Initial Environmental Examination

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Tonga: Nuku'alofa Network Upgrade under the Pacific Renewable Energy Investment Facility

Prepared by Tonga Power Limited for the Asian Development Bank.

ABBREVIATIONS

ADB	–	Asian Development Bank
ATFP	–	Aotearoa Tonga Forest Products
CEMP	–	Construction environmental management plan
CLO	–	Community liaison officer
COEP	–	Codes of Environmental Practice
CCP	–	Consultation and Communication Plan
CSS	–	Country safeguards system
DFAT	–	Department of Foreign Affairs and Trade
DOE	–	Department of Environment
EIA	–	Environmental Impact Assessment
EIA Unit	–	Environmental Impact Assessment Unit
EHSG	–	Environmental Health and Safety Guidelines
ESMP	–	Environmental and social management plan
GDP	–	Gross domestic product
GRM	–	Grievance redress mechanism
HSP	–	Health and safety plan
IEE	–	Initial environmental examination
IUCN	–	International Union for Conservation of Nature
MAFFF	–	Ministry of Agriculture, Food, Forestry and Fisheries
MEIDECC	–	Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications
MFAT	–	Ministry of Foreign Affairs and Trade
MDHRA	–	Multi-Hazard Disaster Risk Assessment
MLSNR	–	Ministry of Lands, Survey and Natural Resources
MOI	–	Ministry of Infrastructure
NBSAP	–	National Biodiversity Strategy and Action Plan
PMU	–	Project Management Unit
SIDS	–	Small island developing state
SPCZ	–	South Pacific convergence zone
SPS	–	Safeguard Policy Statement 2009
TPL	–	Tonga Power Limited
TOR	–	Terms of reference
TWB	–	Tonga Water Board

NOTE

USD ($) is the currency used in the report unless otherwise specified

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Executive Summary

1. **Background.** The Government of Tonga (the government) has been implementing a program of rehabilitation and upgrade of the electrification network to improve power distribution across the island of Tongatapu, in the Kingdom of Tonga (Tonga). This work involves the replacement and upgrade of wooden utility poles, installation of aerial bundled cable (ABC) and replacing overhead powerlines with underground cables from power poles to residences. The project is part of a wider program being implemented in phases. The first phase of the program (Areas 1 and 2), now completed, was implemented under the Cyclone Gita recovery project, with funding from Asian Development bank (ADB) and the Government of New Zealand. Upgrades are currently ongoing in Area 3, financed by ADB and the Government of Australia. Area 5 upgrades, also to be financed by the ADB, will be undertaken as the Nuku'alofa Network Upgrade Project (the project) and which is the subject of this initial environmental examination (IEE).

2. The government has requested continued support from the ADB to upgrade the remaining 25% of the network in Tongatapu (Areas 4 and 5). Area 5 occupies the western end of the NNUP project site, encompassing Sopu, Hofoa and Sia'atoutai. The priority is Area 5, as this area is critical to evacuate the electricity generated from both the ongoing and the scheduled renewable energy developments located west of Nuku'alofa. Following the completion of Area 5, the remaining works for Area 4, located on the eastern end of the Nuku'alofa peninsula will be implemented in conjunction with the proposed works on the upgrade of the Queen Salote international wharf, which is located in the boundary of Area 4, and reported separately.

3. This project, in Area 5, will restore reliable access to the electricity supply network and make it more resilient to extreme weather and disasters. More specifically, it will upgrade the old, inefficient, and less climate-resilient grid assets, i.e. cables, power poles, distribution transformers, and switchgear. The project will result in improved electrification network infrastructure and thus enhance the capacity of the government in providing safer and more resilient and reliable network infrastructure for energy security in Tonga.

4. **Institutional arrangements**. The Ministry of Finance will be the executing agency for this project and Tonga Power Limited (TPL) will be the implementing agency. The MOF has responsibilities that include supervising the implementation of the project and establishing and managing the project coordinating committee (PCC). The PCC will consist of TPL and national policy sector bodies; Ministry of Public Enterprises (MPE) and Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communication (MEIDECC). The PCC will be responsible for overall direction, guidance, and providing an oversight role for the project.

5. TPL will implement the project through its current project management unit (PMU). The PMU will recruit a full-time environment officer to implement and monitor safeguards and all project compliance with capacity building support provided by the project. TPL will also carry out the operations and maintenance (O&M) of the network. TPL intends to implement the project with their current counterpart staff (52 local and one international staff) following the completion of the current works in Area 3 by September 2022. It is envisaged that this project will be implemented between Q4 2022 and October 2026.

6. The project will support TPL in implementation by recruitment to the PMU of a project manager and a specialist to implement the gender action plan. TPL already has an Independent Engineer for supervision and certification who will be supported by the environment officer from the PMU's ESU.

7. The project is estimated to cost about $8.70 million with an indicative grant from ADB of $7.2 million. The government and TPL will provide in-kind contributions of up to $1.5 million.

8. **Screening of the project.** The project has been screened based on an understanding of the proposed works and the site conditions of Area 5, and the experience of the three previous projects under the program have also been taken into account. Given that the project, based on the most sensitive component, is likely to create risks and impacts that are site-specific, largely related to the construction stage, and for which mitigation measures can be readily designed and implemented, the project has been screened as category B for environment in accordance with the ADB Safeguard Policy Statement 2009 (SPS).

9. **Due diligence**. In addition to the SPS, the project will comply with the Tongan country safeguards system (CSS) including Environmental Impact Assessment (EIA) Act 2003. Due diligence has been undertaken for the project and is reported in this IEE, which is considered the appropriate level of assessment for a category B project, and which will also be used as the basis for application for development consent under the CSS.

10. **Land ownership and access**. The project in Area 5 will not involve involuntary resettlement or land acquisition. The upgrading works will be undertaken entirely within government-owned land. The proposed works will not take or require any additional land. Consequently, a resettlement plan is not required for this project since the land has been made available through negotiated settlement, as reported in the land due diligence report. No dwellings, buildings (either temporary or permanent) or non-residential assets will be affected.

11. **Key environmental impacts**. The potential environmental and social impacts arising from the project activities have been evaluated based on existing biological, physical and socio-economic conditions of the project area. Baseline surveys and community consultations were used to determine the likelihood of impacts in the pre-construction, construction, operational phases. Table ES1.1 summarizes the key social and environmental impacts of the network upgrade and maintenance activities in Area 5 and proposed mitigation measures:

Table ES1.1: Summary of key environmental impacts

Project activity/impact	Mitigation measures
Ecological	
- Vegetation removal from cutting trees and vegetation that overhang road reserves – for pole installation and clearance of conductors	- In case clearing of vegetation and trimming of trees is required, it will be undertaken in coordination with local offices of the Lands and Surveys Department, DOE, and tree or land owners. - Construction wastes will be sorted for recycling and disposal at the landfill.
- Clearing of small land areas for the footing of the poles and trimming of trees near the conductors may be required, and some trees that overhang the road reserve may be trimmed.	- Marking of trees or vegetation to be removed within the road reserve (if any) prior to trimming and strict control on clearing activities to ensure minimal clearance. - Any removal of trees / vegetation on non-road reserve to facilitate infrastructure investment will require consultation with the tree owner and if trees require trimming or removal

Project activity/impact	Mitigation measures
	the tree owners will be compensated in accordance with rates prescribed under law. - Mangrove trees affected in one section of the project area are part of a modified habitat as a result of road construction bisecting the mangrove area and effects from invasive species
Social	
- Minor increases in traffic, particularly heavy traffic, from the movement of equipment and machinery.	- Construction activities only undertaken during the day time and local communities informed of the construction schedule.
- Minor and transient construction impacts such as dust, noise, air emissions created by trucks and heavy construction equipment.	- Proper maintenance and operation of construction equipment. - Selection of installation techniques and machinery to minimize ground disturbance and noise vibrations.
Health and safety	
- Potential impacts from handling, storage and transportation of discarded materials	- Selection of suitable storage areas for materials with screening where necessary. - Solid materials will be discarded to approved areas with minimum visibility from residences and roads - Fuel and other hazardous materials will be securely stored above high flood level. - Environmental, health and safety training sessions will be provided to all workers. - Signage and barriers will be deployed around work areas to prevent health and safety risks to bystanders.
- Exposure to arsenic from timber treatment process	- Discarded treatment chemicals will only be disposed off at designated authorized places. - Environmental, health and safety training sessions will be provided to all workers.
Cumulative	
- Sustainability of forest resources	- Local timber supplier will continue replanting programs and allow recovery period for pine tree resources to reach maturity

12. **Environmental and social management plan**. The risks and impacts and measures to mitigate these in the design and pre-construction, construction, and operation stages of the project have been translated into an environmental and social management plan (ESMP). The ESMP also identifies the monitoring requirements to ensure that mitigation is in place and operating effectively. The ESMP also identifies the parties responsible for implementation of the mitigation measures and monitoring requirements. The requirements set out in the ESMP, once the IEE is approved by ADB and the government (under the CSS), along with the development consent and conditions, will be reflected in the construction EMP (CEMP), specific to how they will complete the works, will be developed by TPL. The CEMP will be reviewed by the environment officer of the PMU. Support will be provided to the PMU's environment officer through PARD's regional safeguards technical assistance[1], this will include an independent review of the CEMP that will be prepared by TPL. ADB will also provide comment on the CEMP. Advice will be given to TPL that the CEMP requires revision or may be approved by the PMU, and the Independent Engineer may issue notice to commence works. TPL will nominate a member of the installation team as responsible for monitoring and reporting project activities throughout the project construction phase. The PMU will monitor TPL's compliance with the approved CEMP through routine monitoring conducted by the environmental officer and inspections conducted by the Independent Engineer. ADB will conduct regular project reviews through missions.

[1] Approved in 2020. *Sustainable Capacity Development for Safeguards in the Pacific*. (TA 6597-REG).

13. **Consultation and stakeholder engagement**. A community and consultations plan (CCP) has been developed for the project, this will be updated by the PMU in the early stages of implementation. A stakeholder consultation process was carried out with communities within the project area and key stakeholders. Project information was presented to stakeholders that would be directly and indirectly affected from the project to ascertain the social, environmental and economic impacts of the project. This will contain detailed description of engagement approaches and grievance redress mechanism. Information disclosure, including disclosure of this initial environmental examination complies with ADB's Access to Information Policy (2018) in addition to requirements of the CSS.

14. **Grievance redress**. A grievance redress mechanism (GRM), based on similar processes implemented by TPL for other projects, will be established for the project early in its implementation. The GRM provides a structure for stakeholders to make any project-related complaint and a transparent and consistent mechanism for the complaints to be resolved both locally and centrally. The GRM will be monitored and reported in progress reports and semi-annual safeguards monitoring reports. The CCP will contain details of the GRM.

