractor.
- All safety rules are to be enforced onsite with clear sanctions for repeat offenders.
- Internal monthly audits to be undertaken by PMU of the Contractor and work activities undertaken onsite. In addition, monitoring and assurance by the Contractor to be done on a regular basis.

Impact Significance

The potential for impact on health and safety will be local spread for medium term and with moderate intensity and minor impact significance with the implementation of mitigation measures.

5.4.9 Socio-Economic

Potential Impacts

As mentioned in the Detailed Design Report, the Powerhouse and the Catchment area would require less than 50m^2 of land. Right of Way for the transmission and distribution line would also be attained. No historical sites and no 'tabu' sites were identified in the proximity of the water source. A site with up to 160m2 (8 x 20m) is available for installation of solar PV which has been allocated by the community next to the church. The area is flat and not prone to flooding and free from shading and it is located about 250m distance from the Powerh ouse where the energy produced by the array will have to be injected. Voluntary Land Consents have been signed by three (03) individuals for the required land for the project. The anticipated impacts on the land required for the construction workers is expected to be minimal.

Mitigation Measures

- Continuous stakeholder engagement activities to be undertaken with the land consent owners and land lessors (if any) to understand and resolve any grievances that might arise. Records of all engagements and grievances to be maintained by the Contractor.
- Contractor to ensure that no issues pertaining to dust emissions, muck and wastewater overflow in adjoining land parcels, barrication etc. to be carried out for the communities residing within the vicinity of the construction activities (if any).

Impact Significance

The potential for impact on socio-economic will be local for medium term with moderate intensity and with the implementation of mitigation measures is expected to be minor.

5.4.10 Labour Related Aspects

The construction phase is expected to engage local workers for unskilled and semi-skilled works which is of a minimal number. For technically skilled works, workforce from outside the Project Area will be sourced by the Contractor. Considering that most of the workers will be sourced locally, workers accommodation is not required to be set up for the project. The local workers will be engaged throughout the construction period, thus anticipated impact from labour is expected to be minimal.

Mitigation Measures

- Contractor to ensure that the Labour Management Plan as provided in the ESIA Report is to be implemented onsite.
- Contractor to develop Code of Conduct for workers and communicate the same to all workers onsite.
- All records as required for record inspection by PMU to be maintained by the Contractor onsite in auditable format.
- Contractor to disseminate training on Grievance Redressal Mechanism to all workers onsite and regularly maintain the Grievance Log.
- Contractor to ensure that all labour practices are implemented onsite based on the national regulations and best practices.

Impact Significance

The potential for impact on labour related aspects will be local for medium term with low intensity and with the implementation of mitigation measures is expected to be negligible.

5.5 Impact Assessment for Operation Phase

This section presents a summary of the environmental and social impacts from the activities related to operation of the project.

5.5.1 Water Resource and Quality

Potential Impacts

As per the Detailed Designed Report (DDR), The hydropower potential of the area estimates when the water flow utilization is capped at 20/30% of the recorded waterflow (11 l/s,) utilizing a 144 mm ID, 380m long penstock wherein the combined output of 3 Pelton turbines could reach 3,493W.

For the proposed project, about 03 identical units of 1.75 kW Pelton type turbine (each turbine will have an output of around 1,164 W) will be installed in the Powerhouse. The turbines are required to have a total flow of 10.4 l/s with a combined output of approx. 3,493 W (1,164 W per turbine). The length of the penstock connecting intake and powerhouse is approx. 380m. A 25 kWp PV array on an elevated canopy with SE-NW orientation is expected to be installed as part of the project. It is expected that the PV and hydroelectric systems will deliver a combined generation capacity of up to 28kW.The implication of water diversion will result in change in water quality - due to change in temperature, increase in its turbidity etc.

Mitigation Measures

- Ensure that adequate environmental flow is maintained in the river as mentioned in the DDR.
- Six monthly testing of water quality by third party to be undertaken in first two years of operation and thereafter, an annual testing to be conducted.

Impact Significance

The potential for impact on water resource and quality will be local for medium term with low intensity and with the implementation of mitigation measures is expected to be minor.

5.5.2 Noise Quality

Potential Impacts

Noise and vibration during operation of the Plant will be present which have a minimal impact on the surrounding areas at the vicinity of the operating plant.

Mitigation Measures

- Rehabilitation near the project features with indigenous species is to be planted as a noise barrier between the project areas and the surrounding areas.

Impact Significance

The potential for impact on noise quality will be local for medium term with low intensity, however the overall impact on noise quality with the implementation of mitigation measures is expected to be minor.

5.5.3 Right of Way Maintenance including areas with PV Solar System Installed

Regular maintenance of vegetation within the Right of Way (ROW) of overhead transmission line is necessary to be done to avoid disruption to overhead power lines. Periodical removal or pruning of the vegetation essentially the trees and tall shrubs within the ROW is likely to lead to marginal loss of tree cover. Regular maintenance related to clearing of woody flora within the ROW is likely to limit the regeneration of such species, which may ultimately result in alterations in the natural succession process. This is also necessary to be undertaken in the area identified for the PV solar system installation wherein plants and weeds need to be continuously pruned and maintained.

Mitigation Measures

- Selective clearing of tall-growing tree species and encouragement of low-growing shrubs, herbs and grasses should be undertaken by the Operation and Maintenance team.
- Vegetation maintenance should be limited to pruning and not to be removed completely.
- Use of machinery for vegetation maintenance should be strictly avoided and it should be done manually as far as possible.
- Use of herbicides to control fast-growing plant species within the ROW should be prohibited. Such species could be controlled through manual weeding.

Impact Significance

The potential for impact on ROW and PV Solar System area maintenance will be local for long term with low intensity, however the overall impact on ROW and PV Solar System maintenance with the implementation of mitigation measures is expected to be minor.

5.5.4 Health and Safety Hazards

There is a possibility of the transmission line falling to the ground due to various reasons including natural hazards. Contact with the transmission line can result in electrocution. There might also be possibility that people might try and tap electricity from the transmission line which can lead to fatal accidents.

Mitigation Measures

- Risks to general public during operation will be reduced by public awareness and education and physical measures by attaching an appropriate warning sign where required.
- Once the stringing work is complete, notices and permanent anticlimbing devices are to be installed on the transmission poles.
- The operational start date for electricity transmission and safety implications are to be publicized locally in advance.

Impact Significance

The potential for impact on health and safety hazards will be local for short term with low intensity, however the overall impact on this aspect with the implementation of mitigation measures is expected to be insignificant.

6.0 Analysis of Alternatives

6.1 Introduction

Alternative analysis is considered as an integral part of project feasibility study and to examine the impacts and risk associated with the project. Alternative analysis is primarily governed by the factors like technical feasibility, economic viability and environmental and social acceptability.

The aim of the proposed project is to construct and install a Hybrid system (Pico hydro and Solar PV system). The various alternatives to achieve the project objectives with no or minimum environmental damages are discussed in the following sections covering aspects on energy demand and supply, no project scenarios, project alternate location etc.

6.2 Energy Demand and Supply

The total number of end-users identified in the community is 167. The service packages that have been assigned to the users are summarized in Table below. At the design year, which is the year when 100% of the end-users are connected (year 4), the total demand will be 109.175 kWh/day.

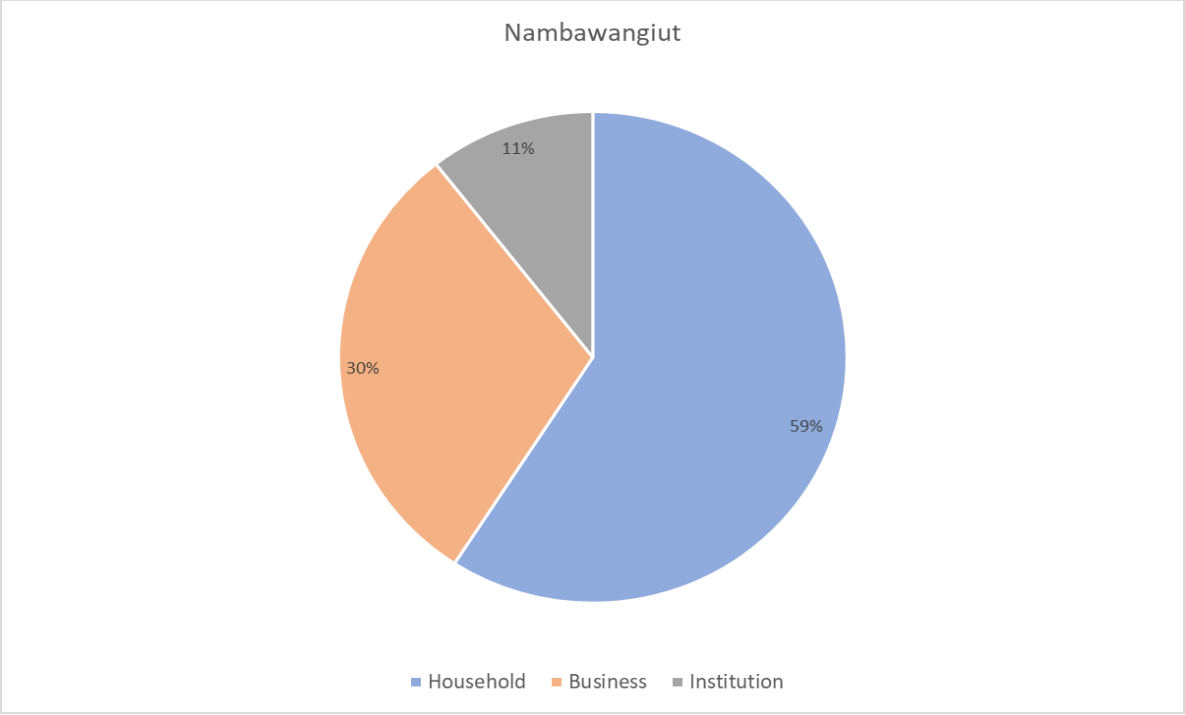


Figure 27: Share of demand covered by each customer type

Table 15: End users package distribution –Nambaranguit

User type	Package	#	EDA (Wh/day)	Total Demand (kWh/day)
Household	Package 1	89	275	24.475
Household	Package 2	45	550	24.75
Household	Package 3	7	2200	15.4
Household	Package 4	0	3850	0

User type	Package	#	EDA (Wh/day)	Total Demand (kWh/day)
Business	Shop (P2)	4	550	2.2
Business	Shops freezer (P4)	8	3850	30.8
Institution	Primary school (P3)	2	2200	4.4
Institution	Church (P1)	6	275	1.65
Institution	Clinic (P3)	2	2200	4.4
Institution	Community building (P1)	4	275	1.1
Total (kWh/day)				**109.175**

The figure below represents the evolution of the service area demand along the project lifetime, the daily load profile with the breakdown per customer type and finally the share of demand covered by each customer type.

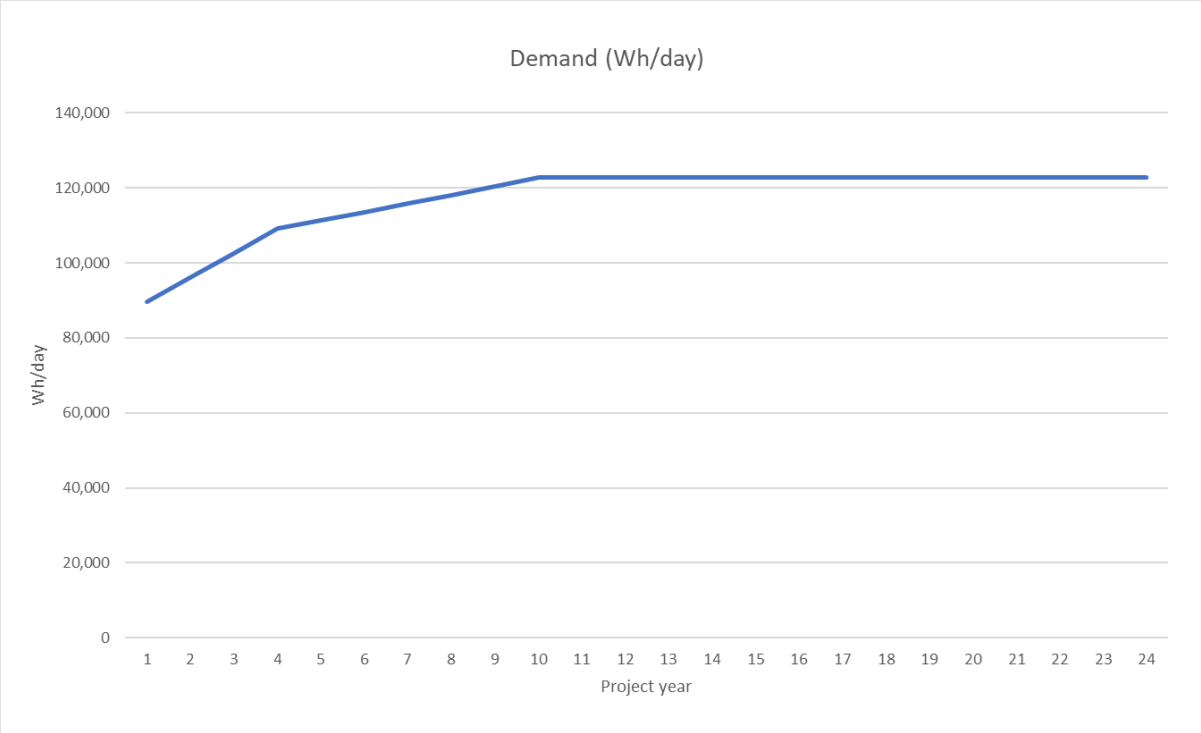


Figure 28: Evolution of the service area demand along the project lifetime

The following assumptions have been considered to obtain the demand and load profile to size the generation and storage system.

- **Connection rate**: A ramp up period is considered for Households with a duration of three years: 70% of households are considered to connect on year 1 (Y1) whereas 100% of households are considered only by year 4 (Y4); 100% of businesses are connected in year 1; 100% of institutions are connected in year 1.
- **Daily Load Profile**. The load profiles assigned to each type of user are based on usage and considering the local habits perceived during the field missions.
- **Demand annual growth forecast**: Between Year 4 and Year 10, the yearly demand growth is set to 2% on the number of new households per year.
- **Utilization Factor** (UF): set to 90%

6.3 No Project Scenario

This Project aims to provide electricity to remote areas of Nambaranguit Village thereby adding up in the national power supply as required. Similarly, limitation exists to access clean energy in rural areas which generates the demand for clean energy. If hydropower and solar generation is not established and continued, power shortage will continue and hamper the overall socio-economic development of the area including Vanuatu. Electricity consumption is one of the parameters to assess the prosperity of the people. No project scenario will lead to non-use of potential power generation, loss of job opportunity, continuation on power shortage, thus also depriving the communities of the other economic benefit due to the project implementation. The 'do nothing' situation will prevent some of the environmental and social adverse impacts at the cost of isolation, difficulty in access, remoteness, malnutrition and severe poverty.

6.4 Alternative Site Location

No other alternate site location was explored as the users in the project location is defined along with the water source as this is a small-scale project and is focused towards the benefitting the users of the targeted community in Nambaranguit. Currently, no information is available for the area identified for the solar PV system except that it would be on community land and a consent would be taken from the community prior to installation activities.

6.5 Alternate Technology

The population within the zone of influence require safe, efficient, cheap and clean energy for daily lighting and cooking activities, domestic and commercial purpose. In order to conserve the environment in terms of physical, biological, social and cultural aspects, possible alternative clean energy options would include wind power, thermal power etc. Power import from neighbouring countries/island is not feasible as the project is located on an island. Wind power is also a source of clean energy which create or produce very less environmental degradation. However, the potentiality of wind power on large extent depends on the wind velocity which may not be available all the time. Installation of Offshore or Onshore Wind turbines has challenges pertaining to cost implications, ratio of wind power in lack of time series data of wind, lack of trained human resources and difficulty in intricate design of wind turbines. Thus, alternate renewable energy of wind power could not be an appropriate alternate for this project size.

6.6 Alternative Routes

No alternate route for the distribution routes were explored as the project coverage is small scale and therefore a 6.8 km single-phase low-voltage distribution network will connect all 167 potential users. It will be composed of sections of 600V to achieve cost efficiency while keeping voltage drop within acceptable values. 600V/230V step-up and down transformers will need to be installed. The remaining sections of the single-phase distribution network will be at 230V with all users being provided with a 230V single-phase connection.

6.7 Conclusion

Through the development of the proposed project, the increasing power demand of the country will be supported with sustainable approach which will in turn support the call for renewable energy alternatives worldwide to curb climate change. The proposal to generate electricity from alternative sources to feed the national grid are not economically justifiable as long as exploitable potential hydropower and solar power sources are available. This gives hydropower and solar power a potential edge over the other alternative technologies on the basis of economics and efficiency.

7.0 Environmental & Social Management and Monitoring Plan

7.1 Introduction

The Environment and Social Management and Monitoring Plan (ESMMP) intends to delineate management measures to minimize the impacts identified by allocating management responsibility for implementation of appropriate mitigation measures during construction and operation phase as depicted in the earlier section of the report.

The ESMMP is formulated to mitigate the adverse environmental and social impacts that have been delineated through the assessment of impacts and its significance. The ESMMP is aimed at managing and monitoring the environmental and social parameters in a sustainable manner. The ESMMP section is organized as follows,

- Implementation Arrangements: This subsection describes the process of implementation pertaining to activities both at the construction and operation phases;
- Organisational Structure: This section details the roles and responsibilities of PMU and Contractors relevant personnel who will be responsible in implementing the ESMMP;
- Environment and Social Management Plan: This section presents the Management Plan in line with the mitigation measures suggested to minimise the adverse impacts identified during the impact assessment. Additional management plans have also been provided to support the personnel onsite in managing the identified risk and impacts;
- Environment and Social Monitoring Plan: This section provides details of the locations, parameters and frequency of environment and social aspects;
- ESMMP Implementation Review Process: This section describes the requirement of periodic reviews and updation of ESMMP to address any new impacts due to change and modifications of the project;
- Documentation and Record Keeping: This section specifies the documentation and record keeping that needs to be maintained by the personnel onsite for E&S components.
- Budgetary Allocation for ESMMP Implementation: This section provides details of budget allocations for various mitigation measures proposed in the Report for the Project.