15. **Conclusions**: This IEE concludes that the potential environmental impacts associated with the electrification upgrade works can be prevented and mitigated adequately. The positive impacts can be strengthened with the implementation of mitigation and enhancement measures identified in the ESMP. Overall, the proposed project is unlikely to cause significant adverse environmental or social safeguards impact. This is due to the following findings:

- Project specific surveys have been conducted and concluded that with identified mitigation, risks and impacts can be adequately addressed;
- A dedicated record and site surveys concluded that there are no sites of cultural heritage significance or areas of natural or critical habitats within the area of influence of the project. The project area comprises modified habitat due to reclamation and development;
- Typical construction impacts due to the operation of construction plant, processing areas, etc., and operation impacts can be readily mitigated by good site practice and standard procedures already adopted by TPL in the Codes of Environmental Practice, giving rise to negligible or at worst, minor temporary environmental impacts.

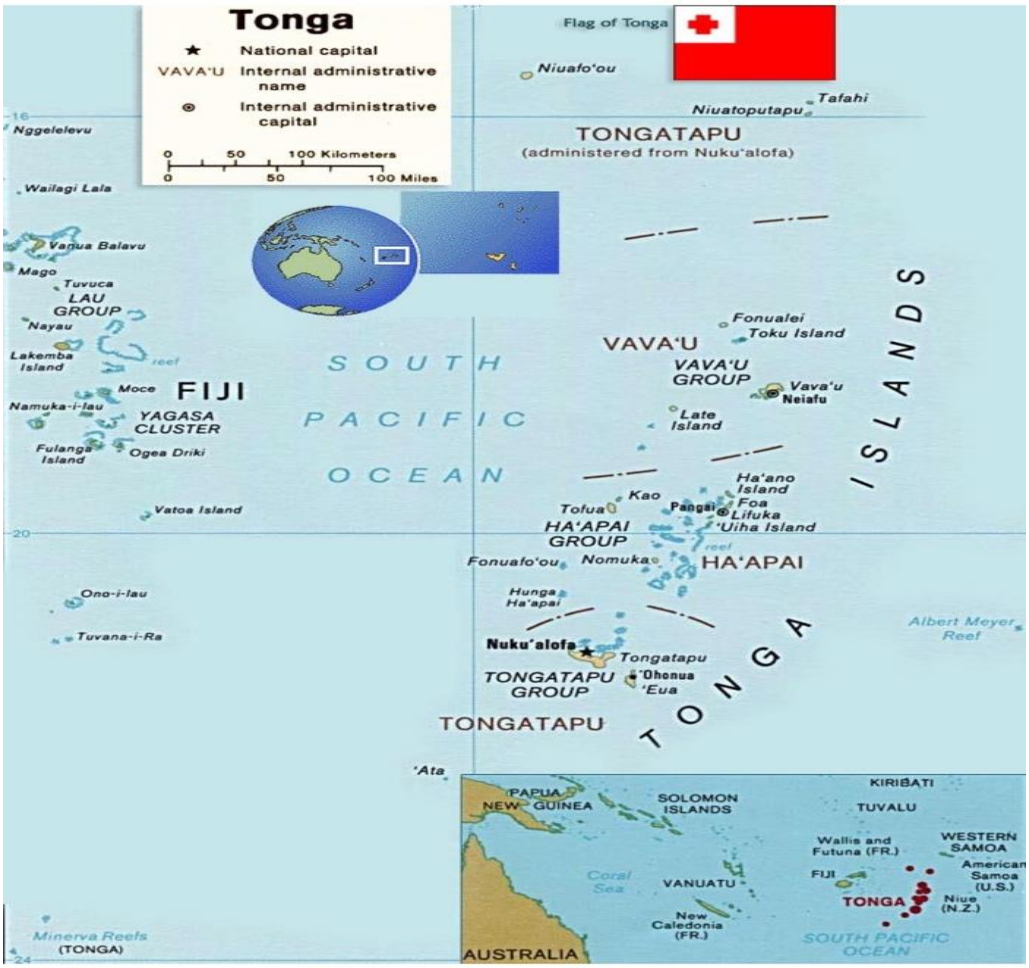
16. The findings of the IEE suggest that the environmental and social benefits of the project far outweigh the low-medium risk and temporary impacts that will arise mostly during the construction stage. Provided that the ESMP is properly updated and implemented, there will be no irreversible impacts arising from the project. The project will result in a more stable electrification network that will strengthen resilience to natural disasters and thereby improve energy security in Tonga.

1 Introduction

1.1 Background to the Project

1. **Location.** Tonga is a small island developing state (SIDS) and is also classified as a 'fragile and conflict-affected situation' country, consisting of 177 islands with a total area of 748 kilometers (km)^2 divided into the following four island groups: Tongatapu, Ha'apai, Vava'u, and Niuas (as shown on Figure 1.1). A total of 36 islands in Tonga are inhabited. Tonga's total population is estimated at 103,000. About 75% of the population lives on Tongatapu, the main island where the capital, Nuku'alofa, is located. The entire country is considered remote from most markets and resources, lying in the Pacific about 1,000 kilometers (km) from Fiji and more than 4,000 km from New Zealand. Among others, Tonga is facing development challenges associated with climate change and high electricity network losses.

Figure 1.1: Map of Tonga

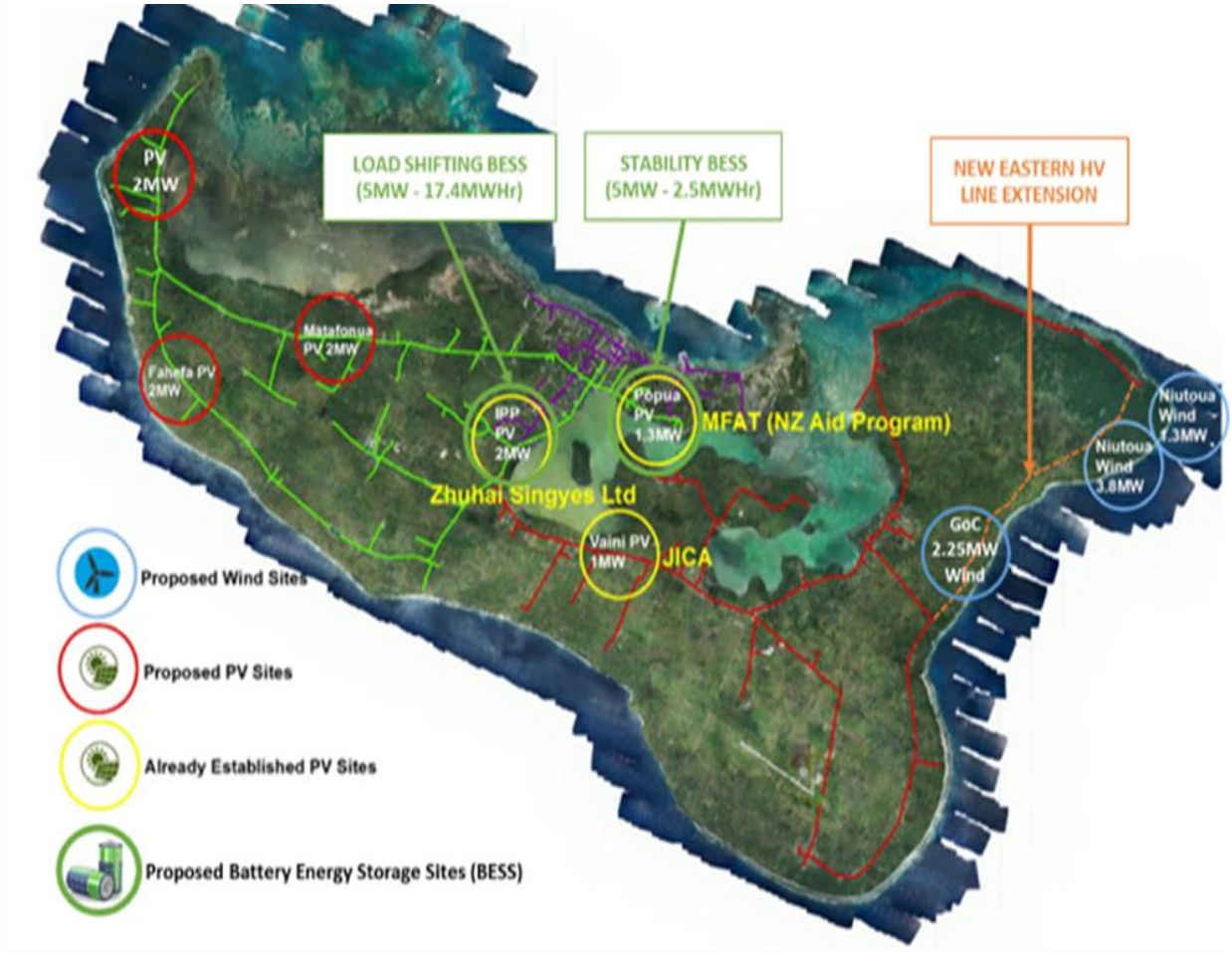


1.1.1 Power supply and distribution system

2. **Power Supply**. Tonga Power Limited (TPL) is a government-owned, vertically integrated public enterprise under the oversight of the Ministry of Public Enterprises and the cabinet. TPL operates four independent grids for on-grid electricity services. These are on the main island of Tongatapu, and main islands of the Vava'u, Ha'apai, and Eua island groups, where it generates, distributes, and retails electricity, and provides operation and maintenance services.

3. Like all of Tonga, Nuku'alofa is highly dependent on diesel for energy and electricity generation. For all of Tongatapu, overall installed energy capacity is nearly 20 megawatts (MW), most of which (14 MW) is conventional diesel capacity from the Popua Power Station. As shown in Figure 1.2, the remaining capacity currently comes from four renewable sources – three solar farms and a wind farm (the Niutoua Wind Farm in the northwest corner of Tongatapu is already operational). Battery energy storage systems (BESS) are currently located at the Popua Power Station and at the independent power producer solar farm (1 MW each).

Figure 1.2 Current and planned renewable energy sources and radial feeders on Tongatapu



4. Figure 1.2 also shows the planned renewable energy sources, which include three new solar farms to the east and two new wind farms to the west (not shown are two solar farms planned to the southeast). In addition, two additional BESS units will be installed on Tongatapu under the Tonga Renewable Energy Project (TREP).[2] These units, also to be located at the Popua Power Station (for grid stability) and the solar farm (for load shifting), will complement the current and planned renewable energy system on Tongatapu. These units will facilitate the investments in solar and wind energy plants and increase the performance of these plants.

5. **Power Distribution**. The power supply and distribution network on Tongatapu is decentralized by design. When completed, the solar and wind farms will feed directly into three existing feeders (shown by the green, purple, and red lines in Figure 1.2), which branch out from the main Popua Power Station. For Area 5, the feeder is currently radial, meaning it has only one power source for a group of customers. It is the simplest and least costly network scheme and also the most vulnerable in a storm. A power failure, short-circuit, or a downed power line would interrupt power in the entire line, which must be fixed before power can be restored. However, there are plans to install ring feeders to enable back feeding and rerouting of energy supply in case of service interruptions (as might happen after a storm). The power distribution system (grid) requires considerable investment and operation and maintenance efforts.[3] It is comprised of wooden utility poles for high voltage (HV) and low voltage (LV) overhead power lines, pole-mounted equipment, ground-mounted transformers, and a few sections of underground power lines. The typical utility pole on Tongatapu is made of pine or other softwood and is anchored about 1.5-2 m into the ground with a concrete foundation. HV poles are approx. 11m tall on average and approximately 350-450mm in diameter, while LV poles are approx. 9m tall on average and approximately 200-300mm in diameter.