7.2 Organization Structure

An Organisational Structure has been established which provides a detailed overview of the monitoring and reporting mechanism from the Regional Hub to the Site and vice versa. The below figure presents the current Organisational Structure as would be followed for the Project,

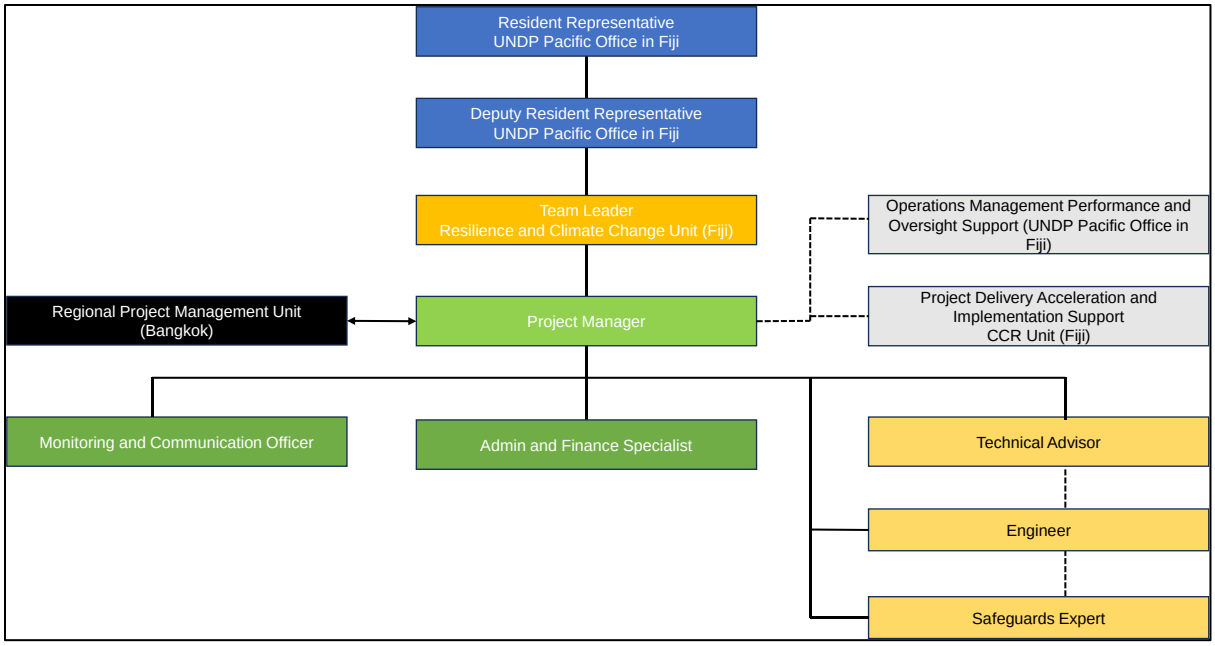


Figure 29: Project Organisational Structure

As noted from the Structure above, at the Regional level, a PMU is to be set up to oversee the project implementation on the ground and will support the Project Manager (PM) in the discharge of his/her responsibility. The PM is supported by the Operations Management Performance and Oversight Support comprising of the UNDP Fiji MCO and the Project Delivery Acceleration and Implementation support comprising of the CCR Unit in Fiji. The PM is also supported by the Monitoring and Communications Officer and Admin and Finance Specialist who are support by the Technical Advisor, Engineer and Safeguards Expert. The PM reports to the Team Leader of the Resilience and Climate Change office who in turn reports to the Deputy Resident Representative and Resident Representative.

Under the Project Manager, the Contractor team would be established and directly report to the PM. The Contractor team would comprise of skilled, semi-skilled and unskilled workers. It is pertinent to mention that the Contractor team would also include a Safety Officer who will be responsible for implementing the ESMMP at the site during construction phase of the project.

At the country level, Senior Management of the individual CO will set up a National Advisory Group to ensure coordination between various donor and government-funded projects and programmes at the national level and ensure that community and other relevant stakeholders are consulted and included in the decision making related to the project implementation and coordination at national and sub national levels. The National Advisory Group will include the direct beneficiaries, and the indirect beneficiaries, which include the communities at the sub national level, all of whom will derive benefit from an improved sustainable and climate resilient environment. The Beneficiary representatives' will be engaged in the decision making for the project and to ensure project results bring positive impact for the community and beneficiaries. The National Advisory Group Structure developed for Vanuatu has been presented below,

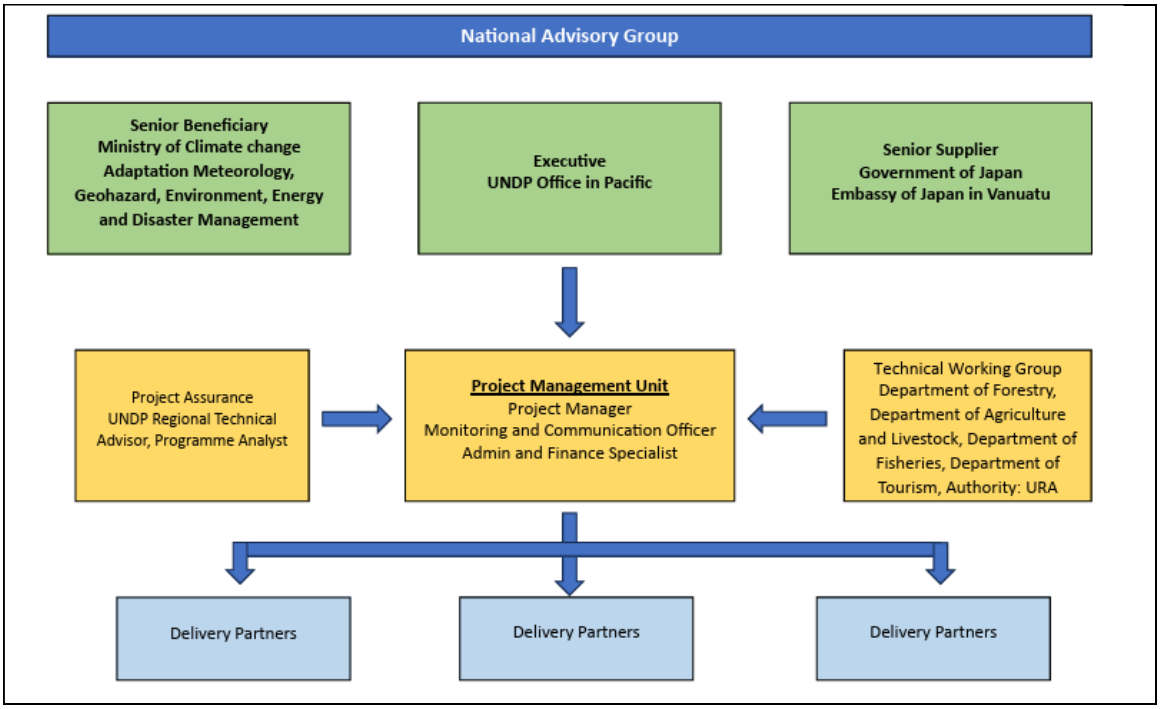


Figure 30: National Advisory Group Organisational Structure

7.3 Roles and Responsibilities

The following presents the roles and responsibilities of the various entities associated with the Project,

High-level oversight of the execution of the project by the Implementing Partner: The primary function of the Project Board includes annual (and as-needed) assessments of any major risks to the project, and decisions/agreements on any management actions or remedial measures to address them effectively. The Project Board shall be responsible for taking corrective action as needed to ensure the project achieves the desired results.

Approval of strategic project execution decisions of the Implementing Partner: Here the role of assessment and management of the risks, monitoring, and ensuring the overall achievement of projected results and impacts and ensure long term sustainability of project execution decisions of the Implementing Partner is provided.

The Project Board is to meet on an annual basis and its responsibilities include:

- Provide overall guidance and direction to the project, ensuring it remains within any specified constraints, and providing overall oversight of the project implementation.
- Review project performance based on monitoring, evaluation, and reporting, including progress reports, risk logs and the combined delivery report.
- In order to ensure UNDP's ultimate accountability, Project Board decisions are to be made in accordance with standards that ensure management for development results, best value money, fairness, integrity, transparency, and effective international competition.
- Responsible for making management decisions by consensus. In case, consensus cannot be reached within the Board, the UNDP representative on the Board, who is BRH Manager, will mediate to find consensus, and if this cannot be found, will take the final decision to ensure project implementation is not unduly delayed.
- Approve the Annual Work Plans (AWP) and Budgets and ensure the Project Manager's tolerances remain within the parameters outlined in the AWP and provide direction and advice for exceptional situations when the Project Manager's tolerances are exceeded.
- Advise on major and minor amendments to the project within the parameters set by UNDP and the donor.
- Provide high-level direction and recommendations to the PMU to ensure that deliverables are produced satisfactorily and according to plans.

- Review and advise on the Project Risk Register and risk management plans including SES that have implications on the project implementation.
- Provide guidance on evolving or materialized project risks and agree on possible mitigation and management actions to address specific risks.
- Address project-level grievances, if any, and follow up actions required.

Project Board will be chaired by the Executive, represented by UNDP Bangkok Regional Hub Manager. Senior Representatives from the Country Offices (Resident Representative or his/her delegate) represent Senior Beneficiaries in the Project Board. A representative of the Donor will serve in the Senior Supplier/Development Partner role.

Project Assurance: UNDP BRH Regional Programme Management Unit performs quality assurance and supports the Regional Project Board, by carrying out objective and independent project oversight and monitoring functions, including compliance with the risk management and social and environmental standards of UNDP. This role ensures appropriate project management milestones are completed, and conflict of interest issues are monitored and addressed. The project assurance function is independent of project execution. Each country office will provide project assurance for their respective country project under the direction of their respective Senior Management. A designated Programme/ M&E Officer in each Country Office will play the project assurance role in line with UNDP corporate rules and regulations. Each individual country office will follow similar structures of project QA.

The UNDP BPPS team on Nature, Climate, Energy and Waste (NCEW) provides technical quality assurance and strategic oversight of the project, in partnership with the Country Office Support and Quality Assurance (COSQA) team through the respective country desk officers. The Regional Project Management Team is to present key deliverables and documents to the Regional Project Board for review and approval, including progress reports, annual work plans, adjustments to tolerance levels and risk logs. BRH Regional Programme Management Unit will perform project assurance role for the regional activities and attend the joint Project Board meetings and support board processes as a non-voting representative.

Project Management: The Regional Project Management Team will consist of:

1) A Regional Project Manager, a Regional Communication and Knowledge Management Specialist, a Monitoring and Evaluation Analyst, and a Project Support and South-South Coordination Analyst, a Project Finance and Administrative Associate, and a Procurement Assistant who will based in UNDP Bangkok Regional Hub.
2) A Strategic Partnership and Communication Specialist will be based in UNDP Tokyo to ensure close coordination and timely response to Ministry of Foreign Affairs of Japan.
3) A Regional Procurement Specialist to be based in UNDP Papua New Guinea to ensure coordination for timely delivery of a procurement plan in all four countries
4) An Energy Policy Specialist to be based in UNDP Samoa MCO to further strengthen the green transformation policy in the energy sector in all four countries

The Regional Project Manager will be responsible for the overall day-to-day coordination of the regional component of the project and ensure thematic and sectoral synergies and coordination of programme activities across all four countries.

For the projects to be implemented in Vanuatu, the country will set up its Project Management Unit, to be led by Country Project Managers. The Project Managers will be responsible for the day-to-day management of the project, managing all project inputs, supervising project staff, responsible parties, consultants and sub-contractors as well as coordinate the procurement and in country coordination. The Project Manager will present key deliverables and documents to the National Advisory Group for their review for onward approval by the Regional Project Board, including progress reports, annual work plans, adjustments to tolerance levels and risk registers. With respect to the ESMMP, the PMU will be responsible for the following,

Prior to Construction

- Ensure that institutional/management support, human and financial resources are allocated to environmental and social safeguard activities in terms of supervision, compliance monitoring and submission of required reports.
- Ensure that the national regulations and adequate environmental flow is maintained in the stream for ecological purposes at all times.
- Ensure that the cost of environmental and social safeguard mitigation measures is included in bidding documents and contract.
- Ensure adequate budget for any plantation as directed by the Department of Environment, if any. .
- Conduct a pre-bid meeting with the Contractor to inform or brief them on relevant policies, standards and safeguard measures as outlined in the ESMMP, that must be incorporated into the Contractor's cost.
- After award of contract, conduct Contractor orientation on Environmental and Social Safeguard measures. During the orientation, topics such as relevant national laws and regulations, chance find procedure, GRM, Compliance with Permits, Contractor self-monitoring and reporting, and water testing to ensure safe drinking water for workers are covered.
- The Quality Control team is to conduct training for Contractor and PMU staff on Quality and Quality Assurance to ensure use of standard materials, construction quality, safety and compliance.
- Ensure project disclosure and information to all project stakeholders.
- Ensure that the GRM procedure is established with GRM committee members at all levels and information is disseminated to all stakeholders.

During Construction

- Institute protocols and requirements to be followed by the PMU and Contractor in case of pandemics such as COVID 19, in line with the National pandemic protocols and instructions issued by the Ministry of Health.
- Review PMU monitoring reports to ensure that all the statutory and regulatory requirements have been met and are in compliance with UNDP Principles and Standard requirements.
- Report any unanticipated impacts and submit an ESMP monitoring report to the donor as required.

Contractor

The Contractor will be responsible for all activities related to the construction of the project. With respect to the ESMP, the Contractor will be responsible for the following,

- Participate in pre-bid meetings and briefing/orientation on safeguard measures.
- Ensure an adequate budget is provisioned to ensure compliance with the ESMP.
- Abide by all relevant national laws and regulations and UNDP Principles and Standards requirements and obtain the necessary permits and clearances as required to implement the Project or construct worker camps, storage sheds and source the required electricity and water connections.
- Hire or designate a full-time Environment, Health and Safety (EHS)/Safety Officer responsible for compliance with the ESMP.
- Comply with the Terms and Conditions of the Permits and clearances.
- Comply with the Quality Control and Quality Assurance requirements of the contract.
- Prepare a worker's code of practice for workers and immediately resolve any conflicts between workers, or between workers and the community.
- Provide prior information to the community on the work schedule to minimize social issues during excavation.
- Undertake necessary corrective actions in case of damage or unanticipated impacts caused during the construction process.
- Ensure regular reporting to the PMU on work progress and alert management on any potential issues or delays.
- In case of pandemics such as COVID 19, follow the prevailing National Pandemic Protocols and instructions issued by the Ministry of Health and the Task Force, and immediately report to the PMU upon detection of positive cases among staff and workers.

Post Construction

The Contractor must:

- Dismantle site offices and worker camps (if any), fill in pit latrines and restore all modified areas after completion of the work.
- Remove all waste from the worksite and worker camps and dispose of these as per prevailing practices in the Local Community.

7.4 Documentation and Record Keeping

Documentation and record keeping system will be established to ensure updating and recording of requirements specified in ESMMP. Responsibilities will be assigned to relevant personnel for ensuring that the ESMMP documentation system is maintained, and that document control is ensured through access by and distribution to, identified personnel as following,

- Operation control procedures;
- Work instructions;
- Incident reports;
- Disaster preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports;
- Stakeholder Engagement records; and
- Complaints register and issues attended/closed.

7.5 Training

The following trainings are to be conducted for the Contractor once onboarded,

- Contractor orientation on Environmental and Social Safeguard measures related to topics such as relevant national laws and regulations, chance find procedure, GRM, Compliance with Permits, Contractor self-monitoring and reporting, Gender based Violence and Harassment (GBVH), Code of Conduct and water testing to ensure safe drinking water for workers are covered.
- Toolbox Talks to be undertaken before start of work each day
- Personnel Protective Equipment (PPE) Awareness and Training
- Waste Generation, Segregation, Storage and Disposal
- Occupational Health and Safety (OHS) related trainings
- Emergency Preparedness and Response etc.

7.6 Environment and Social Management and Monitoring Plan

The Environmental and Social Management and Monitoring Plan (ESMMP) lists out the mitigation measures and management strategies for construction and operation phases of the Project. Relevant management plans based on the impacts assessed have been developed as part of the ESMMP and included in the Annexure E of the Report.

The ESSMP covering various aspects of the construction and operation phase have been provided below,

Table 16: Environment and Social Management and Monitoring Plan (ESMMP)

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
Pre-Construction and Construction Phase					
1	Land Use	• Minimal impact due to project activities	• The usage of land to be restricted to areas identified/voluntary consented by the local community. • The land parcels wherein temporary usage is expected are to be returned to the landowners/community after proper treatment and rehabilitation. • Area to be cleared for the project activities are to be undertaken post receiving consent of the local community. • Information to be initiated onsite is to be shared with the stakeholders prior to start of the construction/installation works. • Monthly meetings to be held with the Chief council of the area to update on the works on ground to create sense of ownership amongst the community members and provide a platform to raise any concerns directly. • Chance Find Procedure to be implemented onsite by the Contractor.	PMU and Contractor	Monthly
2	Topography and Drainage	• Excavation works and earthworks leading to slight alteration of existing topography. • Project activities leading to slight change in slopes which might affect natural drainage patterns and risk of soil erosion.	• All unstable zones are to be avoided. • Drainage pattern areas are not to be disturbed during construction activities. • Identification of possible and active erosion areas to be undertaken within the project area. • To prevent soil erosion, measures such as soil stabilization, slope protection, vegetation restoration, and proper management of the construction process, including proper disposal of construction waste are to be implemented as and where required.	PMU and Contractor	Weekly

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			• Muck and debris to be backfilled to the extent possible. Excess muck if generated, is to be disposed off at a pre-identified site in consultation with the local authority/community. • Sand trap to be provided onsite by the Contractor wherein all run offs and other water sources are to be directed to for pretreatment before discharge in natural water bodies.		
3	Water Resources and Quality	• Wastewater generated through construction activities. • Sediment runoffs from construction activities. • Inadequate storage of fuel, oil etc. on site	• Sand trap to be provided onsite by the Contractor wherein all run offs and other water sources are to be directed to for pretreatment before discharge in natural water bodies. • All muck and debris generated to be used for back filling to the extent possible and excess muck to be disposed of at pre-identified muck dumping site. • Ensure that the muck dumping site (if required) is provided adequate protection so that it does not flow into the water stream. The muck disposal site will be treated with indigenous plant species once the construction works gets completed. • Storage area to be kept away from the water bodies to prevent any runoff into water bodies. • Regular collection of used oil and lubricants into drums/barrels to be done and stored in designated places within the project site with provisions of secondary containment, depending on the quantity onsite. • Waste Management Plan developed to be implemented on site by the Contractor for the use, storage and disposal of solid and hazardous waste materials.	PMU and Contractor	Weekly

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			• Provision of safe drinking water to be provided to all workers onsite for drinking water purposes. • Conduct water quality monitoring once during construction and once post construction of the river to assess the impact on the water quality of the river.		
4	Ambient Air Quality	• Construction activities leading to dust emissions and exhaust emissions from vehicles	• Regular use of dust suppression systems such as water sprinklers to reduce dust emissions during transportation, handling of construction materials and movement of vehicles. • Conduct air quality monitoring at the construction work areas against international standards once during construction and once post construction to assess the effectiveness of mitigation measures and take corrective actions if necessary. • Trucks to be covered during transportation of construction materials. • Review the maintenance of construction equipment prior to construction to minimize smoke in the exhaust emissions. An equipment maintenance register to be kept ensuring that construction equipment are maintained in order to minimize smoke and particulates in the exhaust emissions. • Diesel Generator (DG) set to be met through power supply. The DG set to be optimally operated and regularly maintained. Ensure adequate stack height is provided to the diesel generator as per regulatory requirements. • Reduce traffic speed on all unpaved surfaces to 15 km/hr or less to avoid dust emissions from vehicular movement.	PMU and Contractor	Weekly

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			• Sprinkle water on the area where excavation is done to settle down the particulate matter emissions.		
5	Ambient Noise Quality	• Noise generated through construction activities and vehicles	• Operation hours of construction activities to be restricted during nighttime. • Proper maintenance of construction equipment such as generator, compressor etc. to be undertaken to reduce noise emissions. • The Contractor to consider using low-noise construction equipment where feasible to minimize the noise generated during project activities. • Workers on the construction site to be provided with appropriate personal protective equipment such as ear plugs or muffs to protect their hearing. • Monitoring of noise levels to be undertaken once during construction work to ensure compliance with applicable noise standards and regulations. • PMU in collaboration with DoE to conduct public awareness campaigns to inform nearby residents about the construction schedule and the potential noise impacts.	PMU (& DoE) and Contractor	Weekly
6	Traffic and Transport	• Increase of vehicle movement leading to disruption of traffic and cases of road related hazards. • Damage of existing roads • No identified area for parking of vehicles	• Contractor to prepare a Traffic Management Plan outlining the construction schedule, transportation routes, and times when heavy vehicles can operate to minimize disruption and congestion on local roads. • Ensure that the existing road is maintained and repaired regularly to withstand heavy loads during construction. If necessary, upgradation of the roads to accommodate construction traffic might also be considered. • Designated parking areas to be assigned for construction vehicles to prevent	PMU and Contractor	Once in two weeks

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			vehicles from parking in unplanned areas and causing safety issues. • Skilled local drivers to be engaged for driving and all drivers to be provided with regular training. • Adequate signages to be placed at various locations along the road specifying the speed limits, active road crossing areas used by the local communities and at the road turnings. Speed of vehicles to be controlled in densely habited areas.		
7	Ecological Environment	• Minimal clearing of trees	• Complete ban on use of fuel wood by workers during the construction period. • Water quality control measures as provided in the above section to be implemented. • All construction areas to ensure mechanism for trapping silt and other construction waste from being disposed into the river. • Adequate permission/intimation of tree clearance/felling to be taken by Contractor from the Local Authority/Community and records of communication on the same to be maintained.	PMU and Contractor	Once in two weeks
8	Occupational Health and Safety	• Use of electrical equipment leading to shocks and burns • Welding activities leading to eye/retina damage and photo keratitis • Ergonomics injuries • Working at height • Respiratory diseases • Hearing damage • Other occupational hazards such as road accidents, negligent use of PPE	• The construction contractor and workers involved in the construction activities are to be trained/informed on the mandatory precaution and safety practices as defined in the Construction Safety Management Plan prior to commencement of construction activity. • Contractor to ensure that the Construction Safety Management Plan is implemented onsite. • Construction contractor is required to ensure necessary safety measures to be taken up before and during the	PMU and Contractor	Daily

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			construction activities for all electrically driven machinery. • Vehicle movements to follow the traffic norms and maintain a safe speed while moving through the hilly tracts. • Personal Protective Equipment (PPEs) e.g., helmets, safety belts, welding masks, shock resistant rubber gloves, shoes, other necessary protective gear etc.to be provided to workers handling welding, electricity and related components. • Safety harness and other fall protection measures are to be ensured for workers while working at height. • Periodic inspection of PPE to be done to ensure that they are in proper condition. A register for keeping records of such inspection shall be maintained. • Loading and unloading operation of equipment to be done under the supervision of a trained professional. • All excavation activities are to be conducted under the supervision of the Safety officer. • Proper signage to be provided in places of excavated areas. • Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks. Regular monitoring of the Fire extinguisher is to be done through inspection checklist. • An accident reporting and monitoring record should be maintained. The objective is to minimize such occurrences in the future and attain zero accidents. • Conducting a thorough risk assessment and providing training on handling		

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			hazardous materials and assigning necessary PPE to the workers. • Provide training on proper lifting techniques. • Provisions of first aid kits will be made in all active construction work areas with inventory of medicines available, expired medicines and medicines used is to be developed and recorded. In addition, emergency numbers to be displayed at all active work areas. • An ambulance/vehicle shall be kept standby to take the workers to the medical facility. • Ensure sign boards, safety signages and information on boards are also displayed in regional language. • Ensure hard barricading is installed at all active work sites. • Ensure all gas-cutting sets are provided with flashback arrestors at the torch and the cylinder ends. • Emergency Preparedness and Response Plan developed to be implemented at site by the Contractor. • All safety rules are to be enforced onsite with clear sanctions for repeat offenders. • Internal monthly audits to be undertaken by PMU of the Contractor and work activities undertaken onsite. In addition, monitoring and assurance by the Contractor to be done on a regular basis.		
9	Socio-Economic	• Voluntary Land Consent Land Owners	• Continuous stakeholder engagement activities to be undertaken with the land consent owners and land lessors (if any) to understand and resolve any grievances that might arise. Records of all engagements and grievances to be maintained by the Contractor.	Contractor and PMU	Monthly

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
			• Contractor to ensure that no issues pertaining to dust emissions, muck and wastewater overflow in adjoining land parcels, barrication etc. to be carried out for the communities residing within the vicinity of the construction activities (if any).		
10	Labour Related Aspects	• Engagement of local workforce	• Contractor to ensure that the Labour Management Plan as provided in the ESIA Report is to be implemented onsite. • Contractor to develop Code of Conduct for workers and communicate the same to all workers onsite. • All records as required for record inspection by PMU to be maintained by the Contractor onsite in auditable format. • Contractor to disseminate training on Grievance Redressal Mechanism to all workers onsite and regularly maintain the Grievance Log. • Contractor to ensure that all labour practices are implemented onsite based on the national regulations and best practices.	• PMU and Contractor	• Monthly
Operation Phase					
11	Water Resource and Quality	• Non-maintenance of Environmental flow of water in the river	• Ensure that adequate environmental flow is maintained in the river as mentioned in the DDR. • Six monthly testing of water quality by third party to be undertaken in first two years of operation and thereafter, an annual testing to be conducted.	• O&M Contractor, DOE	• Quarterly • Six Monthly for first two years and annually thereafter
12	Noise Quality	• Minimal Noise and vibration generated due to operation of the Plant	• Rehabilitation near the project features with indigenous species is to be planted as a noise barrier between the project areas and the surrounding areas.	• O&M Contractor, DOE	• Quarterly for first year and six monthly thereafter
13	Right of Way Maintenance	• Maintenance of ROW of transmission line might lead to marginal loss of tree cover	• Selective clearing of tall-growing tree species and encouragement of low-	• O&M Contractor, DOE	• Six monthly

S. No.	Aspects	Potential Impacts	Mitigation Measures	Responsibility	Monitoring
	including areas with PV Solar System installed	and limiting the regeneration of plant species	growing shrubs, herbs and grasses should be undertaken by the Operation and Maintenance team. • Vegetation maintenance should be kept limited to pruning and not to be removed completely. • Use of machinery for vegetation maintenance should be strictly avoided and it should be done manually as far as possible. • Use of herbicides to control fast-growing plant species within the ROW should be prohibited. Such species could be controlled through manual weeding.		
14	Health and Safety Hazards	• Transmission line mishaps	• Risks to general public during operation will be reduced by public awareness and education and physical measures by attaching an appropriate warning sign where required. • Once the stringing work is complete, notices and permanent anticlimbing devices are to be installed on the transmission poles. • The operational start date for electricity transmission and safety implications are to be publicized locally in advance	• O&M Contractor, DOE	• Six monthly

8.0 Stakeholder Engagement and Consultation

8.1 Introduction

Stakeholder consultations are an important process through which a two-way dialogue is created between the project proponent and the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/ or the ability to influence its outcome, either positively or negatively. This section of the report presents detail on stakeholder consultation undertaken by the UNDP Fiji CO and DoE both at present and during the Inception phase of the project.

A reconnaissance survey and consultation were undertaken by the DoE officials as part of BRANTV Project of the project affected population in the project area on 27th March 2019 as part of the baseline socio-economic survey (overall Project ESIA Report) and a follow up site visit on 22nd November 2023 to hold meetings with the project affected population and wider community to gather their views on the proposed project and note their concerns, if any. It is to be noted here that besides the attendance records of stakeholder consultation undertaken with Nambaranguit community in 2019, no records of the discussion were created. However, excerpts of the discussion held, or its outcome were retrieved from the BRANTV Project Report and presented in the relevant sections below.

8.2 Objectives and Scope

UNDP recognises the diverse and varied interests and expectations of project stakeholders and seeks to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the Project. The aim is to create an atmosphere of understanding that actively involves project-affected people and other stakeholders leading to improved decision making.

Overall, the objective and scope of Stakeholder Engagement is undertaken to,

- Develop a plan for stakeholder engagement, including information disclosure and consultation, throughout the project lifespan;
- Undertake Stakeholder identification and analysis associated with the Project;
- Plan engagement modalities through effective communication, consultations and disclosure;
- Provide enabling platforms for influencing decisions;
- Define roles and responsibilities for the implementation of the Stakeholder Engagement process;
- Define reporting and monitoring measures to ensure the effectiveness of the as part of development of Stakeholder Engagement Plan (SEP) and periodical reviews of the SEP based on findings;
- Elaborate on the Project Grievance Redress Mechanism (GRM).

8.3 Engagement Mapping and Analysis

The stakeholders in the project were identified based on their level of interest and influence over the project activities. The stakeholders were primarily divided into direct and indirect and further regrouped as internal and external. In the table below, the types of stakeholders as per their level of interest and influence have been provided,

Table 17: Types of Stakeholders as per their interest and influence

S. No.	Type of Stakeholders	Descriptions	Groups + Individuals
1	Direct/Internal Stakeholders	Direct internal stakeholders comprise the project proponent and the staff of the proponent that are directly controlled by the proponent.	• Project Management Unit (PMU) • UNDP Fiji MCO • UNDP BRH Nature, Climate, Energy and Waste (NCEW)

S. No.	Type of Stakeholders	Descriptions	Groups + Individuals
2	Indirect/External Stakeholders	Indirect external stakeholders comprise the project affected people/families, contractors, supply chain and financial intermediary who are indirectly affected by the project activities but are not directly controlled by the project proponent.	• Project Affected Persons /Families (Landowners) • Department of Energy • Department of Water Resources • Financial Intermediary • Contractors • Vendors • National Advisory Group • Local Community residing in Nambaranguit village. • Opinion Leaders of Nambaranguit village • Local Government Institutions • Department of Environment, Protection & Conservation • Local Media

Stakeholder Analysis

Stakeholder analysis takes a more comprehensive view of the stakeholder's group interests, how they would be affected and to what extent and influence they could have on the project. These aspects cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified in the previous section have been categorised into four major groups: Government Agencies, Positively Influenced Stakeholders, Critical to Engage and Donors. The categorisation list of key stakeholders has been provided in the following Table,

Table 18: Categorisation List of Key Stakeholders

Categorisation	Key Stakeholders
Government Agencies	• Department of Energy • Department of Water Resources • Department of Environment, Protection& Conservation
Positively Influenced Stakeholders	• Project Affected Persons /Families (Landowners) • PMU • UNDP Fiji MCO • UNDP BRH Nature, Climate, Energy and Waste (NCEW) • Contractors • Vendors • Local Community residing in Nambaranguit village.
Critical to Engage	• Opinion Leaders of local community • National Advisory Group • Local Government Institutions • Local Media
Donors	• Financial Intermediary

Summary of Consultations undertaken

As part of the ESIA undertaken for the overall Project by Department of Energy under the BRANTV project in 2019, stakeholder consultation with Project Affected Communities was conducted in line with the requirement of

Free Prior Informed Consent (FPIC) as provided in UNDP Standard 6 on Indigenous People. During the consultations undertaken, the following aspects were covered,

- Informing the community about the project and its activities including general walk through of the project area to assess the physical characterisation of the environment and socio-economic setting of the area and conduct informal discussions with households in the vicinity of the proposed sites.
- Seeking consent from the community and discuss any concerns that the community might have. A certification form was signed by the community chief and leaders demonstrating their consent of understanding the project details and risks and impacts that might emerge including mitigation measures that would be proposed to minimise/mitigate the risks and impacts.

A total of 12 individuals comprising of 7 males and 5 females belonging to the Nambaranguit community participated in the consultation process. The attendance list of the participants that were consulted during the engagement process has been provided in Annexure A of the report.

In addition, to the above consultations, M/s Trama Tecnoambiental, S.L. (TTA) engaged as the Consultant to develop the Detailed Designed Report of the Project area in Nambaranguit by the Ministry of Climate Change & Adaptation, Department of Energy under the BRANTV Project in June 2023 undertook a socio-economic baseline profiling of the Nambaranguit community such as water source, availability of land, waterflow, penstock, powerhouse, headworks, distribution network, simulation study, solar PV system etc. wherein discussions were undertaken with stakeholders (local community, Department of Water Resources) were also held. The following summarises the discussion held during the consultation,

Table 19: Summary of Consultation undertaken during the Detailed Design Report Stage

S. No.	Discussion Points	Responses Received
1	Water Source	• Two water sources were identified where the first source was close to the community and the second source was adjacent to the first source. • The land around the source, potential intake, and powerhouse belong to the two landowners. The area was earlier used by the community for farming and gardening purposes which has been discontinued. • There is no conservation, historical/tabu sites around the water source. • The community reported that the first water source tends to dry up during the dry season. However, the second source does not dry up even during a long dry season. • The Department of Water was consulted to check if they have historical water flow records, but no records of this source are taken. • This location is free from flooding and landslide even during the rainy season, as reported by the community. • No signs of flooding or landslide were found at the site.
2	Community Water Supply	• The second source comes from a natural spring that flows from under a rock and flows naturally into two different paths ending in two small water intakes built by the community. • The community reported that the first water source tends to dry up during the dry season. However, the second source does not dry up even during a long dry season. • Potential water use conflict with community is expected to be low.

3	Socio-Economic Profile	• The total number of potential end-users mapped in Nambaranguit community is 167.
		• Below is the statistics of what was collected during the visit (GPS mapping) for Nambaranguit village:
		  ○ Total HH End Users for Nambaranguit village: 27
		  ○ Total HH End Users from nearby communities: 114
		  ○ Total BB End Users for Nambaranguit village: 3
		  ○ Total BB End Users from nearby communities: 9
		  ○ Total II End Users for Nambaranguit village: 7
		  ○ Total II End Users from nearby communities: 7

S. No.	Discussion Points	Responses Received
		• The main source of income for these communities is predominantly farming and selling kava and other root crops. • The average monthly income per HH is around VT 9,700 which is considerably lower than the average income of other communities on the Island.

Further to the above consultations, UNDP Fiji MCO in collaboration with the DoE undertook another round of consultations with the local communities from 22nd November 2023 as part of the ESIA study wherein 25 individuals comprising of 12 males and 13 females' participants attended. Summary of the consultation has been detailed below,

Table 20: Summary of Consultation undertaken as part of the ESIA study

S. No	Questions	Responses
1.	Awareness of the proposed project coming in the area and through whom this information was communicated. Please provide details.	Some of the participants communicated that they were aware of the proposed project as it was communicated as part of Detailed Designed phase in 2022 while some communicated that they gained awareness during 2021 as part of the BRANTV project.
2.	Has the Community provided their Consent for the proposed project? If yes, please provide details on date and discussion held?	The participants reported that the Community had already provided consent to the proposed project in 2021.
3.	Are the community members aware of the Project features and what is proposed to be developed in the area?	The participants mentioned that the Community members are aware of the project features and development.
4.	Are there any concerns among the community members regarding the proposed project? If yes, please provide details.	The community members reported that they were concerned about the system safety, billing aspect when the project becomes operational, cyclone damage and noise pollution related aspects. More clarity on these aspects will need to be communicated to the community during regular stakeholder consultation exercise by the PMU and DoE.
5.	Are the community members aware that if they have any concerns, who to approach in the village for seeking a resolution?	The community members provided their affirmation that in case of any concerns, they are aware of who to approach.
6.	What is the expectation of the community with the coming of the proposed project?	• The hybrid project will be a reliable source of energy. • The project will help in increasing the revenue of the community • The project will help in increasing the quality of health and educational facilities within the community.
7.	How will the project benefit the local community? Please provide details.	• The project will help increase the health facilities in the community. • The project will help bring more business development to the community, thus, leading to an increase in living standards. • The project will help increase the education facilities in the community.

Details of consultation undertaken with the community with the attendance sheet of participants can be viewed from Annexure B of the Report.

In addition, consultation was also undertaken with the Community Leaders of Nambaranguit village wherein information was sought pertaining to the socio-economic profile of the community, consultations undertaken in the past including voluntary land consent, concerns and expectation of the community. It was concluded that the Community Leader did not have any concern related to the Project and consultation activities amongst the communities were undertaken on frequent intervals between 2021 – 2023. Details of the consultations undertaken with Community Leader can be found in Annexure C of the Report.

Additionally, Voluntary Land Consent forms providing consent from three (03) individuals were filled and signed consenting to voluntarily provide their land to the project for both the construction and operation phase. The filled Voluntary Consent Forms have been added to Annexure D of the Report.

Photograph 4: Consultation undertaken with local community of Nambaranguit in November 2023

9.0 Conclusion and Recommendation

Based on the assessment undertaken, there are potential marginal social or environmental impacts present due to the project activities which are largely reversible and can be addressed through relevant mitigation measures as provided in the ESMMP.

The ESIA report has assessed the overall environmental and social impacts that are likely to arise as a result of Construction and Operation phases of the project. The project will result in minimal adverse environmental and social impacts requiring implementation of suggested mitigation measures. Mitigation measures for potential impacts on Air, Water, Land, Noise, Traffic, Ecology, and Socioeconomics have been specified through proper planning and designing including follow up of best practices. The ESMP provided in the report describes the implementation mechanism for recommended mitigation measures together with post project monitoring to verify overall project performance. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help the Project Team in complying with the environmental and social standards, as part of national regulatory and UNDP SES requirements.

Annexure A: Signature List of Consultation Participants undertaken in 2019 under BRANTV Project

Environmental and Social Impact Assessment (ESIA) Community Consultation

Attendance Lists

Community/Village: Nambwaramgiut

Venue: _____ Date: 29/03/19

NAME	RESPONSIBILITY	CONTACT	SIGNATURE
NELSON James	Carpentry	5950557	
MAHURI C.	Gardener	5910564	
DANIEL TEVI	Gardener	5324578	
MARTIN TIAS	Chief	5411890	
TONNY TEVI	CHAIRMAN WARD COUNCIL	5304176	
RENE TIAS	CARPENTRY	5497287	
Fr. Basil Tabe	Priest	5959989	
Serah Tabe	Gardener	5959988	
Harriet James	Gardener	595059	
Mary Balai	Gardener	5411890	
Harrison Ioli	Gardener	5304116	
Adaign. Mahuri	Gadener	5910564	

Annexure B: Consultations undertaken with Nambaranguit Community in 2023 and Signature List

Consultation with Community

First Name: NAMBARANGUIT & ABATUNVUTN, VANTAVNAT Surname: ______ Title: ______

Contact Details:

Mobile Number ______ Email Addresses: ______ Social Media Name (Facebook/Messenger): ______

S. No	Questions	Responses
1.	Name of Village: NAMBARAGUIT & ABATUNVATU Province: PENAMA Island region: PENTECOST.	
2.	Awareness of the proposed project coming in the area and through whom this information was communicated. Please provide details.	Yes. Awareness were made by Department of Energy.
3.	Has the Community provided their Consent for the proposed project? If yes, please provide details on date and discussion held?	Yes. The Community has signed in the BRANTV project consent form. They now agree signed on form
4.	Are the community members aware of the Project features and what is proposed to be developed in the area?	Yes. With the BRANTV awareness, the community are aware of the project features.
5.	Are there any concerns among the community members regarding the proposed project? If yes, please provide details.	* System Safety * billing of system tariff. * Cyclone damage.
6.	Are the community members aware that if they have any concerns, who to approach in the village for seeking a resolution?	* Yes, the communities are aware of whom to approach if they have concerns.
7.	What is the expectation of the community with the coming of the proposed project?	* Reliable Energy Source * Increase standard of living of communities. * Reduce the use of fuel in the community.
8.	How will the project benefit the local community? Please provide details.	* Make life of communities much easier. * Make/encourage more business activities. * Increase Health facilities e.g. existing dispensary * Improve sanitation and Hygiene. * Increase learning of School kids/students.