Plates 1.1 a & b: Current power distribution equipment in Nuku'alofa

Utility poles and equipment

Ground-mounted transformers

[2] This ADB-supported project, funded through the Green Climate Fund, aims to decrease reliance on imported fuel and increase Tonga's renewable energy generation to achieve its nationally determined targets of 50% renewable generation by 2030.

[3] For TPL, power distribution assets represent 42% of the power system investments (compared to an average of between 20% and 30% for electricity industries).

1.1.2 Challenges for the electricity network

6. **Climate change vulnerability.** Like other SIDS in the Pacific, Tonga is highly vulnerable to external economic shocks and climate change. The country is already experiencing the effects of climate change. Increasing variability in rainfall patterns is causing flooding and droughts in some locations. Increasing ocean temperature has led to coral bleaching and destruction of natural coastal barriers, and sea-level rise contributes to coastal erosion. These changes have heightened Tonga's exposure to disasters brought about by tropical cyclones and storm surges, which have inflicted significant economic losses. A cyclone in 2002 resulted in losses of $60 million, and losses from another one in 2010 reached $22 million. Tropical Cyclone Gita in 2018 resulted in total damage and losses of about $164 million, which is equivalent to nearly 38% of the country's nominal 2017 gross domestic product. The total recovery and reconstruction cost is estimated at $148.7 million, of which $45.9 million is for the energy sector, including the cost of reconstruction of the power grid infrastructure assets on Tongatapu to a higher standard of disaster resilience.

7. **High network losses.** The power distribution system is part of the electricity supply chain and requires considerable investment and operation and maintenance efforts. Power distribution assets typically represent 20%–30% of the required power system investments in electricity industries worldwide. Still, this figure rises to about 42% for TPL. The standard losses in rural power distribution networks are about 5%, yet the rate is more than twice as high in Tonga at around 10.5%. Greater losses mean that more fuel is consumed in power generation, which makes improving the efficiency of the country's power system a matter of paramount importance for the government.

1.2 Overview of the Project

8. **Government programs.** To address the dual challenges of reducing high technical losses and incorporating climate resilience features for the grids in Nuku'alofa, TPL has been implementing the Tonga Village Network Upgrade Program (TVNUP). Under the TVNUP, about 50% of TPL's grids in Nuku'alofa have already been rehabilitated. In 2018, of the grids that had not yet been upgraded, 46% were damaged by Cyclone Gita, compared with damage of only 4.7% of the upgraded grids. The experience from TVNUP clearly demonstrates the resilience benefits of updating inefficient and aging power network infrastructure and building back better.

9. The Government of Tonga (the government) has been implementing a program of rehabilitation and upgrade of the electrification network to improve power distribution across Tongatapu. This work involves the replacement and upgrade of wooden utility poles, installation of aerial bundled cable (ABC) and replacing overhead powerlines with underground cables from power poles to residences. The project is part of a wider program being implemented in phases. The first phase of the program (Areas 1 and 2), now completed, was implemented under the Cyclone Gita recovery project, with funding from Asian Development bank (ADB) and the Government of New Zealand. Upgrades are currently ongoing in Area 3, financed by ADB and the Government of Australia. Area 5 upgrades, also to be financed by the ADB , will be undertaken as the Nuku'alofa Network Upgrade Project (the project) and which is the subject of this initial environmental examination (IEE).

10. The government has requested continued support from the ADB to upgrade the remaining 25% of the network in Tongatapu (Areas 4 and 5). Area 5 occupies the western end of the NNUP project site, encompassing Sopu, Hofoa and Sia'atoutai. The priority is Area 5, as this area is critical to evacuate the electricity generated from both the ongoing and the scheduled renewable energy developments located west of Nuku'alofa. Following the completion of Area 5, the remaining works for Area 4, located on the eastern end of the Nuku'alofa peninsula will be implemented in conjunction with the proposed works on the upgrade of the Queen Salote international wharf, which is located in the boundary of Area 4, and reported separately.

11. **Proposed project.** The project will restore reliable access to the electricity supply network and make it more resilient to extreme weather and disasters by repairing the network infrastructure and upgrading them to a higher standard of disaster resilience. The "building back better" activities will follow the overall plans for upgrading the Nuku'alofa network. The project will support the government in upgrading the remaining 25% of the network in Tongatapu, with Area 5 contributing 10% to the upgrade of old, inefficient, and less climate-resilient grid assets, i.e., cables, poles, distribution transformers, and switchgear covering the entire Area 5.

12. **Impact, outcome and outputs.** The Project's impact is aligned with improved reliable electricity supply in Nuku'alofa. The Project's outcomes are reduced technical power losses and improved climate resilience in Nuku'alofa. The project has the following outputs:

- Output 1: Nuku'alofa electricity network system improved. This output will: rehabilitate 16.5 km of 11 kilovolt (kV) medium-voltage transmission network; (ii) upgrade 50 km of 0.4 kV low-voltage distribution network in seven villages; (iii) climate and disaster proof Nuku'alofa electricity network benefiting 1,240 customer connections; and (iv) connect 59 new households.[15]
- Output 2: Public management capacity of TPL improved. This output involves: (i) improving the project management capacity of TPL; and (ii) enhancing gender inclusiveness of TPL operations.

13. **Implementation arrangements**. The Ministry of Finance will be the executing agency and TPL will be the implementing agency. The Project Steering Committee (PSC) will provide the required oversight. The PSC will be chaired by the Minister of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change, and Communication (MEIDECC). The Department of Environment (DOE) will provide technical oversight in terms of technical assistance and compliance with country safeguard systems (CSS). They will also assist TPL in public consultations prior to implementation of the project and participate in monthly monitoring as required under the environmental and social management plan (ESMP). TPL will retain the current PMU staff engaged for the TREP and Cyclone Gita Recovery Project. TPL intends to implement the project through the PMU and staff (52 local and 1 international staff) following the completion of the current works in Area 3 by September 2022. It is envisaged that this project will be implemented between Q4 2022 and October 2026. TPL will recruit a full-time environment specialist to the PMU to monitor safeguards compliance and deliver and/or receive capacity building support provided by the project. The project will support TPL in implementation by recruitment to the PMU of a project manager and a specialist to implement the gender action plan. TPL already has an Independent Engineer for supervision and certification, who will be supported by the environment officer from the PMU in respect of monitoring compliance with the safeguard requirements.

1.3 Purpose and Objective of IEE

14. **Safeguard screening and categorization**. A screening was carried out, considering the scale and types of works to be undertaken and conditions of the project area. Due to the limited scope of risks and impacts, which will largely occur during the construction stage and for which mitigation measures can be readily designed and implemented, the project has been proposed as Category B for environment, as per the Safeguard Policy Statement 2009 (SPS).

15. Due diligence for category B projects requires the production of an initial environmental examination (IEE) or equivalent. This IEE, which will be submitted as an environmental impact assessment (EIA) under the country safeguards system (CSS), has been carried out in accordance with the requirements of the CSS (including environmental and social legislation and development consent procedures) and the SPS. The draft IEE will be disclosed for public examination both on the ADB website and locally prior to updating and finalization.

16. **Purpose and objective**. The purpose of this IEE is to assess the environmental, health, safety, and social impacts that may arise during the pre-construction, construction and operational phases of the proposed project. The objective of this IEE is to identify and define the project area and the extent of the potential negative and beneficial impacts (physical, biological and socio-economic) from the project, and develop mitigation measures to avoid and/or reduce negative impacts as necessary.

17. **Approach to the assessment.** In order to determine the risks and impacts that require investigation to define the impacts of the project, a scoping exercise was conducted. The scoping included a literature review, site visits to project impact area and consultations with the project implementation agency, TPL. Following the scoping, further information the following tasks:

- Formal and informal consultation with relevant government agencies, businesses and communities. Questionnaire surveys were used during community consultations to determine valuable components of the environment needing protection from project activities
- Ecological baseline surveys were conducted in October-November on the mangroves and terrestrial and marine flora and fauna in the project impact area. This was to identify critical habitats or rare and endangered species in the area that may affect project design.
- Data analysis of information collated guided the development of management and mitigation plans to address the social, economic and environmental issues of the project.

18. **IEE outline.** The IEE document is structured around nine reporting chapters and six supporting appendices . The nine reporting chapters / sections of the IEE are:

- Section 1 – introduces the project providing an overview of the project and the key areas of concern that will be addressed in the document and defines the project area.
- Section 2 –sets out the legal, administrative and policy framework that has defined the need and approach to the IEE. It discusses both the requirements of Tongan

legislation and policy and those of the Asian Development Bank (ADB) supporting the government for the preparation and implementation of the project.

- Section 3 –describes the physical details of the project, the delivery mechanism timeframe and outline costs.
- Section 4 - analyses the alternatives to the project including a "no project" scenario and the different options that have been considered in reaching the preferred option.
- Section 5 – sets out the existing environmental baseline conditions including physical features, ecological resources and socio-economic factors.
- Section 6 – discusses the consultations carried out for the project to disseminate information to the stakeholders and interested parties. It also includes sections on the land ownership, resettlement and compensation.
- Section 7 – is the assessment of impacts and where impact is identified the approach to mitigation. This section draws on the detail from eleven dedicated technical studies carried out as a part of the preparation of this IEE.
- Section 8 – is the environmental and social management plan (ESMP) that will guide interested parties during the detailed design; construction and operation phases of eth project. It sets out specific requirements to elements that must be addressed and included in the detailed design, the issues that a TPL must address during the construction phase and the ongoing management issues that the implementing agency must address in the operational life of the project.
- Section 9 is a summary and conclusion of the findings of the IEE document.

2 Administrative, Legal and Policy Framework

19. This section provides an overview of laws, plans and policies for environmental protection and management that comprise the CSS in Tonga. The project will require the implementation of all national and international environmental and social policies guidelines and performance requirements and also comply with the SPS.

20. All development in Tonga is guided by the Tonga Strategic Development Framework II (2015-2025) with a vision for *"a more progressive Tonga supporting a higher quality of life for all"*. This project contributes towards Pillar 4, Infrastructure and Technology inputs through the provision of more reliable, safe, affordable and widely available energy services built on an appropriate energy mix moving towards increased use of renewable energy.

21. **Compliance with environmental procedures.** As part of the contract, the Project Manager will assess the aspects and impacts of potential environmental hazards relative to the work to be undertaken and will implement controls to eliminate or mitigate any hazards that have the potential for a significant impact upon the environment. Any Environmental incident realized during the course the project will be immediately rectified and the appropriate authority contacted to monitor any ongoing effects.