Date: 22/11/2023

Name and Signature of Interviewer: Joel Kaleb, [signature]

Community NAMBARAN BLOCK

Attendance (Signature) List

S. No	Name of Participant	Gender	Address and Contact Number	Signature	Date
1.	Eddington Tias	M	Nambwaranuit (525840		22/11/23
2	Devina Tabi	F	Avantavoa 5378888		22/11/25
3	Harrison Loli	F	Nambwaran		22/11/25
4	Wickliff B	M	Nambw aranuit		22/11/25
5	Rene Tias	M	Nambwaranuit		22/11/23
6	Ellenor Tevi	F	Nambwaranuit		22/11/23
7	Adalin Daro	F	Nambwaranuit	Daro.	22/11/23
8	Mary Bale i	F	Nabwaranuit	M.B	22/11/23
9	Linet Loli	F	Nabwaranuit	L.L	22/11/23
10	Harriet James	F	Nambwaranuit	H. James	22/11/23
11	Alice loli	F	Nambwaranuit	A L	22/11/23
12	Dyson Tive	M	Nambwaranuit		22/11/23
13	MAKIN tamata	M	ABWatanvutu		2/11/23
14	Danny Tevi	M.	Nambwaranuit		22/11/23

Community _____

Attendance (Signature) List

S. No	Name of Participant	Gender	Address and Contact Number	Signature	Date
	Valorina Shem	F	Abwatanvutu	Shem	22/11/023
	Grace Tamata	F	Abwatanvutu	G.T.	22/11/023
	Rachel Gavo	F	Abwatanvutu	R.G	22/11/023
	CHRISTOVA	M	Nambwaranguit		22/11/023
	BETSY Tovo	F	Avantavoa	Bovo	22/11/23
	Joclyn muhike	F	Lambwatmale	Jlyn	22/11/23
	Roy Brown	M	LoL Toie	Brown	22/11/23
	Manuel Siba	M	Buatitavoa		22/11/23
	Firda Sese	M	Lambwatmale		22/11/23
	William George	M	lol Toi .		22/11/023
	ABLE - TAHI	M	VAN TAVOA	T.	22/11/023

Annexure C: Consultation Undertaken with Community Leaders in 2023 and Signature List

Consultation with Community Leader

Date: ______________________

First Name: ______________________ Surname: ______________________ Title: ______________________

Contact Details:

Mobile Number ______________________ Email Addresses: ______________________ Social Media Name (Facebook/Messenger): ______________________

S. No	Questions	Response
1.	Name of the respondent: Name of Village: NAMBANGARIUT (VANTAUDA) Island Region: PENTECOST Province Name: PENAMA	
2.	Position held in the community and for how many years?	
3.	Name of the villages (falling within 02 km of the project area) including beneficiary villages	Name (ONER, BATMAUHELI, INTELI, BATITAVDA, LOTEL, BERU, LOLBATNIU) All under VANTAUDA
4.	Awareness of the proposed project and consultations happened in the past (mention date of last consultation)	Yes, 2021
5.	Has the Community provided consent to the proposed project? If yes, please provide date.	Yes under BRANTV.
6.	Is the land area for the Project privately owned or community owned? Please provide details.	Community land. Customary land. They agree to have the project

1

S. No	Questions	Response
	Has the Voluntary Land Consent Form been filled in and signed? If yes, please provide date. If no, sign now	Yes. 2021, 1st Pre-liminary Assessment
7.	Do any of the Project Area displace any local community members physically or economically? If yes, please provide details of who and land use pattern of the area.	They agree to have the (transmission / distribution lines) through their land / properties.
8.	Population Details (total including male and female break-up) of the villages falling in project beneficiary village	Pop: > 100 HH: 20 / VANTAUDA: Pop: + 200 HH: > 40
9.	Social Group of Population (indigenous and other population break-up (male and female break-up), language group (% of population speaking the language), religion followed (% of population practicing the various religion)	Male 50% Female 50% | Language one (Hano) Religion: Anglican: 55, NTM: 10, SDA: 20, Pentecostal: 10
10.	Are the indigenous institutions/authorities officially recognized by the Government?	Yes - chiefs recognised by VCC.
11.	Literacy Level (total including male and female break-up) within the community (beneficiary village)	95 % literacy rate.
12.	Type of education qualification attained (total including male and female break-up) within the community (primary, middle school, secondary and/or higher secondary)	Primary: 80% Secondary: 70% Tertiary: 25%
13.	Employment status of the area (how much is employed within the village and how much are migrated to another site/island). Is the migration seasonal or permanent? Please provide details on this and which area the population migrates to and for what purpose.	Substance Farmers. Kava farmers. > 20 RSE/SWP. Vila → > 50 Santo → > 20
14.	Occupation and income level (total including male and female break-up) of the village. Please provide details on type of occupation. (If in case of agriculture, please mention what crops are cultivated)	- farming (substance farming) - fishermen: > 20 - local root crops (all) - Kava. - forest trees / sandle wood.

2

S. No	Questions	Response
15.	Any disease which is common in the area?	Cold/flue. High Blood Pressure. / Diabetics.
16.	Transportation facilities available in the area.	Road available: only 3 vehicles operating. dirt road. not gravelled.
17.	Drinking Water Facilities, Sanitation Facilities and Electricity (source), cooking fuel availability	Safe network: - Vanta Vue - no water. - No electrical appliances.
18.	Medical facilities available in the area	Dispensary: 1 Registered Nurse.
19.	Educational facilities available in the area	1 Primary School (Anglican: class (1-6). Kindy - Vantavue.
20.	Any main waterbodies within 02 km range from the project area and how the community is dependent on the water stream (source) for the Pico Hydro.	Trial fish pond: no longer working.
21.	Land Holding Pattern of the village	customary land, North Pentecost: Daman/matrilineal system.
22.	Any attachment to the land in the village in terms of customary practices, ancestral rights etc.	Matrilineal system (custom).
23.	Any dependency on natural resources by the local population? If yes, please provide details. Do these areas fall near the selected project sites.	Kava, & Taro - main source of income. / Buluk / Pig/ chicken.
24.	Are any of the land area selected for the project features fall within the customary land/forested land? If yes, please provide details (of land area and what type of land)	Yes through family land boundary.

3

S. No	Questions	Response
25.	Land use pattern of the project area (including penstock and transmission line alignment) (Please specify whether forest, agriculture, barren land, water bodies etc).	Farm land (agriculture) Taro - planting.
26.	Will the proposed project pose any restriction on accessibility to the local community in case of pathway to the natural or customary land?	community leaders Agree for area (land) to access transmission & distribution lines.
27.	Accessibility via project area or any restriction on movement to own land/house.	
28.	Are there any other developmental project that have come up near the identified project area? If yes, please provide details	Community (to built) a market house.
29.	Is there any other developmental project that are proposed to come near the identified project area? If yes, please provide details.	None.
30.	Are there any signs of air, noise or water pollution near the proposed project area? If yes, please provide details of source of pollution and for how many years these signs were noted? Also, any measures undertaken by the Government to mitigate this issue? Please elaborate	None. / No environmental concerns.
31.	Any governmental schemes, NGO work etc. undertaken in the project area? If yes, please provide details.	ADRA - WASH - 10yrs ago.
32.	Are any community members dependent on the stream (to be used for pico hydro) for fishing or other purposes. If yes, please provide details.	None.

4

S. No	Questions	Response
33.	Are there any major natural disasters such as cyclone, earthquake, wildfire, flood etc that have occurred in past 20 years? If yes, please provide details.	Recent TC - Lola, and 3 yrs ago TC. Harold 2020, 2023.
34.	Is there any change in the rainfall pattern in past 10 years? If yes, please provide details.	No longer experience heavy rainfall 20-30 yrs ago. creek's all blocked up. dry up.
35.	Is the upcoming project beneficial for the community and for their development? If yes, please provide details.	Yes, water / light, / own business / commercial stores / [illegible] sewing / cooking machine.
36.	Are there any concerns from the local community relating to the upcoming project? If yes, please provide details.	- social issues, noise pollution. / young generation spend time on electronic gadgets.

Date: 22 / Nov / 2023

Interviewer Name and Signature: Donald. Woulseja [signature]

Name:	Title:	Signature:	Date:
①. Roy brown	ELDER : > 20yr	[signature]	22/nov/2023
②. Jocylyn Vara	women's leader > 20yr	[signature]	22/nov/2023
③. Manuel Siba	Priest 4yr	Siba	22/nov/2023
④. Christover Towoa	youth leader 1yr	[signature]	22/nov/2023
⑤. Harison Loli	Women's leader 2yr -	Loli	22/nov/2023

5

Consultation with Community Leader

Date: _____

First Name: _____ Surname: _____ Title: _____

Contact Details:

Mobile Number _____ Email Addresses: _____ Social Media Name (Facebook/Messenger): _____

S. No	Questions	Response
1.	Name of the respondent: Name of Village: NAMBANGELMT (COVER ABATONUTH). Island Region: PENTECOST (NORTH) Province Name: PENAMA	
2.	Position held in the community and for how many years?	Male rep → 2 yrs Youth rep → 2 yrs women rep → 1 yr
3.	Name of the villages (falling within 02 km of the project area) including beneficiary villages	Nambangelmt Vantzolen
4.	Awareness of the proposed project and consultations happened in the past (mention date of last consultation)	Yes 2022 (Detail Design Mission)
5.	Has the Community provided consent to the proposed project? If yes, please provide date.	NO consent to be signed in this consultation
6.	Is the land area for the Project privately owned or community owned? Please provide details.	Land owned by tribe

1

S. No	Questions	Response
	Has the Voluntary Land Consent Form been filled in and signed? If yes, please provide date. If no, sign now	NO
7.	Do any of the Project Area displace any local community members physically or economically? If yes, please provide details of who and land use pattern of the area.	NO
8.	Population Details (total including male and female break-up) of the villages falling in project beneficiary village	250 Population
9.	Social Group of Population (indigenous and other population break-up (male and female break-up), language group (% of population speaking the language), religion followed (% of population practicing the various religion)	40% - Male 60% - Female Anglican, Presbyterial, Worts Fellowship
10.	Are the indigenous institutions/authorities officially recognized by the Government?	Yes
11.	Literacy Level (total including male and female break-up) within the community (beneficiary village)	70%
12.	Type of education qualification attained (total including male and female break-up) within the community (primary, middle school, secondary and/or higher secondary)	All children attended Primary education Absout 70% continue to Secondary & 40% to higher education
13.	Employment status of the area (how much is employed within the village and how much are migrated to another site/island). Is the migration seasonal or permanent? Please provide details on this and which area the population migrates to and for what purpose.	Absout 30-40 reside at Port Vila & Luganville - occupation/education Purposes
14.	Occupation and Income level (total including male and female break-up) of the village. Please provide details on type of occupation. (if in case of agriculture, please mention what crops are cultivated)	10,000 - 20,000/month Agriculture - Taro, banana, kumala, cabbage, Manioc, etc..

2

S. No	Questions	Response
15.	Any disease which is common in the area?	→ Diabetes → Flu → High blood pressure
16.	Transportation facilities available in the area.	→ Truck → Boat
17.	Drinking Water Facilities, Sanitation Facilities and Electricity (source), cooking fuel availability	→ water supply → Solar + Generator
18.	Medical facilities available in the area	→ yes, Tuaran dispensary
19.	Educational facilities available in the area	→ Kindy @ Abinatenvuty → Primary @ Nambarangout
20.	Any main waterbodies within 02 km range from the project area and how the community is dependent on the water stream (source) for the Pico Hydro.	3 water source community doesn't depend on hydro water source.
21.	Land Holding Pattern of the village	Land owned by tribes
22.	Any attachment to the land in the village in terms of customary practices, ancestral rights etc.	
23.	Any dependency on natural resources by the local population? If yes, please provide details. Do these areas fall near the selected project sites.	Water resource
24.	Are any of the land area selected for the project features fall within the customary land/forested land? If yes, please provide details (of land area and what type of land)	NO only conservation area that is located out of the project area.

S. No	Questions	Response
25.	Land use pattern of the project area (including penstock and transmission line alignment) (Please specify whether forest, agriculture, barren land, water bodies etc).	Forest, secondary Forest. Agriculture
26.	Will the proposed project pose any restriction on accessibility to the local community in case of pathway to the natural or customary land?	No
27.	Accessibility via project area or any restriction on movement to own land/house.	No
28.	Are there any other developmental project that have come up near the identified project area? If yes, please provide details	No.
29.	Is there any other developmental project that are proposed to come near the identified project area? If yes, please provide details	NO
30.	Are there any signs of air, noise or water pollution near the proposed project area? If yes, please provide details of source of pollution and for how many years these signs were noted? Also, any measures undertaken by the Government to mitigate this issue? Please elaborate.	No
31.	Any governmental schemes, NGO work etc. undertaken in the project area? If yes, please provide details.	No
32.	Are any community members dependent on the stream (to be used for pico hydro) for fishing or other purposes. If yes, please provide details.	No

S. No	Questions	Response
33.	Are there any major natural disasters such as: cyclone, earthquake, wildfire, flood etc that have occurred in past 20 years? If yes, please provide details.	No flood Cat 4-5 cyclones
34.	Is there any change in the rainfall pattern in past 10 years? If yes, please provide details.	No major changes
35.	Is the upcoming project beneficial for the community and for their development? If yes, please provide details.	Yes, improve living standards, improve health facilities, better education
36.	Are there any concerns from the local community relating to the upcoming project? If yes, please provide details.	No

Date: 22 | Nov | 2023

Interviewer Name and Signature: Donald. Waqaseja

Name : Title : Signature : Date.

1. MAXIM tamata — Men's rep
2. Valorina Sham — Women's rep
3. Grace Tamata. — Youth rep

Sham

GT.

5

Annexure D: Filled Voluntary Consent Forms

C. Voluntary Land Consent Form

(Voluntary Donation)

Date: 22/11/2023

I/We: Dexter Bule **male household head**__________**female household head,**

AND/OR person exercising custom over the affected land

Volvoloana **of the tribe** Bule

Resident/s of Namburwangut **Village on** Pentecost **Island in** Penama **province,**

Declare that I/We/the group is voluntarily donating the use of the specific (area/land, assets, location, size, type of support etc)

Yes, agree on construction & operation of project. Also agree for easement of unlimited area of land as long as it is used efficiently for the project.

For the purpose of: (specify activity)

Mini hydro power plant & grid network

For the duration of: (specify commencement date and duration)

4 Months Construction & 20 years + of operation

Of My/Our own free will, I/We are waiving My/Our right to compensation of any kind for the specified duration of the activity mentioned above.

Signed:

Male household head__________ **Female household head**__________

Person exercising Custom (Kastom Chief) [signature]

D. Certification

I/We certify that I/we have thoroughly examined all the potential adverse effects of this project type. To the best of our knowledge, the project demo implementation plans and associated planning reports (e.g. EMP, IPP), if any, will be adequate to avoid or minimize all adverse environmental and social impacts.

Community representatives (signatures);

Representative (1):

Name: Dexter Bule *Position:* Bule Rep

Signature: __________ *Date:* 22/11/023

Contact: 5463501

Representative (2):

Name: __________ *Position:* __________

Signature: __________ *Date:* __________

Contact: __________

Representative (3):

Name: __________ *Position:* __________

Signature: __________ *Date:* __________

Contact: __________

Project/Department representative (signature):

Name: Joseph Temalan *Position:* PSO-UE

Signature: [signature] *Date:* 22/11/2023

Contact: 5380557

C. Voluntary Land Consent Form

(Voluntary Donation)

Date: 22/11/2023

I/We: Clifford Mahuri **male household head** _____ **female household head,**

AND/OR person exercising custom over the affected land
Volvolcanu **of the tribe** Bule

Resident/s of La Malsangul **Village on** Pentecost **Island in** Penama **province,**

Declare that I/We/the group is voluntarily donating the use of the specific (area/land, assets, location, size, type of support etc)
Yes, agree on construction & operation of project. Also agree on easement of unlimited area of land as long as it is used efficiently for the project

For the purpose of: (specify activity)
Micro - hydro / solar hybrid Minigrid

For the duration of: (specify commencement date and duration)
4 months Construction & 20 years + of operation

Of My/Our own free will, I/We are waiving My/Our right to compensation of any kind for the specified duration of the activity mentioned above.

Signed:

Male household head_____ **Female household head**_____

Person exercising Custom (Kastom Chief) _____

D. Certification

I/We certify that I/we have thoroughly examined all the potential adverse effects of this project type. To the best of our knowledge, the project demo implementation plans and associated planning reports (e.g. EMP, IPP), if any, will be adequate to avoid or minimize all adverse environmental and social impacts.

Community representatives (signatures);

Representative (1):

Name: Clifford mahuri *Position:* BULE (Rep) (La Malsangul)

Signature: _____ *Date:* 22/11/2023

Contact: 5292817

Representative (2):

Name: _____ *Position:* _____

Signature: _____ *Date:* _____

Contact: _____

Representative (3):

Name: _____ *Position:* _____

Signature: _____ *Date:* _____

Contact: _____

Project/Department representative (signature):

Name: _____ *Position:* _____

Signature: _____ *Date:* _____

Contact: _____

C. Voluntary Land Consent Form

(Voluntary Donation)

Date: 22/11/2023

I/We: Alfred Tabi male household head_____female household head,

AND/OR person exercising custom over the affected land

Lol Kasae of the tribe Tabi

Resident/s of Abatun Vutu Village on Pentecost Island Island in Penama province,

Declare that I/We/the group is voluntarily donating the use of the specific (area/land, assets, location, size, type of support etc)

Yes, agree on construction & operation of project. Also agree on easement of uninterrupted use of land as long as it is used efficiently for the project.

For the purpose of: (specify activity)

Mini hydro power plant & grid network & Solar hybrid

For the duration of: (specify commencement date and duration)

4 months construction & 20 years + of operation

Of My/Our own free will, I/We are waiving My/Our right to compensation of any kind for the specified duration of the activity mentioned above.

Signed:

Male household head_____ Female household head_____

Person exercising Custom (Kastom Chief) _____

D. Certification

I/We certify that I/we have thoroughly examined all the potential adverse effects of this project type. To the best of our knowledge, the project demo implementation plans and associated planning reports (e.g. EMP, IPP), if any, will be adequate to avoid or minimize all adverse environmental and social impacts.

Community representatives (signatures);

Representative (1):

Name: Tevi' Alfred *Position:* Tabi Rep Lol Kasae

Signature: _____ *Date:* 22/11/2023

Contact: 5399914

Representative (2):

Name: _____ *Position:* _____

Signature: _____ *Date:* _____

Contact: _____

Representative (3):

Name: _____ *Position:* _____

Signature: _____ *Date:* _____

Contact: _____

Project/Department representative (signature):

Name: Joseph Tevalor *Position:* PSO-UE

Signature: _____ *Date:* 22/11/2023

Contact: 5380557

Annexure E: Management Plans

Stakeholder Engagement Plan (SEP)

The SEP defines a structured, purposeful and culturally appropriate approach to consultation and disclosure of information, in accordance with UNDP Principle 5 on Accountability. UNDP recognises the diverse and varied interests and expectations of project stakeholders and seeks to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the Project. The aim is to create an atmosphere of understanding that actively involves project-affected people and other stakeholders leading to improved decision making.

Overall, this SEP will serve the following purposes:

- Define a plan for stakeholder engagement, including information disclosure and consultation, throughout the project lifespan;
- Stakeholder identification and analysis;
- Planning engagement modalities through effective communication, consultations and disclosure;
- Provide enabling platforms for influencing decisions;
- Define roles and responsibilities for the implementation of the SEP;
- Define reporting and monitoring measures to ensure the effectiveness of the SEP and periodical reviews of the SEP based on findings;
- Elaborate on the Project Grievance Redress Mechanism (GRM).