2.1 Country Safeguards System

22. The key components of the CSS include the Environmental Impact Assessment (EIA) Act 2003, the accompanying regulatory instrument; EIA Regulations 2010, and Environmental Management Act 2010, administered by the DOE. In summary the development consent application must include an environmental assessment which complies with the Act and Regulation requirements. The relevant regulatory framework for this project is the following:

2.1.1 Environmental laws and regulations

23. **EIA Act**. In Tonga, the EIA Act 2003 (the Act) provides for the application of environmental impact assessment to the planning of the development projects within the Kingdom.[4] Under the Act, the term 'environmental impact assessment' is defined as *"the study and evaluation of the potential effects that a development project may have on the environment"*

24. The Act contains a schedule identifying 'major projects' for which EIA must be conducted. Table 2.1 outlines applicable activities classified as major projects

[4] Section 1 Environmental Impact Assessment Act 2003

Table 2.1: Classification of 'major' project scheduled development or activity

Development activity	Applicable to the project
(k) mining, being an activity that disturbs the surface of the land > 1 ha	Yes
(q) removal of trees (incl. mangroves), natural vegetation any area > 0.5 ha	Yes

Source: Environmental Impact Assessment Act (2003)

25. The area of vegetation removal and type of vegetation to be removed will be confirmed in consultation with the property or landowners as described in ESMP during implementation. The current project design does not require the removal of any mangroves or vegetation. Trimming overhanging branches would be essential for overhead power line connections and mitigation steps to undertake these activities are detailed in the ESMP.

26. Excavation works would be considered an activity that disturbs the surface of the land. These will be minimum and contained within property boundaries from the power poles to the meter. It is unlikely that the combined area of excavation works will exceed 1 hectare. All consultation requirements are discussed in the communication and consultation plan (CCP) and ESMP.

27. Accordingly, the ESMP contains mitigation measures to ensure that potential impacts of the project activities described below, are adequately addressed.

- result in or increase pollution;
- result in the occurrence, or increase the chances of occurrence, of natural hazards such as soil erosion, flooding, tidal inundation, or hazardous substances;
- result in the introduction of species of types not previously present that might adversely affect the environment and biodiversity;
- have features, the environmental effects of which are not certain, and the potential impact of which is such as to warrant further investigation;
- result in the allocation or depletion of any natural and physical resources in a way or at a rate that will prevent the renewal by natural processes of the resources or will not enable an orderly transition to other materials; or
- whether utility services are available and adequate for that activity.

28. **EIA Regulations**. These 2010 regulations outline the main steps involved in the EIA process which include a number of steps. The EIA approval process in Tonga begins with the submission of Form 1 - Determination of Category of Assessment. This provides an overview of the proposed development along with a description of the existing environment and assessment of identified environmental risks and mitigation measures proposed. The project proponent will also pay the required registration fee to the DOE's EIA Unit. The Minister will determine whether the proposed development is a minor or major project or if additional information is required and advises the proponent within 30 days.

29. If it is a minor project, it may be approved (with or without conditions) based on the information provided on Form 1. The DOE advises the proponent of the decision using Form 2: Minor Environmental Impact Assessment.

30. If the development or activity is deemed to be a major project, a 'thorough assessment or environmental impacts' is required as per Form 3: Major Environmental Impact Assessment. The proponent is required to seek advice from the Secretariat of the Environmental Assessment Committee (Secretariat) and DOE Director as to the level and depth of assessment required. The EIA is submitted by the proponent along with the accompanying fee (250 TOP).

31. The Secretariat will review the EIA and prepare a report. The Environmental Assessment Committee reviews the application, EIA, Secretariat report, and any additional relevant reports provided before making its recommendation to the Minister responsible for the Environment. The recommendation will state: (a) whether to approve, reject, defer or modify the development application; (b) the reasons for that recommendation; and (c) any conditions that shall be attached to any approval. The Minister makes his decision and the proponent is furnished with a formal approval/ rejection letter and the environmental assessment and conditions for the development activity.

32. **Environment Management Act**. The Environment Management Act 2010 is a comprehensive and makes provisions for environmental management in Tonga. The act is designed in such a way that by fostering the protection of the environment, the Kingdom can comply with its obligations under the international environment-related conventions. Some of these are provided in Appendix 1. Environment Officers have specific powers to enforce the act, including monitoring the impact of any activity, investigating potential breaches of the protection or management of the environment and seizing property reasonably suspected of being used in relation to adverse impacts on the environment.

33. **Other laws and regulations**. Some of the important laws relevant to the Project focusing on environmental assessment are summarized in Table 2.2.

Table 2.2: Summary of other relevant environmental laws and regulations of Tonga

Legislation	Objective
Biosafety Act 2009	To regulate living modified organisms and the applications of modern biotechnology consistent with Tonga's obligations and rights under the Convention on Biological Diversity and the Cartegena Protocol.
Birds & Fish Preservation Act 1988	To protect listed bird and fish species, establish protected areas and describe powers of police and fisheries officers under this Act.
Environment Management (Litter and Waste Control) Regulations 2016	To provide environment, health, police and waste officers with powers to issue notifications or on the spot fines for poor waste management practices; such as dumping, burning and littering.
Forests Act 1961	To provide for the setting aside of areas as forest areas or reserved areas, and for the control and regulation of such areas and of forest production. Unalienated land is defined in the Act as land which at the time of the exercise of any of the powers conferred by the Act is not leased or otherwise disposed.
Hazardous Wastes and Chemicals Act 2010	To regulate and effectively manage hazardous wastes and chemicals in accordance with accepted international practices and the International Conventions applying to the use, trans-boundary movement and disposal of hazardous substances.
National Spatial Planning and Management Act 2012	An Act to provide a framework for planning the use, development, management and protection of land in the Kingdom in the public interest and for related purposes.

Legislation	Objective
Ozone Layer Protection Act 2010	To regulate the use of ozone depleting substances and to implement the provisions of the Convention for the Protection of the Ozone Layer and the Protocol on substances that deplete the ozone layer.
Parks and Reserves Act 1976	To provide for the establishment of Parks and Reserves Authority and for the establishment, preservation and administration of Parks and Reserves.
Preservation of Objects of Archaeological Interest Act 1969	The Act establishes a Committee on Tongan Traditions, appointed by the King in Council. The Committee is responsible for permitting any activity in relation to objects of interest, including removal.
Public Health Act.	An act to prescribe public health services in Tonga
Renewable Energy Act 2008	To regulate the development and use of renewable energy in Tonga
Seabed Minerals Act 2014	To provide for the management of Tonga's seabed minerals and the regulation of exploration and mining activities within Tonga's jurisdiction or under Tonga's control outside of national jurisdiction in line with responsibilities under international law
Waste Management Act 2005	To manage and oversee the function of the Waste Management Board.
Water Resources Act 2020	An act to provide for the management, protection and conservation of the water resources of the Kingdom.
Water Supply Regulations 1963	The regulation and control of water supplies are detailed in the Water Supply Regulations which identify the Village Committee as the sole seller of water. The Chief Executive Officer for Health has the power to inspect all records and works of the Village Committee. Regulation 9 also stipulates that that fouling or pollution of water is an offence

Source: Tonga Crown Law Site (www.crownlaw.gov.to)

34. **International treaties and agreements**. Tonga has ratified a number of international treaties, conventions and agreements. These are listed in Appendix 1.

35. **TPL Codes of Environmental Practice**. Through the World Bank supported New Renewable Electricity Generation and Electricity Infrastructure in Tonga program Codes of Environmental Practice (COEP) for the energy sector have been developed. The COEP, and accompanying guidelines, identify good practice in undertaking safeguards due diligence and developing supporting documentation for the clearance process under the CSS. Both documents were developed to help stakeholders to understand and navigate through the approvals process relating to land and the environment, and they were commissioned under the auspices of the TERM.5 The COEP have been integrated into the project impact assessment and identification of mitigation measures tracked through to the project's ESMP. Appendix 2 provides the list of the COEP.

2.1.2 Tonga's energy policy and laws

36. **Nationally determined contributions** Tonga's commitments to reducing green-house gas emissions include mitigation targets of 13 % (16Gg) reduction in GHG emissions by 2030 compared to 2006. One of the means to achieve this is through 70 percent of electricity generated from renewable sources by 2030 through a combination of solar, wind and battery storage. This would require considerable financing and upgrade of network infrastructure (NDCs 2020).

[5] World Bank. 2016. COEP: Managing Environmental and Social Impacts and Guidelines for Land Acquisition Approvals, Environmental Permits and Building Permits.

37. **TERM to TERM PLUS.** The Tonga Energy Road Map (TERM) focuses on reducing Tonga's fossil fuel dependence through increased energy efficiency and improved supply chains in an effort to mitigate the price volatility of imported products as well as reduce greenhouse gas (GHG) emissions and improve national energy security. TERM PLUS renews Tonga's commitments and ambitions towards renewable energy electricity generation to 70 percent by 2030 and to 100 percent by 2035 and further targets for reduction on line losses from 9 percent.

38. **Tonga Energy Efficiency Master Plan**. The TEEMP comprises electricity use and land transportation. The plan was formulated through a comprehensive study of existing frameworks, plans, programs, and projects in the energy sector and extensive stakeholder consultations. data development and analysis. The TEEMP complements the approach of the 2009 Tonga Energy Road Map 2010–2020 (TERM), who's goal was to create an approach to reduce Tonga's dependence on fossil fuels through cost-effective and sustainable efforts.

39. **Renewable Energy Act 2008.** The Renewable Energy Act applies to the production, storage or distribution of any form of energy derived from a renewable source. It provides a legal framework to promote the utilization of renewable energy in Tonga and has further provisions for establishing the Renewable Energy Authority and its powers to regulate all matters relating to renewable energy. The Act promotes sustainable renewable-based energy sources to provide electrification services to reach both urban and remote rural areas in Tonga

40. **National Energy Bill.** With support from the World Bank and Secretariat of Pacific Community – Energy Division, the National Energy Bill was recently passed in August 2021 and is now subject to be reviewed by the Law Committee before being gazetted. The aim of the National Energy Bill is to create further institutional, regulatory and policy reforms and lead to streamlined policy and decision making. The objectives of the Bill are to: i)to create a centralized oversight function on energy matters within the MEIDECC; ii) to legalize the mandate of the Energy Department (within MEIDECC); iii) to transition and centralize the function of energy-related regulators and; iv) to ensure harmonization and coordination of initiatives within the energy sector.

2.2 Safeguard Policy Statement

41. This IEE has been prepared following the guidance contained in the SPS.[6] ADB uses a classification system to reflect the significance of a project's potential environmental impacts. The project should:

- Avoid adverse impacts of projects on the environment and affected people;
- Where possible; minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

[6] https://emp.adb.org/documents/safeguard-policy-statement

42. Projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts. Projects are assigned to one of the following four categories:

- Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment is required.

- Category B: A proposed project is classified as Category B if its potential adverse environmental impacts are less adverse than those of Category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An Initial Environmental Examination is required.

- Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

- Category FI: A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary.

43. A project's category is determined by its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. The project has been screened and categorized as B for environment.

44. ADB's safeguard due diligence emphasizes screening and scoping, planning, environmental and social impact assessments and safeguard documentation. Through such due diligence and review, ADB will confirm (i) that all key potential social and environmental impacts and risks of a project are identified; (ii) that effective measures to avoid, minimize, mitigate, or compensate for the adverse impacts are incorporated into the safeguard plans and project design; (iii) that the borrower/client understands ADB's safeguard policy principles and requirements and has the necessary commitment and capacity to manage the risks adequately; (iv) that, as required, the role of third parties is appropriately defined in the safeguard plans; and (v) that consultations with affected people are conducted in accordance with ADB's requirements. The procedures for such a process, ensuring compliance with the CSS and SPS.

45. ADB will also assess the borrower's/client's capacity to manage environmental and social impacts and risks and to implement national laws and ADB's requirements. If gaps exist between ADB's requirements and the countries' laws, or where gaps in borrowers' capacity are apparent, the safeguard frameworks should include the details of the specific gap-filling requirements to ensure that policy principles and safeguard requirements are achieved.

46. ADB's SPS applies pollution prevention and control technologies and practices consistent with good practices as reflected in internationally recognized standards such as the EHSG. The EHSG provide the context of international best practice and contribute to establishing targets for environmental performance. Standards incorporated into the EHSG will be used in parallel with Tonga's environmental standards and a precautionary approach adopted. Application of occupational and community health and safety measures, as laid out in the EHSG is required under the SPS.

3 Description of the Project

3.1 Program of Network Upgrading

47. The government proposes to implement the Nuku'alofa Network Upgrade Project as part of the phased network upgrading program. The project aims to contribute to the nation's achievement of the outcomes described in the Tonga Strategic Development Framework II 2015 - 2025[7] towards: i). a more inclusive, sustainable and successful provision and maintenance of infrastructure and technology and; ii) a more inclusive, sustainable and effective land administration, environment management, and resilience to climate and risk. The location of the entire five areas—Area 5 pus areas upgraded under previous projects—are shown in Figure 3.1.

Figure 3.1: NNUP Area 5

Source: Tonga Power Limited

3.2 Proposed Project

48. The proposed project will upgrade the remaining 25% of the network in Tongatapu (Area 5 in Figure 3.1). Area 5 is a remaining priority as this area is critical to evacuate electricity generated from both the ongoing and future renewable energy developments. Through "building back better" the project will restore a reliable electricity supply network and make it more resilient to extreme weather and disasters. More specifically, it will upgrade the old, inefficient, and less climate-resilient grid assets, i.e., cables, poles, distribution transformers, and switchgear.

49. The project's impact is aligned with improved reliable electricity supply in Nuku'alofa. The project's outcomes are reduced technical power losses and improved climate resilience in Nuku'alofa. The project has two outputs.

[7] Government of Tonga. 2017. Tonga Strategic Development Framework II 2015 – 2025.

50. **Output 1**: This output comprises: (i) rehabilitation of 16.5 km of 11 kilovolt HV electricity network; and (ii) upgrade of 50 km of 0.4 kilovolt LV distribution network in seven villages (as shown in Figure 3.2). This output will enable TPL to (i) reduce distribution network line losses; (ii) improve the electricity supply reliability of 1,240 customers; and (iii) serve 59 new customers.

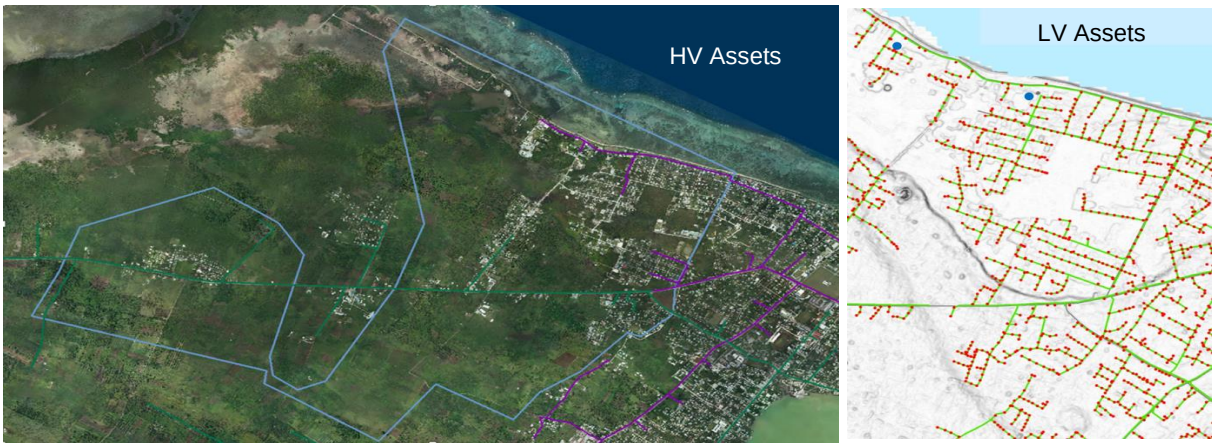
51. **Output 2:** This output involves providing capacity development to reduce the identified remaining capacity gaps in project and financial management, and other relevant areas.

Figure 3.2: Map of Area 5

Source: Google Earth.

52. The power for Area 5 is distributed through HV feeder lines 1 (green) and 2 (purple), which also serve the central business district. Figure 3.3 shows these feeder lines in Area 5 and also provides a partial view of the LV assets (the multiple red dots are connections and the two blue dots are ground-mounted transformers).

Figure 3.3: Power assets in Area 5

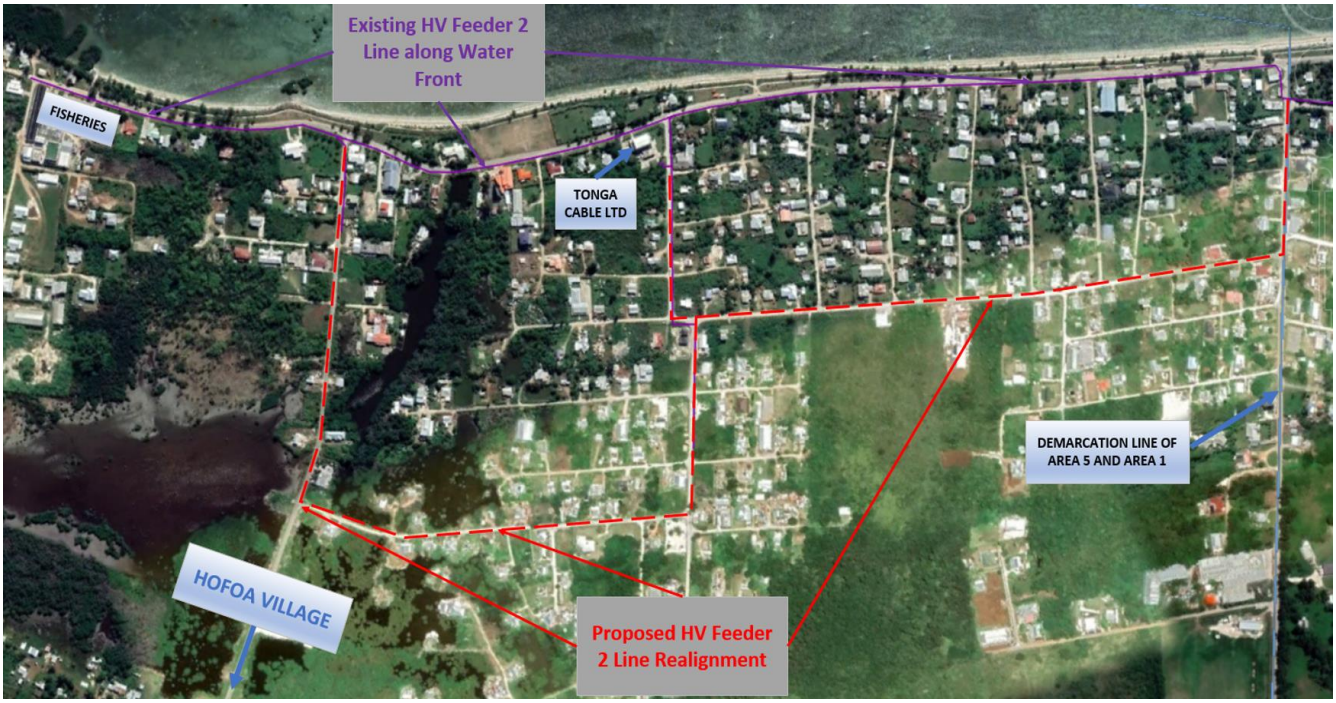


3.2.1 Project components and activities

53. **HV network**. The proposed project provides for upgrading of 11 kV feeders. This includes new conductor, new 11 kV insulators, pole fittings, connectors, etc. Where there are existing 11 kV feeders, then these poles can be reused in some cases provided the poles are in good condition (to be assessed at the time of construction). Otherwise, new poles will be required.

54. In light of the recent tsunami (January 2022) that affected the Nuku'alofa peninsula along Vuna Road, Sopu, the project proposes to realign a section of the HV network along the secondary road where the existing LV network has been installed. Figure 3.4 shows the proposed realignment (in red) which will require an additional 0.65km of newly constructed HV network (compared with the original alignment shown in purple) before connecting back to the original alignment along Vuna Road; heading towards the Ministry of Fisheries (MOF) building. The HV network will be installed within the current network corridor using existing roads, the LV lines will be strung underneath as an under-build using the same HV poles. This realignment will eliminate the risk of tsunami or inundation impacts for approximately 1.3km of HV network that would have traversed the waterfront. In addition, the realignment will contribute to strengthening the resilience and security of supply for one of the essential communication services entities, Tonga Cable Limited.

Figure 3.4: Realignment route for section of HV network



Source: Tonga Power Limited (Mach 2022)

55. In some cases where there is a need for two 11 kV feeders, then the second circuit will be underbuilt with the requisite vertical clearance between circuits. Three phases 11 kV/LV distribution transformers will be pole mounted in one of TPL's standard sizes. Transformers are protected by 11 kV drop-out fuses. On the LV side, each feeder will be protected by HRC fuses. The key quantities are shown in Table 3.1. The proposed works follow international best practice and have been proven through several major tropical cyclones.

Table 3.1: Key 11kV quantities

Key Item	Quantity
Transformers new	42
Transformers rebuilds	77
Total transformers	119
11 kV poles light	519
11 kV poles heavy	519
Total 11 kV km	**34**

Source: Tonga Power Limited (January 2022)

56. **LV network**. All new LV will be installed as ABC because of the inherent safety and technical advantages over the open wire system. The key quantities are shown in Table 3.2. The proposed works follow international good practice and are considered acceptable. It is expected that the new works will reduce system losses.

Table 3.2: Key LV quantities

Key Item	Quantity
Supply under built LV 3 phase	56
Supply LV 3 phase	102
Total LV 3 phase	158
Poles LV 9 m 6 kN	4,069
Poles LV 9 m 12 kN	1,459
Total Poles LV	**5,528**

Source: Tonga Power Limited (May 2020)

57. **Customer service lines**. Customer services will be laid underground, to replace the existing overhead services which in many cases are in poor condition and often an associated danger to the customer. The service line will be installed safely and securely down the LV pole in the street, undergrounded to a meter box mounted in an accessible place on the side of the customer's house. Each meter box will contain a tariff meter, main switch and surge diverter. Apart from added safety advantage, the underground service will also minimize the risk of damage during cyclones.