Stakeholder Mapping and Analysis

The stakeholders in the project were identified based on their level of interest and influence over the project activities. The stakeholders were primarily divided into direct and indirect and further regrouped as internal and external. In the table below, the types of stakeholders as per their level of interest and influence have been provided,

Table 21: Types of Stakeholders as per their interest and influence

S. No.	Type of Stakeholders	Descriptions	Groups + Individuals
1	Direct/Internal Stakeholders	Direct internal stakeholders comprise the project proponent and the staff of the proponent that are directly controlled by the proponent.	• Project Management Unit (PMU) • UNDP Fiji MCO • UNDP BRH Nature, Climate, Energy and Waste (NCEW)
2	Indirect/External Stakeholders	Indirect external stakeholders comprise the project affected people/families, contractors, supply chain and financial intermediary who are indirectly affected by the project activities but are not directly controlled by the project proponent.	• Project Affected Persons /Families (Landowners) • Department of Energy • Department of Water Resources • Financial Intermediary • Contractors • Vendors • National Advisory Group • Local Community residing in Nambaranguit village – Project Beneficiaries • Opinion Leaders of Nambaranguit village • Local Government Institutions • Department of Environment, Protection and Conservation

S. No.	Type of Stakeholders	Descriptions	Groups + Individuals
			• Local Media

Stakeholder Analysis

Stakeholder analysis takes a more comprehensive view of the stakeholder's group interests, how they would be affected and to what extent and influence they could have on the project. These aspects cumulatively provide the basis for constructing the stakeholder engagement strategy. The key stakeholders identified in the previous section have been categorised into four major groups: Government Agencies, Positively Influenced Stakeholders, Critical to Engage and Donors. The categorisation list of key stakeholders has been provided in the following Table,

Table 22: Categorisation List of Key Stakeholders

Categorisation	Key Stakeholders
Government Agencies	• Department of Energy • Department of Water Resources • Department of Environment, Protection and Conservation
Positively Influenced Stakeholders	• Project Affected Persons /Families (Landowners) • PMU • UNDP Fiji MCO • UNDP BRH Nature, Climate, Energy and Waste (NCEW) • Contractors • Vendors • Local Community residing in Nambaranguit village – Project Beneficiaries
Critical to Engage	• Opinion Leaders of local community • National Advisory Group • Local Government Institutions • Local Media
Donors	• Financial Intermediary

In order to map the interest/influence of the stakeholders on the project activities, a matrix showcasing the stakeholders and their interest/influence has been developed. This step is to assess the interest/influence into high, medium and low levels. In the table below, the interest/influence matrix has been provided.

Table 23: Interest/Influence Matrix of Stakeholders

Categorisation	Key Stakeholders	Influence Power to facilitate or impede the Project	Interest in the Project
Government Agencies	Department of Energy	High	High
	Department of Water Resources	High	High
	Department of Environment, Protection and Conservation	High	High
Positively Influenced Stakeholders	Project Affected Persons/Families	High	High

Categorisation	Key Stakeholders	Influence Power to facilitate or impede the Project	Interest in the Project
	Local Community residing in Nambaranguit village - Project Beneficiaries	High	High
	PMU	High	High
	UNDP Fiji MCO	High	High
	UNDP NCEW	High	High
	Contractors	High	High
	Vendors	High	High
Critical to Engage	Opinion Leaders of local community	Medium	High
	National Advisory Group	Medium	High
	Local Government Institutions	Medium	High
	Local Media	Medium	High
Donors	Financial Intermediary	High	High

Communicative Methods

Stakeholder engagement becomes a successful exercise when proper and participatory communicative methods are used. This ensures that the stakeholders are kept engaged and well informed of the project development at every stage. A combination of communicative methods is usually used to engage with the stakeholders. To determine which option is best suited to the various stakeholders, a benefit analysis of each option has been carried out. The communicative methods are:

- General Information consisting of the project's various activities, the operation stage and impacts that might arise shall be made available:
  - on information board of the Catholic Mission's office within the project area
  - on information board of Contractor's site office
  - on UNDP's website

Detailed information including documents like ESIA and ESMP including environmental decisions shall be in hard copies and disseminated to:

- PMU's site office
- Electronic version of these documents will be made available at UNDP's website.

In addition to this, a host of tools and techniques can be adopted to engage with the stakeholders in a transparent and accountable manner. Below a list of the tools and techniques which can be adopted are mentioned:

- **Public Meeting**: This tool can be used to disclose information on a large scale involving the stakeholders of a particular village. A schedule of the meeting can be circulated well in advance and discussions can involve feedback session from the stakeholders. The meeting can be conducted in the premise of the village school/Mission compound for proximity and familiarity purposes. Once the

meeting concludes, minutes of the same should be kept as a record with the site office and a copy given to the village head. Schedules of future meetings should be discussed and finalised so that the stakeholders can gauge the seriousness of the project proponent in continuing the engagement process.

- **Focus Group Discussion (FGDs):** FGDs are important when gauging with a particular group of stakeholders on issues related to the project activities. It can be used to understand the needs, perceptions and concerns of the group. The discussion will give space for the members to voice their concerns and suggestions. The moderator of the discussion should be impartial in his/ her view and should encourage everyone present to participate in the discussion. Records of the FGDs should be maintained and updated regularly.
- **Participatory Workshops**: Participatory workshops are meetings which enable local people to analyse, share and enhance their knowledge to plan, manage and evaluate development projects and programmes. Visual aids – such as mapping, videos, illustrations, timelines, card sorting and ranking, Venn diagrams, seasonal calendar diagramming and body maps are often used in participatory workshops to engage participants and capture knowledge. They are often an effective means of getting participants to reflect on issues and their own personal experiences. These workshops also pay particular attention to group dynamics and breaking down distinctions between 'uppers' – those with power, standing, influence etc. within a community – and 'lowers' – those with less power, influence and standing within a community. To initiate such a workshop, an expert familiar with participatory tools and conducting such workshops shall be engaged.
- **Participatory Rural Appraisal (PRA) Techniques**: PRA techniques are usually adopted to emphasize local knowledge by enabling local people to make their own appraisal, analysis and plan. PRA uses group animation and exercises to facilitate information sharing, analysis and action among stakeholders. This process can be useful when the project proponent initiates any developmental activities in the area and uses the local knowledge to plan and strategize so that they feel responsible for delivery of the objectives.

Stakeholder Engagement Program

A list of the consultation activities that the project proponent is to undertake as part of the Engagement Plan pertaining to the project have been provided below:

Table 24: Stakeholder Engagement Plan

Project Phase	Consultation Topic	Suggested Communicative Method	Target Stakeholders	Timeline	Responsibility
Project Design	FPIC and Voluntary Land Consent	Face to face Meetings, FGDs	Local Community, Project Affected Population and Beneficiaries, Local Governing Institutions	Prior to Pre-Construction (one time)	PMU, DoE
Project Pre-Construction	Permits and Clearances	Face to Face Meetings, Written Application	DEPC, Department of Water Resources, Forest Department	Prior to Construction (one time)	PMU
	Terms of Reference to Contractors and Vendors	Bid Application	Potential Contractors and Vendors	Prior to Construction n (one time)	PMU
	Onboarding of Contractor - Contractor orientation/training on SES measures and reporting	Face to face Meetings	Contractor Selected	Prior to Construction (one time)	PMU

Project Phase	Consultation Topic	Suggested Communicative Method	Target Stakeholders	Timeline	Responsibility
	requirements including ESMP				
	Translate the project design, ESMP, the project timeline and GRM into local language and make this available at the Local Government Institution office	Written Document	Local Community, Project Affected Population and Beneficiaries, Local Governing Institutions	Prior to Pre-Construction (one time)	PMU
	Recruitment Opportunities	Written Notices – Display Information	Local Community	Prior to Pre-Construction (one time)	PMU and Contractor
	Post project signboard at work site with contact numbers of EHS officer and GRM focal in Local Language and English	Written Signages – Display Information	Local Community	Prior to Pre-Construction (one time)	PMU and Contractor
	Water Testing of river	Sample test and report	Contractor	Prior to Pre-Construction (one time)	PMU
Construction	Compliance Monitoring and reporting of ESMP	Site Visit, Face to face meetings, Records	Contractor	Construction (once every month)	PMU – SES Specialist
	Quality Control and Assurance	Site Visit, Face to face meetings, Records	Contractor	Construction (once every month)	PMU
	Information to Local Community on progress and before start of any work including registering any grievances, if any	Face to face Meetings	Local Community, Project Affected Population and Beneficiaries, Local Governing Institutions	Construction (once every two months)	PMU, DoE
Post Construction	Information to Local Community on completion of work and operation phase of the project including registering any grievances, if any	Face to face Meetings	Local Community, Project Affected Population and Beneficiaries, Local Governing Institutions	Post Construction (one time)	PMU, DoE
	Water Testing of river	Sample test and report	Contractor	Post Construction (one time)	PMU
	Compliance Monitoring and reporting of ESMP on demobilisation of Contractor	Site Visit, Face to face meetings, Records	Contractor	Post Construction (once every month)	PMU

Project Phase	Consultation Topic	Suggested Communicative Method	Target Stakeholders	Timeline	Responsibility
Operation	Information to Local Community on operation phase including registering any grievances, if any	Face to face Meetings	Local Community, Project Affected Population and Beneficiaries, Local Governing Institutions	Once every six months	PMU, DoE
Throughout Project Phases	Progress Report on Implementation and Work Progress	Report	Donor (Financial Intermediary)	As agreed by the Lending Agency	PMU
	Progress Report on Implementation and Work Progress	Report, Face to face Meetings, Virtual Meetings	National Advisory Group	As agreed during consultation	PMU
	Progress Report on Implementation and Work Progress	Report, Face to face Meetings, Virtual Meetings	Regional Hub - UNDP	As agreed during consultation	PMU

Monitoring and Evaluation

Monitoring: Monitoring of project activities is necessary to cater to the stakeholder's concerns by ensuring transparency in guaranteeing the project proponent's commitment in implementing the mitigation measures that addresses the environmental and social impacts arising from the project.

Through this information flow, the stakeholders feel the sense of responsibility for the environment and welfare in relation to the project and feel empowered to act on issues that might affect their lives.

Internal monitoring of project related activities as well as associated activities involving the local communities should be contemplated upon on a regular yearly basis (by identified staff from the PMU/DOE) to bring in openness in the Project's commitment. In addition, external monitoring can strengthen stakeholder engagement processes by increasing transparency and promoting trust between the project and its key stakeholders.

PMU should undertake a commitment in undertaking internal audits every six months during construction phase. All related information shall be readily maintained at the Contractor's office and produced at the time of the audits.

Audit reports shall be accordingly created by PMU after every audit and submitted to Regional Hub and National Advisory Group. All records of these reports shall be maintained at the site office as well as the UNDP Fiji MCO.
Reporting: Performance of the project will be reviewed six monthly against the Stakeholder Engagement Plan. The report will include, but not be limited to, the following:

- Informative materials disseminated, its types, frequency, and location
- Place and time of formal engagement events and level of participation
- Other interactions with the community; and Numbers and types of grievances (both from the community and workers) and the nature and timing of their resolution.

Grievance Redressal Mechanism

Objective

The objective of a Grievance Redress Mechanism (GRM) is to assist in resolving complaints in a timely, effective and efficient manner. The site level GRM can provide the most effective way for stakeholders to raise issues and concerns about the project that affect them. The GRM provides a transparent and credible process for fair, effective and lasting outcomes. It also builds trust and cooperation as an integral component of broader stakeholder engagement, that facilitates corrective actions and helps the community to have ownership of the project. The GRM for this project will be designed in accordance with UNDP Principle 5 on Accountability for the benefit of all project affected persons, including workers and other stakeholders. The GRM would also provide for handling of grievances related to SEA/SH.

Principles

The GRM would be designed in a culturally appropriate way so as to effectively respond to the needs and concerns of all parties involved.

- The GRM would be well-publicized and known to all stakeholders. The implementing agency will ensure that the GRM is widely publicized and will also conduct awareness campaigns in this regard among the wider network available onsite. Implementing agencies will brief target stakeholders about the scope of the mechanisms, the safety of the complainant, time of response, the referral and appeal processes.
- Accessibility - The GRM will be clear, accessible to all Project stakeholders including workers engaged onsite by the Contractor based at national, regional and provincial level.
- The Mechanism would allow for multiple avenues of uptake of grievances.
- The system would be sensitive to women, men, boys and girls, as well as vulnerable populations such as persons with disabilities, elderly, displaced persons and other marginalized groups.
- Confidentiality and prevention against retaliation.
- The GRM would be designed to protect beneficiaries and stakeholder's rights to comment and complain, and even raise their complaints to higher management if they are not satisfied with services or receive insufficient solutions. The mechanism would facilitate their sharing of concerns freely with understanding that no retribution will be exacted for their participation. To create a safe space, anonymous complaints will also be allowed.
- The GRM shall provide for relaying regular information and feedback regarding the redressal of the grievance to the aggrieved.
- The Mechanism shall be responsive in redressal of grievances by facilitating resolution with the concerned actor in the implementing chain.
- The GRM would be based on transparency and accountability. All complainants will be heard, taken seriously, and treated fairly. The community and stakeholders will be aware of the expectation from the project; the GRM procedures; understand its purpose, have sufficient information on how to access it.
- The GRM will have provisions to appeal if the grievances are not resolved satisfactorily.
- The GRM would not prevent access to judicial and administrative remedies.
- The mechanism would provide for prompt time-bound redressal of grievances.
- For SEA/SH cases, three guiding principles of confidentiality, survivor centricity and survivor safety are to be applied to specific cases of SEA/SH cases as per the World Bank's guidance. Reporting mechanisms will enable complainant to report SEA/SH cases without being publicly identified given the risk of stigma, reprisals, and rejection associated with sexual exploitation and abuse and sexual harassment.

The PMU will manage the GRM in collaboration with the DoE utilising formal, informal and traditional grievance process. The grievances primarily will be resolved at the community level in the first instance and to the best

possible extent. The PMU along with DoE will aim to address all grievances received, regardless of whether they arise from real or perceived issues. The stakeholders affected by the project activities will have access to this procedure at no cost or threat of any negative repercussions. The statutory rights of the Complainant to undertake legal proceedings remain unaffected by participation in this process.

Institutional Arrangements

The PMU in collaboration with the DoE will be responsible for managing grievances including updating the grievance database to track the progress of formal grievances for the duration of project activities. This involves coordinating between key agencies on a regular basis (i.e. weekly or fortnightly). The PMU is responsible for final oversight of community consultation and grievance management. Local and Area Councils will be briefed on issues and engaged to support in convening community consultation, as and when required.

The nominated person from the PMU will be designated as the Grievance Officer focal point and will be responsible to administer the grievance database of issues raised, status on progress of resolution and resolved cases.

Awareness of GRM

The PMU will inform the Local Councils, Area Councils. Local communities, contractors and key stakeholders and agencies on the GRM. Communities and affected persons are to be advised of the GRM in the early stages of engagement and made aware of the following component,

- How it can be accessed
- Who to speak to and process of lodging a formal complaint
- Timeframes for each stage of the process
- Confidentiality, responsive and transparency of the process
- Alternate avenues of dispute resolution where conflicts of interest exist.

Grievance Procedure

The grievances can be resolved through four key stages,

i. Receive and register grievances
ii. Acknowledge, Assess and Assign
iii. Propose Response
iv. Agreement on Response

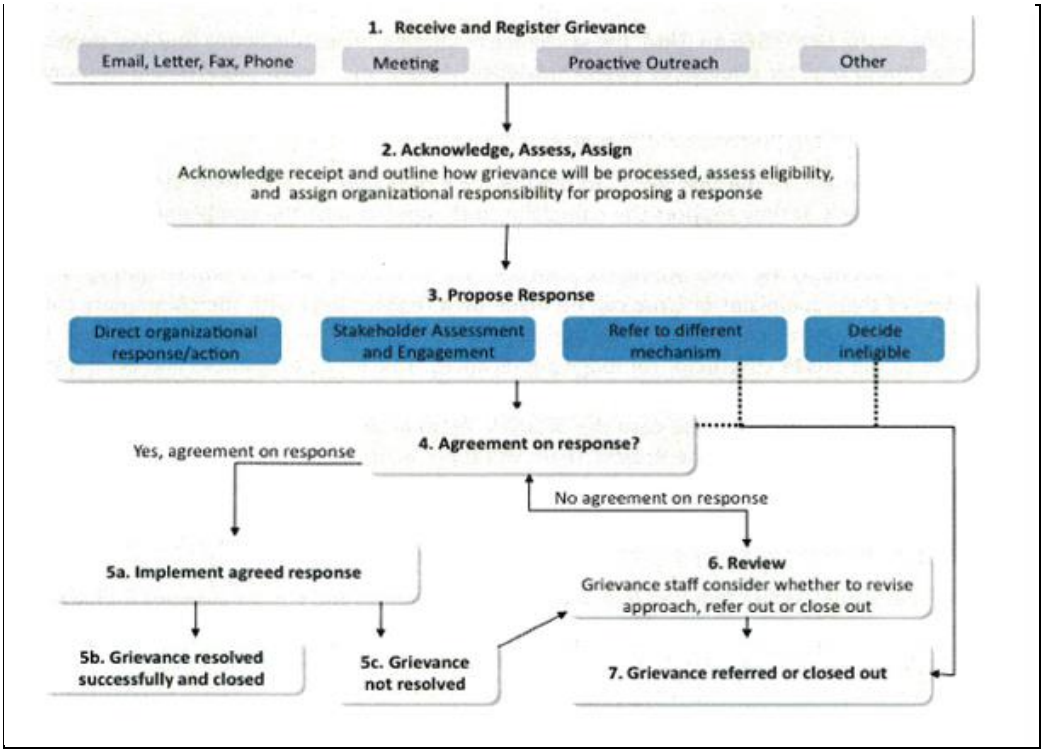
Brief description of the steps to be followed is provided below,

i. Receive and register grievances: The first step is for the complainant to bring the grievance to the community chief and leaders to discuss the concern directly. If both parties agree on the eligibility of the grievance, the same is forwarded to the focal point (Grievance Officer) of PMU for registration and onward deliberation. For those who wish to remain anonymous, a register of their complaint or issue can be made on a register held with the community chief or leader and a grievance box can be installed at the local council office and checked by the Grievance Officer once in two weeks. In case of workers grievances, they can approach the Grievance Officer directly. Once the grievances are received by the Grievance Officer, the incumbent will record all grievances in the Grievance Log. This will later contribute to the lessons learnt during the project and ensure that all grievances are duly discussed and resolved within the stipulated timeline.
ii. Acknowledge, Assess and Assign: Grievances once received are to be registered and an acknowledgement of the same is to be provided to the Grievant Party. The eligibility of the grievance will be deliberated on by the PMU wherein the assignment of responsibility for proposing a response would be provided.
iii. Propose Response: It is to be noted that the severity of each grievance and subsequent course of action are to be determined by the PMU. If the issue is easily resolvable, the responsible party is to endeavour to address the issue directly onsite and record the details into the Grievance Log managed by the PMU. If the grievance is of more complex nature, it may require additional deliberations and further

investigation. A formal response is to be provided within a two-week timeframe or a timeframe which has been agreed with the Grievant Party. If additional time is required, the Grievant Party would be duly informed of this aspect well in advance.

iv. Agreement on Response: The resolution once reached would be shared with the Grievant Party for agreement. If the Grievant Party agrees to the resolution provided, the PMU will mark the grievance closed in the system. If in case the Grievant Party is not satisfied with the response provided, the grievance is escalated to the Director of DoE.

The following figure illustrates the stages of Grievance Redressal Mechanism to be adopted for the project,



***Source**: UNDP Supplemental Guidance*

Figure 31: Grievance Redressal Mechanism

Timelines

The following timelines have been proposed for the stages of Grievance Resolution,

- Receipt of Grievance and reference to nominated person: 01 working day.
- Determine severity of grievances, provide acknowledgement receipt, resolve immediately and registration: 02 working days.
- Discussion with relevant parties and confirm resolution with Grievant Party: 14 working days.
- Grievance Escalated, Discussed and Resolution Sought: 07 working days.
- Grievance closed out and database updated: 30 working days.

Construction Safety Management Plan

The Construction Safety Management Plan (CSMP) has been developed to ensure work safety of the employees working at site and aims to minimize the risks on employees arising from work-related activities. The measures mentioned in this Plan are applicable to all Project personnel and covers the construction phase of the Project.