58. TPL standard installation now provides Smart Meter replacement as part of the project in keeping with modern international practice.

59. The key quantities of customer connections (service lines) are shown in Table 3.3. The proposed works follow international good practice and are considered acceptable. The proposed designs will improve customer safety and reduce non-technical losses.

Table 3.3: Area 5 TPL customer data

Village	Existing accounts				Total number (closed + active)	5% lift in customer connections (no.)	Total new connections (incl. 5% lift)
	Active	Closed	Commercial	Residential			
Sia'toutai	231	21	76	176	252	265	13
Sopu	267	51	73	245	318	334	16
Hofoa	275	23	35	263	298	313	15
Isileli	11	4	3	12	15	16	1
Maui	39	3	3	39	42	44	2
Halaovave	115	21	22	114	136	143	7
Tuataklangi	115	4	11	108	119	125	6
Total	**1053**	**127**	**223**	**957**	**1180**	**1240**	**60**

TPL (December 2021)

60. **Local infrastructure required**. Upgraded network will be built to a modernized related network which is confirmed safe, efficient, reliable and high resilience. Both HV and LV network will be in overhead topology mostly along the legal access road down to the household. All electric poles will be wooden type at 11m and 9m high for HV and LV respectively. Majority of pole location will be erected at the boundary of all household, whereas all boundaries have been confirmed through the Ministry of Land and Survey Natural Resources.

61. **Workforce and equipment.** TPL intends to retain the current workforce under Area 3 project to continue works on the network upgrade proposed for Area 5. There are currently 52 local staff and 1 international staff employed under Area 3 component. At present no camp sites are erected under Area 3 and all workers return to their individual dwellings at the end of their shift. It is therefore not a necessity to set up camp for the workers throughout the construction period.

62. The power distribution system (grid) requires considerable investment and operation and maintenance efforts. It is comprised of wooden utility poles for high voltage (HV) and low voltage (LV) overhead power lines, pole-mounted equipment, ground-mounted transformers, and a few sections of underground power lines. The typical utility pole on Tongatapu is made of pine or other softwood and is anchored about 1.5-2 m into the ground with a concrete foundation. HV poles are approx. 11m tall on average and approximately 350-450mm in diameter, while LV poles are approx. 9m tall on average and approximately 200-300mm in diameter.

63. A list of equipment used during construction phase including vehicles, transformers and other installation equipment will be kept by the PMU and TPL. Maintenance and servicing of vehicles will be conducted quarterly to ensure that health and safety work standards are up to standard and reduce risk of injury to workers and pedestrians and other users of the areas within the vicinity of the upgrade works. Any faulty equipment or site accidents are to be reported immediately to the PMU and procedures and measures to communicate and address these in a timely manner will be made available in the ESMP and CEMP.

64. **Schedule and timeframe**. The time to construct the project will be just over two years commencing in the fourth quarter of 2022 and expected to be completed by December 2024.

65. **Project cost**. The total project cost, including environmental mitigation, monitoring and offsetting measures is estimated to be $8.7 million. This is excluding taxes, cost of interest during construction and financing charges.

3.3 Project Benefits and Justification

66. The successful implementation of the project will improve power distribution network efficiency by reducing line losses to a target figure of 5%. As a result, the network system would expect approximately 458MWhr of energy per annum, no longer lost in the Nuku'alofa areas due to an overloaded and aging network. Furthermore, the project is designed to be climate change resilient.

67. The added value of the proposed project is to demonstrate that combining deployment of renewable power generation and power distribution loss reduction is an appropriate strategy to optimize existing energy matrixes and reduce their carbon output. Additional electricity will contribute to power security, create sustainable livelihoods and reduce environmental pressure by avoiding emission of about 300 tons of CO_2 per year for Nuku'alofa area only. Overall, at a local level, the project will improve socio-economic conditions of the local communities in the targeted areas and at a national level will help improve the national gross domestic product (GDP) and enable the Tonga Strategic Development Framework 2015-2025 energy goals to be realized.

4 Analysis of Alternatives

4.1 Technology Options

68. The alternatives considered for this project mainly involved evaluation of the alternative pole materials. Current utility poles seen throughout Tonga are timber poles, galvanized steel and reinforced concrete. These options were each assessed based on longevity, installation simplicity, affordability and environmental and carbon footprint. Table 4.1 sets out the alternatives considered including sourcing options and cumulative impacts on land resources.

Table 4.1: Alternatives for Utility Poles[8]

Type of pole	Advantages	Disadvantages
Concrete Poles *CO2 created per 1000 poles = +1460 tonnes	- Very strong and durable - Decay/ rot-proof - Termite resistant - Fire resistant	- High production cost - Corrosion of reinforcement materials - Difficult to install and handle - Difficult to fix and high impact when struck by vehicles - High carbon footprint (production process)
Galvanised Steel Utility Pole *CO2 created per 1000 poles = +784 tonnes	- Very strong and durable - Decay/ rot-proof - Termite resistant - Fire resistant	- Conducts electricity - More expensive to install - Corrosion causes failure - Environmentally unfriendly (high carbon footprint)
Timber (wooden) poles *CO2 absorbed per 1000 poles = -316 tonnes	- ready available - strong - low weight and unit cost - easy installation and easy to replace when damaged - less carbon footprint - good insulator	- Sustainability consideration in replanting trees. - Intensive treatment process - Chemical traces on finished product - Prone to decay from termites weathering if not treated properly - Reduced fire resistance if not treated properly

Source: Treated Wood Council 2012

69. Out of the three alternatives considered, the most feasible option for this project was determined to be timber poles due to its availability to source locally compared to concrete poles and galvanized steel poles that would require materials to be imported. Moreover, timber poles are economical and environmentally friendly with less carbon footprint. Timber poles are therefore considered as the best option for power poles for this project.

[8] Treated Wood Council. 2012. Conclusions and Summary Report on an Environmental Life Cycle Assessment of Utility Poles

4.2 Location Options

70. The project is effectively the fourth stage of the larger Nuku'alofa grid upgrading program conducted in five stages. Each stage follows existing network structures. TPL completed Area 1 with the financing support of the Government of New Zealand and completed Area 2 with ADB funding from TON: Cyclone Gita Recovery Project. Area 3 is expected to be financed by the Government of Australia. Among the remaining Areas 4 and 5, network improvement in Area 5 is prioritized to evacuate the electricity generated from the ongoing and scheduled renewable energy developments. Area 5 accounts for approximately 10% of the entire grid asset of TPL in Nuku'alofa.

71. The upgrade and maintenance work in this project will follow the existing grid system within Area 5, along the main Hihifo Road and adjoining roads connections towards Hofoa, Sopu, Halaovave and selected sections of Tu'atakilangi. As such, alternatives for network routes were not analyzed in the scope of the proposed works.

72. This study found reclamation and new settlements being established particularly in Hofoa and Sopu villages. New connections in these settlements will be assessed on a needs basis when land boundaries and new sub-divisions are demarcated and mapped by the MLNR. The Area 5 is prioritized and will be completed before Area 4 due to the new solar farms being installed concurrently with Area 3 project. The solar farms are expected to be completed by June 2022 and is therefore critical to harness the lines from the solar farms to the communities nearby to ensure effective energy transfer and reduce line losses due to old power lines.

4.3 No Project

73. This project is the fourth and integral stage of an overall program of network upgrades. The "without project" or "no action" alternative is defined as a decision not to implement a project that can meet the objectives. The "without project" alternative means that there will be no upgrading of the distribution and medium voltage network in Nuku'alofa and TPLs long term goal of reducing line losses will not be achieved. This will compromise Tonga's second NDC targets aimed at reducing greenhouse gas emissions by 13 percent through upgrading of network infrastructure. Consequently, Tonga's reliance on fossil fuel will continue to grow and the current network will suffer line losses, resulting in deteriorating state of the distribution network.

74. The current conditions of the power network in Area 5 (shown previously Figure 3.2) depict the urgency for upgrade and replacement of conductors and overhead cables as well as the need to connect residential sectors to the power grid. Tropical cyclone Gita destroyed about 46% of the power grids that had not been upgraded compared to less than 5% destruction to the village networks that were upgraded under the TVNUP.

75. Therefore, without this project, the estimated loss and damage that may occur during the cyclone season will be significant. In the event of a cyclone, imminent disruptions to the power supply will be detrimental to TPL's normal operations and customer consumption. The materials and time required for repair will incur additional costs to TPL and its customers. It is probable that cumulative costs for recovery from major infrastructural damage may well exceed the cost for this project.

76. Moreover, the poor condition of poles that have been observed to be tilting and in need of replacement, pose hazardous impacts to the communities due to the instability of the poles and the cables that are connected to such poles. High voltage lines are not secure and will be a serious health and safety concern for surrounding communities and the TPL workers tasked to maintain the grid.

77. **Summary**. The analysis above, suggests therefore, that the negative consequences of not implementing this project will be greater than if the project was to proceed.

5 Description of Existing Environment (Baseline)

5.1 Location and Project Area

78. **Location**. The Kingdom of Tonga is located in the central South Pacific between 15º and 23º30' South and 173º and 177º West. It is an archipelago comprising 172 named islands dispersed over an area of 747 km^2 of which 36 islands (area of 649 km^2) are inhabited. Tonga is divided geographically into four clusters of islands extending over a north-south axis: Tongatapu (347 km^2) in the south (Figure 5.1), Ha'apai (109 km^2) in the centre; Vava'u (121 km^2) in the north; and Niua (72 km^2) in the far north. Tonga is situated at the subduction zone of the Indian-Australian and the Pacific tectonic plates and within the Ring of Fire where intense seismic activities occur.

Figure 5.1: Map of Tonga

79. Uneven uplift has resulted in a pronounced tilt from south-east to north-west. The maximum elevation on the south-east side is 65 m above mean sea level. The island is generally flat, apart from some small, localized slopes. The most rugged topography on the island is associated with near-vertical sea cliffs up to 30 m high on the windward coasts. In most areas, these are fringed by a narrow reef flat with a well-developed algal rim. Elsewhere, the morphology of the island is very subdued.

80. The capital, Nuku'alofa is located on the main island of Tongatapu (260 km^2). Tongatapu is a flat coral limestone Island surrounded by coral reefs and sheltered with dense fertile soil consisting of volcanic ash from neighboring volcanoes.

81. **Defining the project area**. This project aims to upgrade the electrical network for both LV and HV within the urban area of Nuku'alofa. This project will finance network upgrades in Area 5 encompassing seven villages (Halaovave + Maui are considered together) as shown in Figure 5.2.

Figure 5.2: Villages in Area 5

Source: Tonga Power Limited

82. Areas 1 and 2 have been completed and Area 3 is underway and expected to be completed in June 2022. This project (Area 5) is going ahead of Area 4 due to the proposed works of the 6MW solar farms in the west of Tongatapu.[9] It is timely for the Area 5 to be upgraded in order to align line upgrades with the new solar plant sites located at Liukava and Ha'utu both located in the Kolovai District, Ha'utu and Fualu in the Nukunuku District along the western region of Tongatapu Island. Network upgrade in Area 4 is pending assessment and feasibility studies on the proposed Fanga'uta Lagoon Bridge and the Queen Salote Port Upgrade, both in the vicinity of Area 4.