Applicable Regulations

The following regulations and guidelines shall be adhered by the Project Team,

- Health and Safety at Work Act (Cap. 195)
- UNDP Standard 7 on Labour and Working Condition
- WBG General EHS Guidelines, 2007

Roles and Responsibilities

PMU:

- Conduct regular inspections to ensure compliance with OHS management protocols and identify areas requiring improvement.
- Provide guidance and support to the Contractor team on providing awareness on the OHS management practices, regulations, and requirements.
- Monitor safety measures adopted by the Contractor to verify adherence to the plan.
- Coordinate with relevant stakeholders to address any non-compliance issues promptly and implement corrective actions.
- Keep detailed records of OHS trainings undertaken on site including accidents/incident records.
- Inform the Regional Hub within 24 hours in case of any major accidents/fatality onsite.

Contractor EHS/Safety Officer:

- Ensure implementation of the Construction Safety Management Plan onsite.
- Provide necessary training to workers on OHS management practices, including code of conduct and grievances, if any.
- Cooperate with the PMU during inspections and audits, implementing corrective actions as required.
- Ensure that the working manpower attend all trainings arranged by the EHS/Safety Officer.
- Maintain records of trainings provided, including accident/incident register and first aid register.
- Ensure that toolbox talks are undertaken on a daily basis prior to the start of work to the workers.

Management Measures

The Construction Safety Management Plan includes the following component,

- site or activity specific details of planned work procedures
- hazard identification and management
- orientation and training requirements
- emergency management procedures, and
- safety monitoring to be implemented during construction.

Details of each component have been provided below,

Safety Training : Orientation, Training and Toolbox Talks

The Contractor would be responsible in ensuring that all workers under them are appropriately trained and competent to implement the requirements of the CSMP. Prior to the start of site work activities, the Contractor will implement safety training programs necessary to train all persons performing Work on the Site. These training

programs shall include all materials, actions and evaluation processes needed to allow workers to perform the required and assigned Work in a safe and competent manner. The contractor's safety training programs shall:

- comply with all requirements of the national regulations and UNDP Standard 7 on Labour and Working Conditions;
- identify and address both general and task specific hazards;
- address the rights, obligations and duties of all persons engaged in the performance of the Work with respect to occupational health and safety;
- address the potential consequences of non-compliance with the Construction Safety Management Plan;
- be tailored to the tasks, duties and responsibilities of each person engaged in the performance of the Work;
- be delivered by qualified persons;
- be modified as and when required based on the performance on individuals on the ground;
- be documented, tracked and kept on file and made available for audit and review by the PMU;
- all persons working on the project construction site will be informed about the CSMP during their initial orientation and have access to the CSMP. All workers will understand the requirements of the safety schedules and CSMP as they apply to their work.

The Contractor's EHS/Safety Officer will be responsible in maintaining the awareness and understanding of safety hazards, mitigations strategies and accepted behaviours and practices onsite on a daily basis.

Emergency Preparedness and Response

An Emergency Preparedness and Response Plan (EPRP) has been prepared as part of this ESIA Report which is to be implemented onsite by the Contractor. The EPRP provides a framework, defines the structure and roles and responsibilities to effectively respond to and manage major events or emergencies which may affect or have affected public/employee/contractor safety, operations or assets, reputation, or the environment.

Hazard Identification and Management

A complete comprehensive site-specific hazard identification and risk assessment (HIRA) is to be undertaken by the Contractor prior to beginning work at site. The assessment will identify all potential hazards and provide adequate mitigation measures to be implemented onsite. Besides the HIRA, the following hazards are to be considered by the Contractor,

Potential Fire Hazards

During Project construction, site-specific work activities may create fire hazards. Potential causes of fire may include:

- temporary or permanent heating devices
- electrical arc
- smoking
- hot works including welding etc.
- mobile equipment

Mitigation and Safety Measures

- The Contractor should have already prepared procedures for temporary or permanent heating devices, electrical arc, smoking, other industry related fires; mobile equipment, management of hazardous materials, removal of combustible debris and the maintenance of emergency access roads
- A site plan that identifies the following:
  - designated assembly or muster areas and evacuation routes
  - the location of storage facilities for flammable/combustible liquids, compressed gas etc.
  - the location and type of fire equipment and fire protection systems

Work at Height

Work at height means work in any place where, if there were no precautions in place, a person could fall a distance liable to cause personal injury. Height work at or more than 1.8 m is considered to be work at height.

Control Measures

- Avoid work at height where it's reasonably practicable to do so;
- Where work at height cannot be easily avoided, prevent falls using either an existing place of work that is already safe or the right type of equipment;
- Minimise the distance and consequences of a fall, by using the right type of equipment where the risk cannot be eliminated.

Do's

- Person to work at height must be trained;
- Medical testing for people required to work at height should be conducted and the tests should include conditions such as vertigo or illness that may affect the person or the work;
- As much work as possible from the ground;
- Ensure workers can get safely to and from where they work at height;
- Ensure safety equipment is suitable, stable and strong enough for the job, maintained and checked regularly;
- Take precautions when working on or near fragile surfaces;
- Provide protection from falling objects;
- Consider emergency evacuation and rescue procedures.

Don'ts

- Overload ladders/ elevated platforms – consider the equipment or materials workers are carrying before working at height. Check the pictogram or label on the ladder for information;
- Overreach on ladders or stepladders;
- Rest a ladder/ elevated platforms against weak upper surfaces;
- Use ladders or stepladders for strenuous or heavy tasks, only use them for light work of short duration (a maximum of 30 minutes at a time); and
- Let anyone who is not competent (who doesn't have the skills, knowledge and experience to do the job) work at height.

Hand and Power Tools

All portable electric equipment must be handled in safe manner that will not damage or reduce service life.

General Instructions

- Flexible cords connected to equipment should not be used for raising or lowering equipment and should not be used if damage to the outer insulation is present.
- Visual inspections are required and unauthorized alterations of the grounding protection are not allowed to ensure the safety of employees. Prior to each shift, a visual inspection should be performed for external defects and for possible internal damage.
- Attachment plugs and receptacles should not be connected or altered in a manner that would prevent proper continuity of the equipment grounding conductor. In addition, these devices should not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.
- Portable electric equipment and flexible cords used in highly conductive work locations or in job locations where employees are likely to contact water or conductive liquids shall be approved by the manufacturer for those locations. The hazardous locations that employees should be aware of include, wet locations and locations where combustible or flammable atmospheres are present.
- For wet locations, employees' hands will not be wet when plugging and unplugging energized equipment. Energized plug and receptacle connections should be handled only with protective equipment if the condition could provide a conductive path to the employee's hand (if, for example, a

cord connector is wet from being immersed in water). In addition, ground-fault circuit interrupter (GFCI) protection is required for some equipment/locations and is also recommended for use in all wet or highly conductive locations.
- For combustible/flammable atmospheres, all electric equipment and wiring systems in classified locations must meet the regulatory standard.

Personnel Protective Equipment

Personal Protective Equipment (PPE) means any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards.

- The fundamental principle is that personal protective equipment (PPE) should only be used as a last resort.
- The safety and health of employees must be first safeguarded by measures to eliminate workplace risks at source, through technical or organisational means (e.g. by substituting hazardous chemical) or by providing protection on a collective basis (e.g. providing scaffolding instead of harnesses).
- Collective protective measures covering numbers of employees in a workplace must have priority over protective measures applying to individual employees.
- If these measures are not sufficient, only then should PPE be used to protect against the hazards that are unavoidable. Employers need to supply PPE to workers where risks cannot be eliminated or adequately controlled. Employers cannot pass on to employees any financial costs associated with duties relating to safety, health and welfare at work. An employer may not ask for money to be paid to them by an employee for the provision of PPE whether returnable (e.g. a deposit) or otherwise.

Construction Works

Basic Safety Rules

- Comply with the applicable local and national health and safety regulations;
- Undertake risk assessment of all the activities undertaken on the site;
- Maintain good housekeeping at all situations;
- Adequate personal protective equipment to be provided and used based on the PPEs identified during the risk assessment activity;
- Ensure only trained people handle and use with firefighting equipment and electrical circuits;
- Proper ventilation, lighting facilities, drinking water and sanitary facilities to be provided to the labour;
- Provide First aid box onsite;
- Adequate provision of fire prevention systems;
- No child labour;
- No smoking;
- Workers will be covered under occupation accident policy;
- Monitoring of implementation;
- Ensure that everyday toolbox talks are conducted to familiarise the workers regarding hazards and safety concerns onsite;
- On the job training on the safe working practices.

Hygiene and Housekeeping

<u>Measures</u>

- Regular cleaning of workplaces, equipment and devices should be carried out to ensure an adequate level of workplace hygiene. A designated person should be assigned the responsibility to oversee such operations.
    - All containers should be properly labelled and marked, and the labels must remain clean and visible.
    - All containers must be kept in good condition and tightly closed when not in use.
    - When practical, chemicals, fluids and supplies should be kept in a pre-identified area away from any water bodies and covered at all times.

  - Spill kits and drip pans must be kept near any liquid transfer areas, protected from rainfall.
  - Absorbent spill clean-up materials must be available in maintenance areas and shall be disposed of properly after use.
  - Collect waste fluids in properly labelled containers and dispose of them properly.
- Rubbish or waste should be kept in suitable containers or litter-bins which are located at convenient locations in the workplace. The containers should be emptied daily, preferably near the end of each working day.
- All refuse containers and dumpsters should remain covered and not leaking.
- The conditions of housekeeping can be easily assessed by visual observations. Records of maintenance work must be kept for evaluation of the performance, including information on the responsible person(s), contact and date/time of the action taken.
- Visual inspection of workplaces to note down the conditions and spot out malpractice would be required.

Vehicle Movement

Measures

- The access route should be wide enough for the safe movement of largest vehicles and should be clearly demarcated;
- Ensure surfaces are suitable for the vehicles using them;
- Signs, signals and marking should be well positioned and easy to understand and as much as possible should be similar as those displayed on public roads to avoid confusion.
- Avoid steep slope, sharp corners, and blind bends, clear from obstructions and maintained.
- Visibility should be good enough for drivers to see any potential hazards and to see pedestrian for any vehicle;
- Reduce vehicle speed internally to 15 kmph;
- Wheel chokes should be applied to parked vehicles on operating sites and parking should be identified and designated for various vehicles.
- Vehicles used in the workplace should be suitable for the purpose for which they are used. Carefully consider the working environment in which a specific vehicle will be used and the suitability of that vehicle for the people using it. Consulting with those who will use it is a key part of developing a vehicle specification (Planning stage).
- Vehicles should be designed so that, wherever possible, those who use them can do their work from the ground. Where people have to work at height on vehicles, suitable means of safe access onto and around vehicles should be provided.
- Vehicles should be maintained in good working order so they remain mechanically sound, and any devices, such as flashing beacons, function properly. Vehicles such as lift trucks and those with tail lifts must be thoroughly examined by a competent person and reports kept.
- Planned inspections are a vital part of preventative maintenance. These may include daily safety checks carried out by drivers and regular maintenance inspections based on time or mileage.
- Considerations should be given that vehicle must have:
  - In vehicle monitoring system;
  - Speedometer;
  - Fixed seat belts
  - Driver and passenger air bags;
  - Fire extinguishers, first aid kit , emergency road side triangles, emergency contact details;
  - Audible reverse alarms.
- Training requirements will depend on an individual's experience and the training they have previously received.
- Fitness to operate: medical test especially eye test, colour blindness test and authentic driver's license from the concerned authority;
- A system must be in place to manage driver's fatigue;
- System should be in place to ensure that drivers:
  - Have a valid driver's license
  - Are subject to behaviour based feedback;
  - Perform a pre-operation safety check;

    - Understand emergency crash and breakdown procedures, including tire changing where applicable.
- Driver and all other passengers must wear seat belts;
- No drugs or alcohol for drivers should be accepted.
- A formal inspection and preventive maintenance system must be in place to ensure that vehicles are maintained in safe and road worthy condition;
- Vehicle must comply with local laws and regulations, particularly as these apply to the transport of hazardous materials.

Excavation

All excavation work should be planned and the method of excavation and the type of support work required shall be decided considering the following,

Control Measures

- All excavation work must be supervised.
- Sites of excavation should be thoroughly inspected:
    - Daily, prior to each shift and after interruption in work of more than one day;
    - After an unexpected fall of ground;
    - After substantial damage to supports;
    - After heavy rains.
- Safe angle of repose of particular type of soil while excavating trenches exceeding 1.5m (5') depth up to 3.0m should be maintained. Based on site condition, proper sloping should be provided.
- No load, plant or equipment should be placed or moved near to the edge of excavation where it is likely to cause collapse and thereby endanger any person unless precautions such as the provision of shoring or piling are taken to prevent the sides from collapsing.
- Proper approach to be made to back fill the excavated area.
- Proper PPEs (dust mask etc.) to be provided to workmen engaged in backfilling.

Records to be maintained Onsite

- Accident/Incident Records
- First Aid Record
- Training Records
- PPE Issuance Register

Labour Management Plan

Purpose

The Labor Management Plan prioritizes fair treatment, non-discrimination, and equal opportunity for all workers. It establishes and fosters a constructive worker-management relationship while complying with national employment and labour laws. It is committed to providing a safe working environment for all categories of workers involved in the project.

Applicable Regulations

- UNDP Standard 7 on Labour and Working Conditions
- World Bank Group Environmental, Health, and Safety General Guidelines (2008)
- Employment Act, 1983 and its subsequent amendments
- Minimum Wage and Minimum Wages Board Regulations (Order No. 56 of 1987) and its subsequent amendments
- Convention on the Rights of the Child (Ratification) Act [Cap 219] (Act No. 26 of 1992).
- Abolition of Forced Labour Convention (Ratification) Act 2006 (Act No. 5 of 2006)
- Convention on the Elimination of All Forms of Discrimination against Women (Ratification) Act No. 3 of 1995

Roles and Responsibilities

Project Management Unit

- The PMU oversees the implementation of the Labour Management Plan by the Contractor.
- Conduct regular inspections to ensure compliance with labour management protocols and identify areas requiring improvement.
- Provide guidance and support to the Contractor team on providing awareness on the labour management practices, regulations, and requirements.
- Coordinate with relevant stakeholders to address any non-compliance issues promptly and implement corrective actions.

Contractor (Admin Manager)

- Ensure that the Labour Management Plan is being implemented online.
- Ensure that the project is in compliance with the national regulations and best practices.
- Ensure that no workers are discriminated upon based on gender, age, skill, class, creed, ethnicity etc.
- Ensure that the workers are aware of their terms and conditions and benefits.
- Provide training awareness on workers terms and conditions and GBV related aspects.
- Maintain all records of workers including age, address, attendance including overtime hours records, wage register including overtime wages, health/accident insurances etc.
- Verify all workers engaged as per Child and Forced Labour regulations.
- Provide all records to PMU as requested during inspection.

Standard Operating Procedure

The following aspects should be undertaken by the Contractor,

Terms and Conditions of Workers

- Contractor to ensure that proper communication is undertaken to inform the Community Chief or Council on the requirements of employment to engage local population in the project.
- Contractor to ensure that all workers engaged have proper appointment letters with terms and conditions of employment mentioned.
- Contractor to ensure that working hours, weekly offs and overtime work and wage are adequately captured in the terms and conditions of employment.
- Contractor to ensure that all workers are provided equal payment as per the national regulations for the type of work performed irrespective of gender.
- Contractor to ensure that workers are provided equal opportunities of employment irrespective of any discriminatory practices.
- Contractor to ensure that the date of payment of wages is clearly defined within the appointment letter.

- Contractor to ensure that during the Induction Trainings of workers onsite, the terms and conditions are duly communicated to all workers engaged onsite.

Verification of all Workers

- Contractor to ensure that all workers engaged are duly verified based on their date of birth and address with national identity cards.
- Contractor to ensure that all records of workers are maintained by them including their address of residence.
- Contractor to ensure that the national identity cards of the workers are provided back to workers post verification process.

Working Conditions on Site

- Contractor to ensure that all workers are informed of the site conditions and risks during the Induction Training.
- Contractor to develop Code of Conduct for the workers.
- Contractor to ensure that all workers are given adequate information on the Code of Conduct and ensure its implementation onsite.
- Contractor to ensure that adequate sanitary, safe drinking water, designated areas for rest and dining are provided to all workers.
- Contractor to ensure that all workers duly informed about the safety signages displayed onsite and its interpretation.
- Contractor to ensure that all workers engaged onsite are provided Toolbox Talks on a daily basisi prior to work onsite.
- Contractor to ensure that all workers are provided adequate information on the Grievance Redressal mechanism implemented onsite including the contact details of the Grievance Officer designated onsite.
- Contractor to ensure that all national regulations and best practices including the respective Management Plans are implemented onsite and records are maintained onsite.
- Contractor to ensure that trainings on routine work are duly provided to all workers and training records are maintained onsite.
- Contractor to ensure that all workers are provide adequate PPEs onsite and the same is captured in the PPE Issuance Register.
- Contractor to ensure that all workers maintain good housekeeping conditions onsite.
- Contractor to ensure that all workers follow instructions on Waste Management onsite including accommodation provided on rental basis to any semi-skilled and skilled workers engaged from outside the project area.
- Contractor to ensure that all communication with the local community is duly captured in the Minutes of Meetings.
- Contractor to ensure that all workers are insured for medical/accidental purposes.
- Contractor to provide all information sought by PMU as and when necessary, in auditable formats.

Monitoring

- PMU to ensure that the Contractor is implementing the Management Plan onsite.
- PMU to ensure and verify that the Contractor is adequately capturing all information of workers including all records.
- PMU to monitor the performance of workers once a month to ensure that no untoward incidents occur related to workers.
- PMU to ensure that the Contractor captures all grievances of workers adequately in the Grievance Log and assess its closure to the satisfaction of the grievant party.
- PMU to provide feedback to the Contractor on any non-compliances noted during the monthly inspection. All communication between PMU and Contractor to be adequately documented.

Documentation

- Record of workers engaged onsite
- Training records
- Grievance Log
- PPE Issuance Register

Waste Management Plan

Purpose

The purpose of this plan is to effectively manage various types of waste generated during the construction period of the project. This plan aims to minimize impacts generated through the construction phase and provide guidelines on waste reduction, segregation, collection and disposal practices in accordance with international best practices, to avoid deterioration of the natural environment and negative impacts on the health and safety of communities in the Project Area.

Applicable Regulations

The following regulations and guidelines shall be adhered by the Project Team,

- Environmental Protection and Conservation Act, 2002 and its subsequent amendments
- Pollution (Control) Act No. 10, 2013
- Waste Management Act No. 24, 2014
- Water Resources Management Act No.9, 2002
- UNDP Standard 8 on Pollution Prevention and Resource Efficiency
- WBG General EHS Guidelines, 2007
- WBG EHS Guidelines for Construction Material Extraction, 2007

Roles and Responsibilities

PMU

- Conduct regular inspections to ensure compliance with waste management protocols and identify areas requiring improvement.
- Provide guidance and support to the Contractor team on providing awareness on the waste management practices, regulations, and requirements.
- Monitor waste handling, segregation, recycling, and disposal activities by the Contractor to verify adherence to the plan.
- Coordinate with relevant stakeholders to address any non-compliance issues promptly and implement corrective actions.
- Keep detailed records of waste management activities, including waste generation, segregation, recycling, and disposal, for reporting and regulatory compliance.

Contractor EHS/Safety Officer

- Ensure proper segregation and storage of waste materials in designated areas as outlined in the waste management plan.
- Provide necessary training to workers on waste management practices, including waste segregation, recycling, and disposal methods.
- Cooperate with the PMU during inspections and audits, implementing corrective actions as required.
- Ensure that the working manpower attend all trainings arranged by the EHS/Safety Officer.
- Maintain records of waste generation and disposal records including trainings provided.

Management Measures

Waste Generation Impacts

The following waste generation streams have been identified for the construction phase of the project,

- Construction and demolition waste
- Excavated waste
- Packaging waste
- Domestic waste
- Battery waste

The identified activities and potential impacts relevant to waste generation including waste classification are summarised in the table below.

Table 25: Potential Impact of Waste Generation

Activity	Waste Type	Potential Impact
Excavation and Earthworks	• Generation of excavated material • Excess spoil	• Increased waste from improper practices or failure to implement waste hierarchy. • Excess volumes of excavated material requiring storage, treatment or disposal • Incorrect treatment of potentially contaminated soils leading to regulatory non-compliance or environmental impact
Demolition and construction waste	• Generation of inert waste • Generation of liquid hazardous waste • Resource consumption (fuel and power) • Iron and steel, Non-ferrous scrap associated with construction activities	• Increased waste from improper practices or failure to implement waste hierarchy. • Inappropriate disposal of hazardous wastes leading to regulatory non-compliance or environmental harm • Inappropriate disposal of wastewater leading to environmental and community health and safety concerns • Reduced resource availability
Workshop (if any) Operations	• Packaging materials including scrap metals, timber and cardboard • Batteries • Oil and Lubricants • Oil soaked clothes and rags	Increased waste from improper practices or failure to implement waste hierarchy
General office/ administration, amenities including food and human waste	• Generation of Office Waste • Generation of Food and Domestic Waste • Generation of Grey and Septic Waste	• Increased waste from improper practices or failure to implement waste hierarchy. • Inappropriate disposal of domestic waste from construction personnel • Inappropriate disposal of grey and septic wastes leading to regulatory non-compliance or environmental risks
Storage of Waste onsite	• Emissions to air, land and water • Classification and segregation of waste	• Pollution of soils, groundwater and surface water • Dust emissions or odour pollution • Reduction in re-use of waste • Contamination of soil
Waste transport and disposal	• Unlicenced waste contractor's transporting waste	• Regulatory non-compliance • Potential illegal dumping of waste

Management and Mitigation Measures

All waste that would be generated onsite would be mitigated through measures as depicted in the waste management hierarchy framework illustrated below,

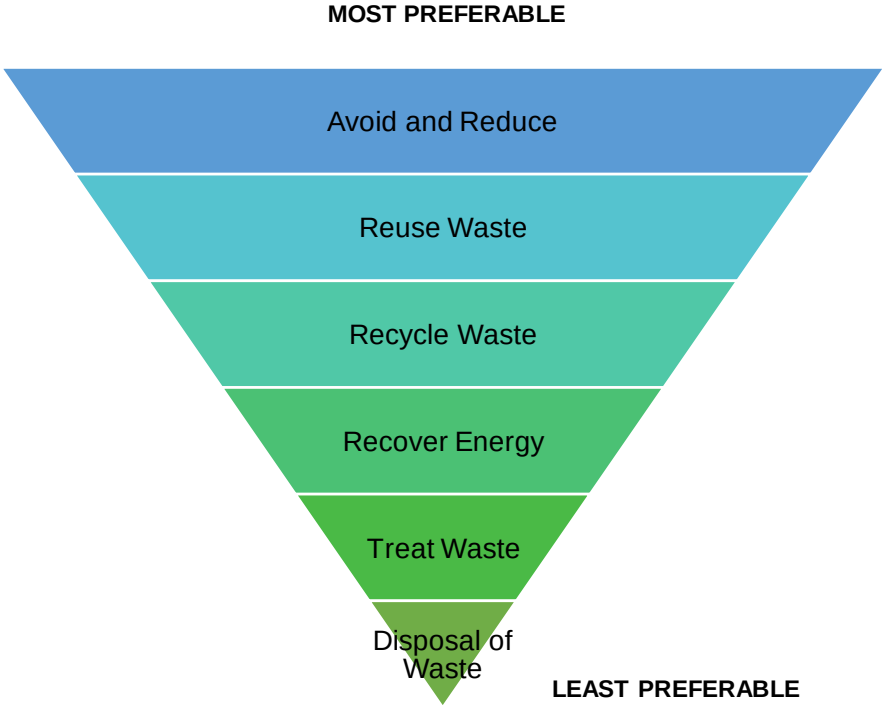


Figure 32: Waste Management Hierarchy

Material Storage, Handling and Use

Material handling and storage areas are to be mitigated through the following measures,

- The Contractor must implement his own waste recycling system, i.e. separate bins for food waste, plastics, paper, wood, glass cardboard, metals, etc.
- Re-using materials on site wherever possible during the construction phase with respect to excavated spoil;
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to construction needs;
- Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible;
- Designate an area within the project site for material storage with proper storage mechanisms.
- The location of all temporary waste storage areas must aim to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control.

Construction Debris

- The disposal of construction debris including muck, concrete aggregates etc are to be disposed off at identified and approved muck disposal sites in consultation with the PMU.
- Trash and debris are not to be buried within filled or backfill areas.
- All arrangements for transportation during construction including provision, maintenance, clearing debris, where necessary, are to be considered incidental to the work and should be planned and implemented by the Contractor.
- Once the work is completed, all construction generated debris are to be cleared from the site by the Contractor.

Solid Waste

- All the Solid waste generated including Biodegradable waste, plastic waste, cans, non-biodegradable waste, etc will be collected at pre-designated area such as compostable organic portion of the solid waste would be disposed through composting in a dug pit or can be sold directly to the agriculture farmers and piggeries. The recyclable portions such as plastic bottles, cans, etc. shall be segregated and are to be kept at designated site and later can be sold to the recycling vendors.
- The Contractor is to clearly identify and demarcate disposal areas, indicating the specific materials that can be deposited in each waste container.
- The storage area should be covered to prevent direct contact with surface runoff and be fenced off to prevent wind-blown litter.
- The Contractors to ensure that all facilities have good housekeeping condition, and the construction sites are be kept free of litter. Measures is to be implemented to reduce the potential for litter and negligent behaviour in waste disposal.
- Recyclable materials such as wooden plates, steel, packaging material, paper, empty cement bags and containers, glass, wood, and junk are to be collected and segregated on-site.
- The collected recyclable material is to be reused or sold to a waste collector for recycling.
- Open burning of solid waste is to be strictly prohibited.
- Workers are be trained on waste segregation practices, with demarcated bins provided for recyclables and perishables placed in common areas.

Wastewater Management

The Contractor is responsible for complying with local legislation related to wastewater discharges. The following processes should be implemented for effective wastewater management,

- Construction and installation of sand trap and access road strengthening to mitigate any erosion risks, control sediment runoff, and improve site safety.
- Domestic sewage from the site office and toilets should be treated using on-site facilities such as soak pits. Discharge of treated wastewater must comply with local wastewater discharge standards.
- Under no condition, wastewater is to be discharged into water bodies without prior treatment.
- Domestic sewage collected from the site office and toilets should be cleaned weekly.

Solar Panels

- For broken, unused and cracked solar panels, a buy back policy with the Vendor is to be initiated so that no storage related risks are present onsite.
- All solar panels are to be stored in designated areas (away from water bodies) either horizontally or vertically in a box on a platform with adequate weather protection. Usually, separators are placed between each module, and extra protections are added to the four corners of each module stack.

Training and Awareness

- Contractor is to conduct comprehensive training programs for all workers involved in waste handling to raise awareness about the hazards associated with different types of waste.
- Emphasize the importance of proper segregation and handling procedures to minimize risks.
- Display informational materials, such as posters and pamphlets, to raise awareness about waste management practices and encourage active participation.

Monitoring and Reporting

Monthly review is to be undertaken to evaluate the effectiveness of the Waste Management Plan by the PMU. Identification of areas for improvement and implementation of necessary changes to enhance waste management practices is to be part of the monitoring process.

Water quality testing is to be undertaken by the Contractor once during and once after the construction phase. Parameters to be monitored and is to be analyzed to evaluate water quality standards includes pH, dissolved oxygen (DO), turbidity, temperature, and major pollutants (e.g., suspended solids, heavy metals)

Regular visual inspections of water intake points, treatment facilities, and discharge outlets to be conducted to identify any visible anomalies, leaks, or spills, discharged at unauthorized sites or directly into the river by the Contractor.

The Contractor will keep accurate records that track the amount of waste generated and the disposal method used, and materials recovered and their subsequent use. The volume of waste produced on site are be monitored through visual inspection of the content of waste containers and recording of waste quantity produced by type of waste. Activities likely to produce additional or non-routine waste will be pre-notified to Contractor's EHS/Safety Officer.

All waste generated will be tracked on the Waste Tracking Log as per the format provided below,

Table 26: Waste Tracking Log

S. No	Type of Waste	Source	Quantity Generated	Total Disposed	Disposal method	Total Stored currently

Auditing

Audits will be undertaken to assess the effectiveness of environmental controls, compliance with the Waste Management Plan and relevant Infrastructure Approval conditions. Quarterly Monitoring Audits will be undertaken by PMU.

Emergency Preparedness and Response Plan

The Emergency Preparedness and Response Plan (EPRP) for the construction phase aims to establish a structured framework to efficiently address and mitigate potential emergencies. Its primary objective is to safeguard the well-being of all personnel involved by outlining clear protocols, designated responsibilities, and effective procedures to respond to various emergency scenarios. This plan seeks to minimize risks, ensure a coordinated response during crises, and maintain a safe working environment by adhering to regulatory standards and best practices.

Applicable Regulations

- World Bank Group Environmental, Health, and Safety General Guidelines (2008)
- Health and Safety at Work Act (Cap. 195)
- UNDP Standard 7 on Labour and Working Conditions

Roles and Responsibilities

Project Management Unit (PMU):

- Oversee the implementation of the Emergency Preparedness and Response Plan in line with regulatory standards and best practices.
- Ensure that the Contractor allocates necessary resources, including personnel, training, equipment, and finances, to support effective emergency response measures and procedures.
- Ensure that the Contractor organizes specialized emergency response training for all project personnel, emphasizing roles, procedures, and emergency equipment utilization.
- Ensure clear and effective communication channels among team members, stakeholders, and relevant authorities during emergencies.
- Regularly evaluate the compliance of the EPRP onsite.

Contractor's EHS Officer or Safety Officer:

- Implement the EPRP on-site.
- Ensure the emergency response protocols is in place onsite by conducting regular drills and inspections to identify and address potential hazards.
- Provide specialized emergency response training to workers emphasizing their roles during emergencies.
- Facilitate prompt reporting of emergency incidents, conduct thorough investigations, and recommend corrective actions.
- Maintain effective communication with the PMU, workers, and stakeholders regarding emergency preparedness and safety concerns.
- Ensure accurate documentation and maintenance of records related to emergency drills, incidents, training, and compliance checks.

List of Emergencies

The following list the emergencies that can occur on site,

Category	Description
Internal Emergencies	
Workplace Accident/Incident	Incidents related to collapsed structures/ excavations
	Incidents related to working at height
	Incidents related to vehicles/moving equipment's
	Incidents related to exposure to electrical hazards viz., Electrical shock, electrocution
	Incidents related to Snake, insect bites

Category	Description
Fire and Explosions	Incidents related to Electrical Fires viz., Fire at electrical substation
	General fire incidents at workplace
	Incidents related to fire and explosion at hazardous installations viz., gas cylinder storage area
Spillage and Contamination	Spillage of oil, diesel or other chemical substance on unpaved surface.
External Emergencies	
Natural Calamities	Flooding at Site
	Other events such as landslides, earthquakes
Major Fires/Explosions	Incidents related to major fires, explosions, spills which require urgent involvement of external authorities.
Others	Terrorism

Measures

Workplace Accidents/ Incidents

- The individual who is responsible or who discovers the incident would report the incident to the EHS/Safety Officer
- Evacuate the workmen to a safe distance / Assembly Point;
- Barricade the area to prevent unauthorized entry;
- Put security guard till the investigation is done by the EHS Officer
- Take out the causality (if any) to open area and give first-aid and call for further medical assistance;
- In case of fatal incident inform the PMU immediately and then the police station
- Comply with legal and statutory requirement.

Overturning of Vehicle/Equipment

- The individual who is responsible or who discovers the incident would report the incident to the concerned Authority
- Arrange all required facilities like lifting equipments, transport vehicles etc. to clear the road.
- Inform the PMU and seek necessary assistance in terms of co-ordination with Government authorities,
- Barricade the area;
- If casualty, provide immediate first aid and shift victim to hospital;
- Put security guard till the area is cleared.

Electrical Shock

- Cut off power supply and raise alarm;
- Use fire extinguisher (ABC type) for extinguishing the fire;
- While tackling this incident, make sure you are wearing safety shoes, if not; stand on wooden planks / platform or rubber / synthetic mat;
- If night, then arrange emergency electric supply from outside sources; and
- If possible, disconnect connection with other equipment / machines.

Incident related to Snakes/Insects Bites

- Remove the victim from the risk of a second bite;
- Take off any jewellery or tight clothing near the bite quickly before the swelling starts;
- Calm the patient and keep encouraging him;

- Lift a bitten arm or leg so it is level with your heart;
- Keep the extremity at heart level or lower. In most cases severe complications do not occur until several hours post-bite. If the victim must be transported or walked out, make wise use of those first few hours. If medical help is more than 30 minutes away, tie an elastic wrap two inches above the bite. The wrap would be loose enough to slip a finger underneath it;
- Limit liquid intake because the body pumps the fluids to the bite site, increasing painful swelling. Avoid alcohol which increases metabolism and impair judgment;
- Remember that most bites even from poisonous snakes are not fatal. Panic can increase the danger to the victim by increasing heartbeat;
- Don't excite the victim or even allow the victim to walk if it can be avoided. Doing so will increase the blood circulation, speeding the spread of the venom beyond the area of the bite;
- Don't cut an 'X' or suck out the venom with mouth. This is ineffective and increases trauma in the area of the wound;
- Do not bleed the wound;
- Do not put any ice on the bite area; and
- Snake bite can often cause severe pain at bite site. This can be treated with pain killers like paracetamol. Do not take Aspirin tablet.

Fire and Explosion

- Communication from the spot;
- Apply fire extinguishers and extinguish the fire;
- In case fire is more then
    - Switch off electrical power;
    - Start evacuation with nearby people at open area; and
    - Ensure all the precautionary measures to take that there would not be any fire. - Remain calm and assess the situation;
- The concerned engineer would instruct the workers to reach the nearest assembly point and ask them remain calm;
- Alert the firefighting team or brigade;
- Determine the type of fire and try to extinguish it immediately by the appropriate method;
- There are four categories of Fires, namely:
    - Class A - Ordinary combustibles;
    - Class B - Flammable liquids, Gases, Greases;
    - Class C – Electrical; and Class D – Chemical metals.
    - Use Dry Chemical Extinguishers common for above A, B, C type of Fires (available at site).

Explosion of gas cylinder at storage area

- The individual who is responsible or who discovers the incident would report the incident to WMC; - Immediately barricade the area;
- Use Fire extinguishers (ABC type or DCP) to suppress the fire;
- If casualty is there, provide proper first aid and shift the victim to hospital;
- Inform the local authorities about the incident;
- Seek for external help from fire brigade, if required;
- Depute security guard till the area is cleared;
- Try to put out fire only if it is small and tame; and
- Alert fire department. When necessary, leave the fire fighting to professionals.

Medical Emergency

- In case of medical emergency, inform the nearest hospital regarding the case as soon as the medical emergency is identified;
- Do not move the person until absolutely necessary;
- Provide the following information:
    - Nature of medical emergency,
    - Location of the emergency (address, building, room number), and

- Your name and phone number from which you are calling
- After prescription from the doctor, take the affected person to the nearest hospital for doctor prescription; and
- When the person is under doctor's supervision, undertake the required steps to comply with the local regulatory requirements.

Natural Calamities

- Flooding at Site - Inform the local authority and emergency services etc.;
- If casualty is there, provide first aid and shift the victim to hospital, if required;
- Seek for external help from local authority, fire brigade etc. if required;
- Inform to mechanical department and pump operator (Make all the dewatering pumps working);
- Inform the electrical department to switch off H.T. line, if water level increases rapidly;
- Arrange for passenger vehicles and start evacuation. If vehicles cannot be operated, start evacuation by walking or running;
- If possible, crane and other equipment's may be shifted / marched in a safe place; and
- Always get updated about the weather forecast from weather authority before planning any activity.
- Other Events (such as Landslides, Earthquakes etc.) - Inform the local authority, emergency services etc.;
- If casualty is there, provide first aid and shift the victim to hospital, if required;
- Seek for external help from local police, fire brigade etc. if required; - Inform the electrical department to switch off H.T. line, if water level increases rapidly;
- Arrange for vehicles and start evacuation. If vehicles cannot be operated, start evacuation by walking or running;
- If possible, crane and other equipment's may be shifted / marched in a safe place; and
- Always get updated about the weather forecast from weather authority before planning any activity.

Monitoring

- Inspection: The purpose of an inspection is to identify conditions and hazards in the workplace that can lead to an incident and identify positive conditions, behaviours, and observations. Audits: The purpose of an audit is to evaluate the implementation of systems and processes within this manual against a defined standard.
  i. Informal Inspection and
  ii. Formal Inspection
- Informal Inspection Informal inspections include the daily visual inspection of workplace conditions. These inspections are conducted by all employees as a part of their regular work tasks.
- Formal Inspection/ Monitoring Formal inspections are documented visual tours of the workplace, used to identify hazards and hazardous conditions. Formal project inspections will be conducted weekly by the Project Manager and EHS Officer. All noted deficiencies are to be signed off and communicated to the person in charge.

Audits

Audits are much more detailed than inspections and focus on the overall implementation of the CSMP Plan. This includes such items as communication, administration, documentation, HSE related education, training, practices, and procedures. When supported within a framework of frequency statistical analysis and HSE inspections, this system is very efficient and effective in terms of HSE performance measurement.

Audit findings will indicate areas that are good and areas that may need some improvement. Action plans are developed with responsibilities delegated and timelines designated for items of improvement. Follow up is conducted to ensure that the improvement item action plans have been conducted.

Chance Find Procedure

Purpose

The chance find procedure is a project-specific procedure that outlines the actions required to be implemented if previously unknown heritage resources, particularly archaeological resources, are encountered during the construction or operation of the project. The procedure, as defined in UNDP Standard 4 on Cultural Heritage and national regulations on Preservation of Sites and Artefacts (Amendment) Act No. 21 of 2008 and Protection of Traditional Knowledge and Expressions of Culture Act, 2019, is a process that prevents chance finds from being disturbed until an assessment by a competent authority is made and actions consistent with the requirements are implemented.

Scope

This procedure is applicable to all activities conducted by the Project Management Unit/Site Engineer including the Contractor, that have the potential to uncover a heritage item/site. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during the construction activities. The procedure outlines the roles and responsibilities and the response times required from both project staff, and any relevant heritage authority.

Induction/Training

All personnel, especially those working on earth movements and excavations, shall be provided with the induction/training on the identification of potential heritage items/sites and the relevant actions that require them to take with regards to this procedure during the induction and regular toolbox talks.