[9] ADB. 2019: TA 94242-REG: Pacific Renewable Energy Program. Initial Environmental Examination - Hihifo Solar 6 MW Power Project (Tongatapu).

83. The seven villages distributed throughout the west and extend towards the central district have varying gradations of settlements and community development. Some data is presented in Table 5.1, more detailed information about the population and demography of the project area is presented in Section 5.4.

84. **Sia'toutai.** The line upgrades will begin from Sia'toutai village, located closest to the solar farm in Fualu. The settlements in Sia'toutai are clustered around the Sia'toutai Theological College compound with an estimated population of 460 (247 males and 213 females). The area comprises mostly vegetation with a gas station located across the established Sia'toutai community.

85. **Hofoa** village is still developing with new settlements and new network connections expected around this area. This village is the largest in Area 5 with an estimated population of 1173 comprising 52 percent males and 47 percent females. There are mangrove sites in this area with observed human disturbance. A more detailed ecological description of mangrove habitats is provided in Section 5.3.3.

86. **Sopu** is located along the west coast of Nuku'alofa and is closest to established special managed areas (SMAs). This is a well-established community with an estimated population of 1166 people of which 51 percent are males and 49 percent females. The mangroves in this area are well distributed with high biodiversity profile. Section 5.2 provides more detailed analysis of this ecosystem.

87. **Halaovave, Maui and Isileli** These villages are well established settlements with more than 250 households. These are flood prone areas and the network in these areas are in considerable need of upgrade due to observed slanting power poles and power lines laying precariously less than 6m from the ground increasing vulnerability to cyclones for communities in these areas. See Plates 5.1 a - d.

88. **Tu'atakilangi** This established settlement is located further away to the south of Sopu and consists of many vegetation plots and overgrown trees entangled in the overhead cables. The streets in this village are considerably narrow.

Table 5.1: Data for Area 5 villages

Village	No. of households	No. of occupied households	Population (approx.)
Sia'toutai	156	98	460
Halaovave + Maui	167	152	903
Sopu	279	221	1,166
Isileli	120	104	666
Hofoa	214	193	1,173
Tu'atakilangi	144	126	739
Total	**1080**	**894**	**5107**

Source: Government of Tonga – Census of Population and Housing (2016)

Plates 5.1 a - d: Condition of power poles in Area 5

Slanting poles and low-hanging cables

Unstable poles in Area 5, vulnerable to cyclone

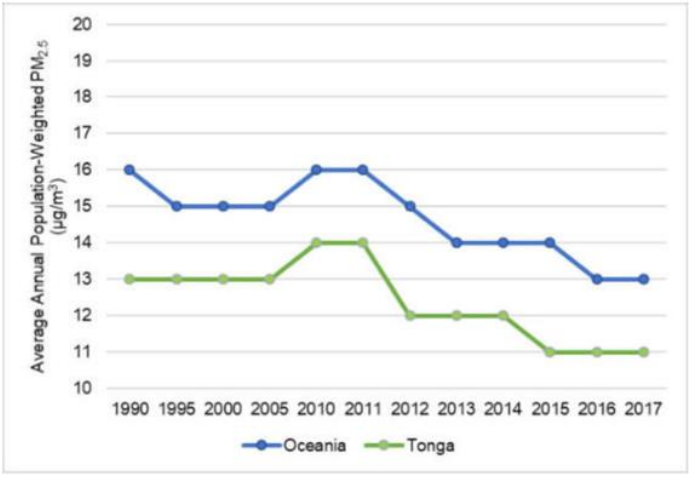
5.2 Physical Environment

5.2.1 Air quality, climate, and climate change

Air quality. While there are no air quality data available for the project area and no air quality standards enforced in Tonga, air quality is expected to be relatively good due to limited air pollution sources. The main sources of air pollution in Tonga are also generated by industry (power generation (92% diesel and 8% renewables), transport and some open burning of agricultural/ municipal waste)[10].

140. Air emission sources in and around Area 5 are likely to be vehicular road traffic exhaust releases. The quantity and composition of vehicle emissions would vary depending on type of fuel, engine type, size and efficiency, vehicle speeds and the type of exhaust emissions abatement equipment employed. The main pollutants of health concern vehicle exhaust are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$), as these pollutants are most likely to approach their respective health-based air quality standards in proximity to busy roads. Given that the project location is not in the vicinity of the CBD, air quality is not deemed to be a major concern. Information on global air quality presented by Health Effects Institute in 2019, found that the average annual population-weighted $PM_{2.5}$ concentration for Tonga was 11µg.m^{-3} in 2017. The annual mean concentration of $PM_{2.5}$ in urban areas of Tonga as 10µg.m^{-3} in 2016 (WHO, 2018). Figure 5.3 shows the average annual population weighted $PM_{2.5}$ concentration in Tonga from 1990 to 2017 compared to the Oceania region concentration.

Figure 5.3: Average annual population weighted $PM_{2.5}$ (µg.m-3) for Tonga and Oceania Region

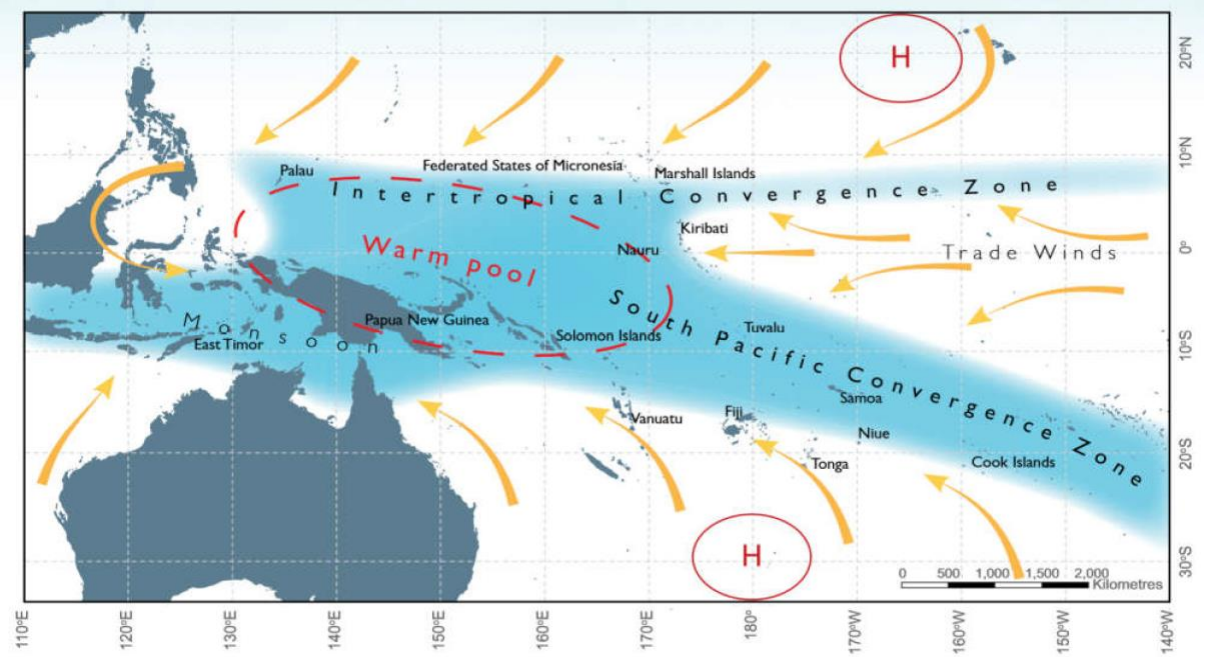


Source: Health Effects Institute (2019)

[10] Based on research in 2015 on air quality in the Solomon Islands (Ehsani & Mwaniki, 2017)

89. **Climate**. The Tongan archipelago is located in the tropics and is subject to an annual tropical cyclone season, typically between November and April. The country has two distinct seasons – a warm wet season from November to April and a cooler dry season from May to October. Nuku'alofa has a tropical monsoon climate, with hot temperatures year round. Most of Tonga's rainfall is associated with the movement of the SPCZ, this band of heavy rainfall is caused by air rising over warm water where winds converge, causing thunderstorms (Figure 5.4).

Figure 5.4: South Pacific Convergence Zone



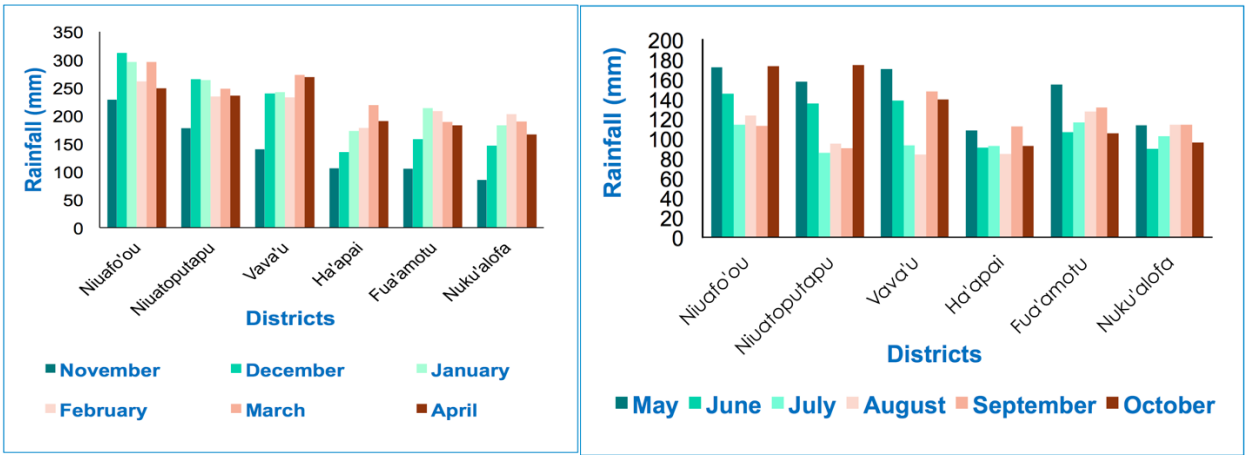
Source: Pacific-Australia Climate Change Science and Adaptation Program (2015)

90. The climate of Tonga is tropical. It lies within the south-east trade wind zone of the South Pacific. Wind speed over its surrounding oceans averages around 12 knots. Strong winds are not common except during tropical cyclone passages in summer (November- April) and gales from eastward migrating high-pressure systems during winter (May-October). Rainfall is moderate, with high relative humidity. Tonga's annual rainfall is defined by two seasons, the Wet and Dry seasons. Temperature variations throughout the country show an increase in daily and seasonal variations with increasing latitude. Mean annual temperatures vary from 27^0C at Niuafo'ou and Niuatoputapu to 24^0C on Tongatapu.