Standard Operating Procedure

In case of discovery of physical cultural resources by a person, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during the excavation or construction, the following steps shall be undertaken by the Contractor and PMU:

- All works shall be stopped in the vicinity of the find, until a solution is found for the preservation of these artefacts/chance finds, or advice from the relevant authorities is obtained.
- Immediately notify the supervisor onsite in case of a chance find. The supervisor shall, thereafter, notify the PMU who, in turn, is required to inform the concerned authorities of the discovery.
- The PMU shall record the details of the chance find and undertake photo documentation.
- The discovered site or area shall be delineated and secured to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over.
- The preliminary evaluation of the findings by the concerned authorities shall be undertaken. The officials from the concerned department shall visit the site and undertake an assessment of the site or find to determine its importance. Based on this assessment, the appropriate strategy shall be implemented. The significance and importance of the findings shall be assessed according to the criteria relevant to cultural heritage such as aesthetic, historic, scientific or research, social and economic values of the find.
- If the site is of minor significance (such as isolated or unclear features, and isolated finds) based on the assessment, the findings shall be recorded immediately to minimize disruption to the work schedule of the Contractor.
- In case of significant find, the department shall investigate the find further within two weeks from the date of notification and provide a summary report of the finding.
- The decision on how to handle the finding shall be taken by the concerned department. The PMU shall support the department in removal, transporting or preserving the find to the extent possibly required by the department.
- The construction works could resume only after permission is granted from the concerned department.
- In case no response is received within the 2 weeks period mentioned above, the PMU shall follow up with the concerned department and inform them of the requirement to proceed with the suspended construction works.

Management of Replicable and Non-replicable Heritage

Replicable Heritage

Where tangible cultural heritage that is replicable and not critical is encountered, the following mitigation measures shall be applied:

- Avoidance.
- Minimization of adverse impacts and implementation of restoration measures, in situ.
- Restoration of the functionality of the cultural heritage, in a different location.
- Permanent removal of historical and archaeological artefacts and structures.
- Compensation of loss where minimization of adverse impacts and restoration is not feasible.

Non-replicable Heritage

Most cultural heritage is best protected by in situ preservation since removal is likely to result in irreparable damage or even destruction of the cultural heritage. The non-replicable cultural heritage must not be removed unless all of the following conditions are met:

There are no technical or financial alternatives to the removal.

The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and any removal of the cultural heritage must be conducted using the best available technique advised by the relevant authority and supervised by an archaeologist.

Human Remains Management Options

The handling of human remains, believed to be archaeological in nature, requires communication according to the same procedure described above. The following measures shall be adopted:

- **Avoidance:** The project is redesigned to completely avoid the found remains based on the assessment undertaken by the concerned authorities.
- **Exhumation:** The exhumation of the remains shall be considered in an appropriate manner by the concerned authorities. This will involve the predetermination of a site suitable for the reburial of the remains. Certain ceremonies or procedures may need to be followed before the construction activities recommence in the area of the discovery.

Emergency contact details of the concerned department and contact person shall be maintained by the PMU and Contractor in case of chance find.

Record Keeping

It is pertinent that all finds must be registered. The photolog, copies of communication with decision making authorities, conclusions and recommendations/guidance, implementation reports shall be recorded and maintained by the PMU.

Annexure F: Information sourced from DEPC, 2023

Consultation with Department of Environment

S. No	Questions	Responses
1.	Awareness of the proposed project coming at the respective sites and through whom this information was communicated. If yes, please provide details.	Imran Khan via email
2.	Is there any environmental monitoring station installed to monitor ambient air and noise at the islands especially near the respective proposed project sites falling in Vanuatu? (If yes, please specify the locations and whether it is conducted in house or through a third-party agency/NGO? Please provide the monitoring data for last 2 years (if any)).	At the moment, there is none
3.	At what intervals is the monitoring undertaken and through what media the recording of readings is done? Please provide details	Monitoring by locals through social media platforms
4.	Has the Department undertaken any independent study pertaining to climate change? If yes, please share the details	No
5.	Is there any recent map available of the Island covering the following elements (If yes, please share the details), - Landuse - Drainage Pattern - Ecology and Biodiversity - Geology and Geomorphology - Soil Classification - Natural Hazard - Population Distribution	No maps available that covers the listed layers
6.	Any project developed in the past or is under-construction within or nearby the respective proposed project area (0-5km)? If yes, please share the details on type of project, its extent, features and location (for all four identified sites)	Not sure of the developments happening within those areas of interest
7.	Has the Department undertaken monitoring activities related to any identified environmental risk with respect to increase in pollution, ecology and biodiversity, etc. for any new projects developed/developing in the	Biodiversity studies and environmental monitoring of natural physical processes

S. No	Questions	Responses
	respective proposed project sites? If yes, please share the details on risk, impact and mitigation measures suggested by the Department	
8.	Any complaints/ grievance received from community residing near the respective proposed project areas pertaining to any project development in the area or rise in air emissions or noise levels? If yes, please share the details of concerns and measures adopted to resolve the issue	Often, the local community may be discontent over development issues that would directly affect them. For a specific locality, and any issues in relation to disturbances to sacred (Taboo) area is highly sensitive.
9.	List of applicable Clearances/Permits required and to be obtained from the Government (if any) for the Pico hydro and installation of Solar PV with distribution networks during construction and commissioning phases	Environmental permit from the DEPC. It has to be filled and submitted attached with all the necessary support documents. The support documents checklist can be found at the back of the application form.
10.	Any prior approval required from the Department for cutting trees for the respective proposed projects? If yes, please share details. Also, is there any compensatory afforestation required to be undertaken at the respective proposed project sites? If yes, please mention to what percentage afforestation needs to be undertaken.	Work may commence once permit is granted. No work including clearance may start until permit is granted. Afforestation may be part of the long-term management plan of any development if necessary to help its sustainability.
11.	Are there any natural resources in the respective proposed project area which is used by the community for their livelihood or customery practices? If yes. Please provide details.	The local communities are largely agrarian who practice shifting cultivation for subsistence living and access sources of water and resources found in them to survive and perform cultural activities.
12.	Do you have any concern related to the upcoming projects. Also, what recommendations should be adopted by the project team to minimise any environment risks envisaged for the respective proposed projects?	Awareness to the beneficiaries must be clear. Careful handling of work procedures must be practiced at all times. Environmental risks that may endanger project will be determined during the site assessments.

Date: 23/10/2023

Name and Signature of the Interviewee (including Designation and contact details):

Damien Hinge

Damien Hinge

Environment Officer, Department Environment Protection and Conservation (DEPC)

Name and Signature of Interviewer:

Imran Khan

Imran Khan, VGET project Manager

Annexure G: Species Profile found in Pentecost Island

Table 27: List of Tree species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Neoveitchia brunnea*	Devil Palm	Arecaceae	CR
2	*Carpoxyloon macrospermum*	Carpoxylon Palm	Arecaceae	CR
3	*Agathis macrophylla*	Pacific Kauri	Araucariaceae	EN
4	*Endospermum medullosum*	White wood	Euphorbiaceae	VU
5	*Cycas seemannii*	Logologo	Cycadaceae	VU
6	*Agathis silbae*	Pacific Kauri	Araucariaceae	NT
7	*Veitchia spiralis*	Kajewskia Palm	Arecaceae	NT
8	*Canarium indicum*	Galip Nut	Burseraceae	LC
9	*Terminalia catappa*	Tavola	Combretaceae	LC
10	*Liquidambar styraciflua*	Sweet Gum	Altingiaceae	LC
11	*Pinus caribaea*	Caribbean Pine	Pinaceae	LC
12	*Cocos nucifera*	Coconut	Arecaceae	-
13	*Cordia alliodora*	Manjack	Boraginaceae	LC
14	*Metroxylon salomonense*	Sago Palm	Arecaceae	-
15	*Metroxylon warburgii*	Natangura Palm	Arecaceae	-
16	*Pandanus nogaret*	-	Pandanaceae	-
17	*Callophyllum inophyllum*	Tamanu	Clusiaceae	LC
18	*Ficus granatum*	Vanuatu Wild Fig	Moraceae	-
19	*Clinostigma harlandii*	-	Arecaceae	-
20	*Citrus grandis*	Pamelo	Rutaceae	LC
21	*Heterospathe uniformis*	Sagisi Palm	Arecaceae	-
22	*Spathodea campanulata*	African Tulip Tree	Bignoniaceae	LC
23	*Bruguiera parviflora*	Lenggadai	Rhizophoraceae	LC
24	*Physokentia tete*	-	Arecaceae	-
25	*Rhizophora mucronata*	True Mangrove	Rhizophoraceae	LC
26	*Ceriops tagal*	Spurred Mangrove	Rhizophoraceae	LC

S. No.	Scientific Name	Common Name	Family	IUCN Status
27	*Sonneratia alba*	Mangrove Apple	Lythraceae	LC
28	*Avicennia marina*	Sweet Scented Apple Mangrove	Acanthaceae	LC
29	*Citrus aurantium*	Bitter Orange	Rutaceae	-
30	*Xylocarpus granatum*	Cedar Mangrove	Meliaceae	LC
31	*Barringtonia procera*	Cut Nut	Lecythidaceae	LC
32	*Heritiera littoralis*	Tulip Mangrove	Malvaceae	LC
33	*Rhizophora apiculata*	Tall Stilt Mangrove	Rhizophoraceae	LC
34	*Rhizophora stylosa*	Spotted Mangrove	Rhizophoraceae	LC
35	*Bruguiera gymnorhiza*	Oriental Mangrove	Rhizophoraceae	LC
36	*Lumnitzera littorea*	Black Mangrove	Combretaceae	LC
37	*Artocarpus altilis*	Breadfruit	Moraceae	-
38	*Averrhoa carambola*	Star Fruit	Oxalidaceae	-
39	*Carica papaya*	Papaw	Caricaceae	DD

Table 28: List of Shrub species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Mimosa diplotricha*	Nila Grass	Fabaceae	-
2	*Excoecaria agallocha*	Milky Mangrove	Euphorbiaceae	LC
3	*Cajanus cajan*	Pigeon Pea	Fabaceae	-
4	*Citrus hystrix*	Makrut lime	Rutaceae	-

Table 29: List of Herbs species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Halophila ovalis*	Paddle Weed	Hydrocharitaceae	LC
2	*Halodule pinifolia*	Needle Seagrass	Cymodoceaceae	LC
3	*Cymodocea serrulata*	Serrated Ribbon Seagrass	Cymodoceaceae	LC
4	*Thalassia hemprichii*	Turtle Grass	Hydrocharitaceae	LC
5	*Zannichellia palustris*	Horned Weed	Potamogetonaceae	LC

S. No.	Scientific Name	Common Name	Family	IUCN Status
6	*Landoltia punctata*	Dotted Duckweed	Araceae	LC

Table 30: List of Climber species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Mikania micrantha*	Bitter Vine	Asteraceae	-
2	*Momordica charantia*	Bitter Gourd	Cucurbitaceae	-

Table 31: List of Mammal species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Pteropus anetianus*	Vanuatu Flying Fox	Pteropodidae	VU
2	*Dugong dugon*	Dugong	Dugongidae	VU
3	*Mus musculus*	House Mouse	Muridae	LC
4	*Pteropus tonganus*	Pacific Flying Fox	Pteropodidae	LC
5	*Pteropus tonganus*	Insular Flying Fox	Pteropodidae	LC

Table 32: List of Reptile species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Caretta caretta*	Loggerhead Turtle	Cheloniidae	VU
2	*Dermochelys coriacea*	Leatherback Turtle	Dermochelyidae	VU
3	*Gehyra georgpotthasti*	-	Gekkonidae	VU
4	*Laticauda frontalis*	Yellow Lipped Sea Snake	Elapidae	NT
5	*Hemiphyllodactylus typus*	Indo-Pacific slender gecko	Gekkonidae	LC
6	*Emoia nigra*	Black emo skink	Scincidae	LC
7	*Candoia bibroni*	Pacific Boa	Boidae	LC
8	*Cryptoblepharus novohebrididcus*	-	Scincidae	LC
9	*Lepidodactylus lugubris*	Mourning gecko	Gekkonidae	LC
10	*Laticauda laticaudata*	Blue lipped sea krait	Elapidae	LC

S. No.	Scientific Name	Common Name	Family	IUCN Status
11	*Emoia sanfordi*	Sanford's Tree Skink	Scincidae	LC
12	*Emoia caeruleocauda*	Pacific Blue Tailed Skink	Scincidae	LC
13	*Gekko vittatus*	Lined Gecko	Gekkonidae	LC
14	*Gehyra insulensis*	Pacific Stump Toed Gecko	Gekkonidae	LC
15	*Hydrophis platurus*	Yellow-bellied Sea Snake	Elapidae	LC
16	*Hemidactylus frenatus*	Common House Gecko	Gekkonidae	LC
17	Indotyphlops braminus	Brahminy blind snake	Typhlopidae	LC
18	*Nactus multicarinatus*	Solomons slender toad gecko	Gekkonidae	LC

Table 33: List of Avifaunal species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Calidris acuminata*	Sharp tailed sandpiper	Scolopacidae	VU
2	*Pterodroma brevipes*	Collared petrel	Procellariidae	VU
3	*Megapodius layardi*	Vanuatu Scrubfowl	Megapodiidae	VU
4	*Charmosyna palmarum*	Palm Lorikeet	Psittaculidae	VU
5	*Ardenna bulleri*	Bullere's Shearwater	Procellariidae	VU
6	*Pterodroma leucoptera*	White Winged Petrel	Procellariidae	VU
7	*Pterodroma cervicalis*	White-necked Petrel	Procellariidae	VU
8	*Aplonis zelandica*	Rusty winged starling	Sturnidae	NT
9	*Calonectris leucomelas*	Streaked shearwater	Procellariidae	NT
10	*Erythrura cyaneovirens*	Red-headed parrotfinch	Estrildidae	NT
11	*Limosa limosa*	Black tailed godwit	Scolopacidae	NT
12	*Pseudobulweria rustrata*	Tahiti petrel	Procellariidae	NT
13	*Esacus magnirostris*	Beach Thick-knee	Burhinidae	NT
14	*Calidris ruficollis*	Red Necked Stint	Scolopacidae	NT
15	*Limosa lapponica*	Bar-tailed Godwit	Scolopacidae	NT
16	*Tringa brevipes*	Grey-tailed Tattler	Scolopacidae	NT

S. No.	Scientific Name	Common Name	Family	IUCN Status
17	*Pterodroma inexpectata*	Mottled Petrel	Procellariidae	NT
18	*Phoebastria nigripes*	Black Footed Albatross	Diomedeidae	NT
19	*Numenius phaeopus*	Eurasian whimbrel	Scolopacidae	LC
20	*Gerygone flavolateralis*	Fan tailed gerygone	Acanthizidae	LC
21	*Gallus gallus*	Red junglefowl	Phasianidae	LC
22	*Artamus leucoryn*	White breasted woodswallow	Artamidae	LC
23	*Tringa incana*	Wandering Tattler	Scolopacidae	LC
24	*Circus approximans*	Swamp harrier	Accipitridae	LC
25	*Myzomela cardinalis*	Cardinal myzomela	Meliphagidae	LC
26	*Sterna sumatrana*	Black naped tern	Laridae	LC
27	*Anous minutus*	Black noddy	Laridae	LC
28	*Phaethon lepturus*	White tailed tropic bird	Phaethontidae	LC
29	*Phaethon rubricauda*	Red tailed tropic bird	Phaethontidae	LC
30	*Turdus poliocephalus*	Island thrush	Turdidae	LC
31	*Cuculus optatus*	Oriental Cuckoo	Cuculidae	LC
32	*Neolalage banksiana*	Buff bellied monarch	Monarchidae	LC
33	*Porphyrio porphyrio*	Western swamphen	Rallidae	LC
34	*Egretta sacra*	Pacific reef heron	Ardeidae	LC
35	*Anas superciliosa*	Pacific black duck	Anatidae	LC
36	*Onychoprion anaethetus*	Bridled Tern	Laridae	LC
37	*Urodynamis taitensis*	Long tailed koel	Cuculidae	LC
38	*Hypotaenidia Philippensis*	Buff banded rail	Rallidae	LC
39	*Tachybaptus novaehollandiae*	Australasian grebe	Podicipedidae	LC
40	*Lalage leucopyga*	Long tailed triller	Campephagidae	LC
41	*Myiagra caledonica*	Melanesian flycatcher	Monarchidae	LC
42	*Aerodramus vanikorensis*	Uniform swiftlet	Apodidae	LC
43	*Stercorarius pomarinus*	Pomarine jaeger	Stercorariidae	LC

S. No.	Scientific Name	Common Name	Family	IUCN Status
44	*Fregetta grallaria*	White bellied storm petrel	Oceanitidae	LC
45	*Ptilinopus tannensis*	Tanna fruit dove	Columbidae	LC
46	*Todiramphus chloris*	Collared kingfisher	Alcedinidae	LC
47	*Tyto alba*	Common barn owl	Tytonidae	LC
48	*Ducula bakeri*	Vanuatu imperial pigeon	Columbidae	LC
49	*Accipiter fasciatus*	Brown goshawk	Accipitridae	LC
50	*Pterodroma solandri*	Providence Petrel	Procellariidae	LC
51	*Aythya australis*	Hardhead	Anatidae	LC
52	*Columba vitiensis*	Metallic Pigeon	Columbidae	LC
53	*Zosterops flavifrons*	Vanuatu White Eye	Zosteropidae	LC
54	*Sterna dougallii*	Roseate Tern	Laridae	LC
55	*Rhipidura spilodera*	Vanuatu Streaked Fantail	Rhipiduridae	LC
56	*Fregata minor*	Great Frigate Bird	Frigatidae	LC
57	*Falco peregrinus*	Peregrine Falcon	Falconidae	LC
58	*Gliciphila notabilis*	Vanuatu Honey-eater	Meliphagidae	LC
59	*Gygis alba*	White Tern	Laridae	LC
60	*Hirundo javanica*	House Swallow	Hirundinidaemicroca	LC
61	*Microcarbo melanoleucos*	Little Pied Cormorant	Phalacrocoracidae	LC
62	*Pluvialis fulva*	Pacific Golden Plover	Charadriidae	LC

Table 34: List of Butterfly species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Badamia atrox*	-	Hesperiidae	-
2	*Hasora chromus*	Common Banded Awl	Hesperiidae	-
3	*Borbo cinnara*	Rice Swift	Hesperiidae	-
4	*Papilio fuscus*	Canopus Swallowtail	Papilionidae	-
5	*Catopsilia scylla*	Orange Emigrant	Pieridae	-
6	*Appias athama*	Rare Albatross	Pieridae	-

S. No.	Scientific Name	Common Name	Family	IUCN Status
7	*Appias paulina*	Common Albatross	Pieridae	-
8	*Cepora perimale*	Caper Gull	Pieridae	-
9	*Delias nysa*	Yellow Sptted Jezebel	Pieridae	-
10	*Nacaduba kurava*	-	Lycaenidae	-
11	*Catochrysops taitensis*	-	Lycaenidae	-
12	*Famegana alsulus*	Black Spotted Grass Blue	Lycaenidae	-
13	*Zizina labradus*	Common Grass Blue	Lycaenidae	-
14	*Jamides celeno*	Common Cerulean	Lycaenidae	-
15	*Parantica pumila*	Least Tiger	Nymphalidae	LC
16	*Danaus affinis*	Malay Tiger	Nymphalidae	LC
17	*Danaus chrysippus*	Plain Tiger	Nymphalidae	-
18	*Melanitis amabilis*	-	Nymphalidae	-
19	*Hypolimnas octocula*	Mariana Eight Spot Butterfly	Nymphalidae	-
20	*Vagrans egista*	-	Nymphalidae	-
21	*Euploea boisduvalii*	Pacific Crow Butterfly	Nymphalidae	-

Table 35: List of Fish species present in Pentecost Island

S. No.	Scientific Name	Common Name	Family	IUCN Status
1	*Sicyopterus aiensis*	-	Gobiidae	NT
2	*Akihito vanuatu*	Vanuatu's Emperor	Gobiidae	LC
3	*Lentipes kaaea*	New Caledonian Red Nose Goby	Gobiidae	LC
4	*Stenogobius yataeiensis*	-	Gobiidae	LC
5	*Stiphodon sapphirinus*	-	Gobiidae	LC
6	*Sicyopus pentecost*	-	Gobiidae	DD
7	*Stiphodon astilbos*	-	Gobiidae	DD
8	*Stiphodon mele*	-	Gobiidae	DD