91. Diurnal and seasonal variations can reach as high as 6^0C throughout the island group. During the hot wet season (November-April), the average temperature ranges from 27-29^0C whereas at dry cool season (May-October), the average temperature ranges from 20-24^0C. Data on rainfall patterns (figure 5.5) generally suggest a decrease in dry season rainfall and an increase in wet season rainfall over the course of the 21st century. Wet season increases are consistent with the expected intensification of the South Pacific Convergence Zone. Drought projections are inconsistent across Tonga. Model projections show extreme rainfall days are likely to occur more often.

Figure 5.5: Climate data for Tonga: Average Rainfall, 1980-2010

Average rainfall during dry season **Average rainfall during wet season**



Source: Tonga MET Services (2010)

92. **Climate change**. Increasing evidence and observation of long term changes in global weather patterns is the main challenge around issues of adaptability and resilience. Increases in average temperatures, changes to average rainfall and changes to the intensity and frequency of extreme events, such as cyclones are becoming more apparent and threatening ecological systems throughout the world. Climate change risk management approaches focus on predicting how these changes could impact on natural systems including hydrologic, geological processes, agricultural systems, ecological equilibrium, and the built environment, and building resilience in these systems through adaptive interventions.

93. Tonga has seen an increasing trend in the occurrences of tropical cyclones. There is also evidence that the intensity of cyclones has increased since the 1980's in Tonga. Since the 1960's many cyclones have severely affected Tonga. To name but a few; Cyclone Flora in March, 1961 affected Vava'u and Ha'apai districts, Cyclone Isaac in March, 1982 affected Ha'apai and Tongatapu and Cyclone Waka in December, 2001 affected the northern group of Niua, Cyclone Tam in 2006, Cyclone Renee in 2010 severely affected Tongatapu, Vava'u and Ha'apai groups, a combination of Cyclone Cyril and swiftly followed a week later by Cyclone Jasmine heavily impacted Tongatapu in February 2012 and Cyclone Ian caused catastrophic damage to the Ha'apai islands in January 2014. Category 5, Cyclone Gita caused significant damage in Tongatapu in February 2018.

94. Cyclone Harold in 2020 exacerbated the predicted king tide and wreaked havoc and significant property damages along the central and western coast of the main island Tongatapu. These cyclone events caused severe damages to crops and food supply, infrastructures, tourist resorts, coral reefs and disrupted essential services. Consequently, the damages have had long-term impacts on the wellbeing of the people and many communities are still recovering from such impacts.

95. Scientists from the Pacific Climate Change Science Program (PCCSP) have evaluated 24 models from around the world and found that 18 best represent the climate of the western tropical Pacific region. These 18 models have been used to develop climate projections for Tonga.

96. The climate projections for Tonga are based on three IPCC emissions scenarios: low (B1), medium (A1B) and high (A2), for time periods around 2030, 2055 and 2090. Climate projections for Tonga are shown in Table 5.2:[11]

97. Temperatures will continue to increase - projections for all emissions scenarios indicate that the annual average air temperature and sea surface temperature will increase in the future in Tonga. By 2030, under a high emissions scenario, this increase in temperature is projected to be in the range of 0.3–1.1°C. More very hot days - increases in average temperatures will also result in a rise in the number of hot days and warm nights and a decline in cooler weather;

Table 5.2: Climate Projections under different emissions scenarios

Scenarios	2030 (°C)	2055 (°C)	2090 (°C)
Low emissions	0.6 ± 0.2	1.0 ± 0.2	1.4 ± 0.3
Medium emissions	0.7 ± 0.2	1.3 ± 0.3	2.1 ± 0.4
High emissions	0.7 ± 0.2	1.4 ± 0.2	2.6 ± 0.3

Source: PCCSP (2011)

98. Less frequent but more intense tropical cyclones - on a global scale, the projections indicate there is likely to be a decrease in the number of tropical cyclones by the end of the 21st century. But there is likely to be an increase in the average maximum wind speed of cyclones by between 2% and 11% and an increase in rainfall intensity of about 20% within 100 km of the cyclone center. In the Tonga region, projections tend to show a decrease in the frequency of tropical cyclones by the late 21st century and an increase in the proportion of the more intense storms;

99. Sea level will continue to rise - sea level is expected to continue to rise and by 2030, under a high emissions scenario, the increase 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. Ocean acidification will continue - under all three emissions scenarios (low, medium and high) the acidity level of sea waters in the Tonga region will continue to increase over the 21st century, with the greatest change under the high emissions scenario. The impact of increased acidification on the health of reef ecosystems is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure.

5.2.2 Geology, soils, and topography

100. **Geology**. The Kingdom is divided into four major groups, or clusters of islands: Tongatapu and Eua in the south, Ha'apai in the centre, Vava'u in the north and "the Niuas" (Niuafo'ou and Niuatoputapu) in the far north. Tonga's archipelago lies along the boundary of the Pacific and Indian-Australian tectonic plates. It comprises both volcanic and uplifted coral islands and reefs, which cap the peaks of two parallel submarine ridges stretching south of Fiji.[12] Within Tonga there is a western line of islands of volcanic origin, steep topography and generally high elevations, and an eastern line of generally low-lying limestone and mixed geology islands.

[11] PCCSP. 2011. International Climate Change Initiative. Volume 2 - Climate Change in the Pacific: Scientific Assessment and New Research and Climate Projections Tool – Pacific Climate Futures.

[12] SOPAC. 2007. National Integrated Water Resource Management Diagnostic Report.

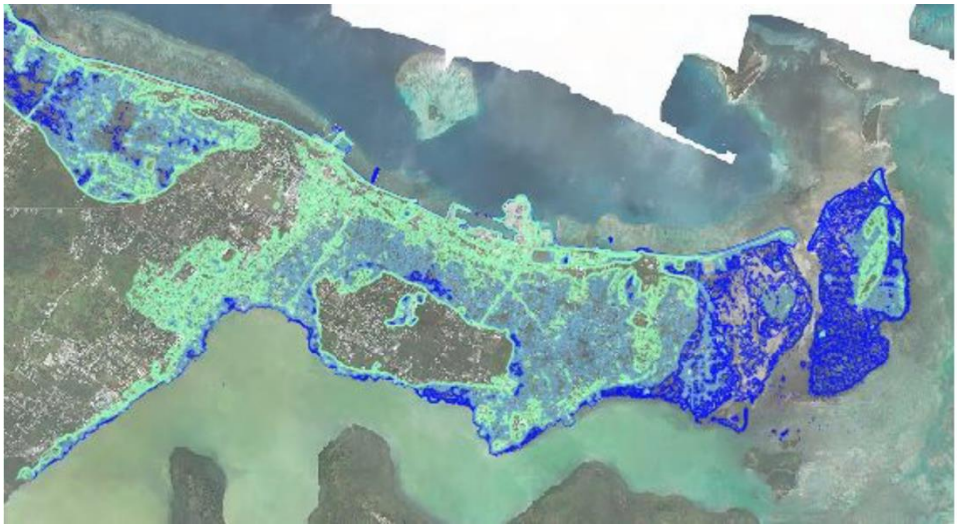
101. Amongst the western group are Tofua (507 m), Kao (1030 m), Late (519 m), Niuafo'ou (260 m), Niuatoputapu (106 m) and Tafahi (548 m). The eastern group where the majority of the population lives consists of Tongatapu (65 m), 'Eua (312 m) and most of the islands of the Ha'apai and Vava'u groups.

102. Tongatapu and Eua are limestone capped or karst islands, and these combine with a number of small coral islands to form the Tongatapu group. Nuku'alofa, the capital is located on Tongatapu, the largest island in the Kingdom. The south of the Vava'u group is generally composed of high volcanic and elevated limestone islands with reef communities or fringing reefs. Ha'apai has high volcanic and low limestone islands or atolls. The Niuas are high volcanic islands surrounded by fringing and barrier reefs.

103. **Soils** The soils of Tonga are derived from a mixture of volcanic ash and coral. Island groups are isolated from each other, and are physically and economically different, the country is described in four parts. Most of the islands of Tonga which include Tongatapu, have a soil layer overlying coral limestone. While soils vary from island to island, they are mainly derived from volcanic ash (andesitic tephra) deposited by a series of volcanic eruptions from emergent volcanoes such as Tofua and Kao and from submarine volcanoes to the west. Other soils include coral and lagoon sands and mud. Tongatapu and Eua are limestone capped or karst islands, and these combine with a number of small coral islands to form the Tongatapu group. In Tongatapu, many primary depositional features - reef rim, patch reefs and lagoon bed - are still evident and some may be associated with relict deposits of construction material. Soils were formed from a thick deposit of volcanic ash covering most of Tongatapu and ranging in thickness from about 5 meters in the west of the island to just 1 meter in the east (Orbell, 1983).

104. **Topography** The topography of Nuku'alofa is flat and low lying, creating challenging conditions for flood management in the areas of Sopu, Halaovave and Maui. Figure 5.6 shows contours with the lowest lying areas shaded in dark blue at <=0.6m (0.0m datum = Mean Sea Level). Areas with light blue shading have levels of 0.8 – 1.0m, whilst turquoise areas have levels of 1.2 – 1.6 m. The highest areas are unshaded, with contour levels at a minimum of 1.8 m. Dark blue areas are generally subject to tidal influence, or depict wetland areas with significant ponding of water following rain events.

Figure 5.6: Contour map of Nuku'alofa



5.2.3 Natural disasters and hazards exposure

105. This section summarizes the results of the Multi-Hazard Disaster Risk Assessment (MHDRA) for Tongatapu that was developed in 2021. With the aim of informing future planning and investment decisions, the MHDRA looks at the three components of risk:

- Hazards, including pluvial flooding, coastal inundation, combined pluvial flood and coastal inundation, tsunami, wind, and seismic;
- Exposure of different types of assets, including buildings, roads, water infrastructure and power infrastructure; and
- Vulnerability of these assets to establish estimates for asset damage as a result of the hazards listed above.

106. **Seismology and earthquakes.** The Tonga region experiences hundreds of earthquakes each year due to its location on the Kermadec Tonga Subduction Zone Trench, one of the most seismically active regions of the world. The high seismicity is due to the high convergence rates between the Australian and Pacific plates. During the last century, more than 1,000 events occurred in the area with magnitude over 5 (Mw>5). However, less severe tremors are common. The Tonga Seismic bulletin issued by the Tonga Geological services describes the number of earthquakes occurring in Tonga per month. Earthquake occurrences in January 2021 were recorded at 35 compared to 42 for the month of August. These earthquakes were at magnitudes less than 5 and thus are unlikely to be felt or cause damages to the earth surface.

107. The subduction trench can produce earthquakes as large as magnitude (Mw) 8, but these are rare. Of note are the earthquake that hit in June 1977 (Mw 7.1) and the double earthquake that hit on September 2009 (an initial Mw 8.1 earthquake immediately followed by a second Mw 8.0 shock) and caused a tsunami that resulted in nine casualties. Earthquakes can damage structures, from partial to total due to permanent deformations (cracks, settlements), liquefaction, and failure. They can also lead to changes in bathymetry and/or landforms. During an earthquake, instability can occur along slopes or cause permanent deformations due to lateral spreading.

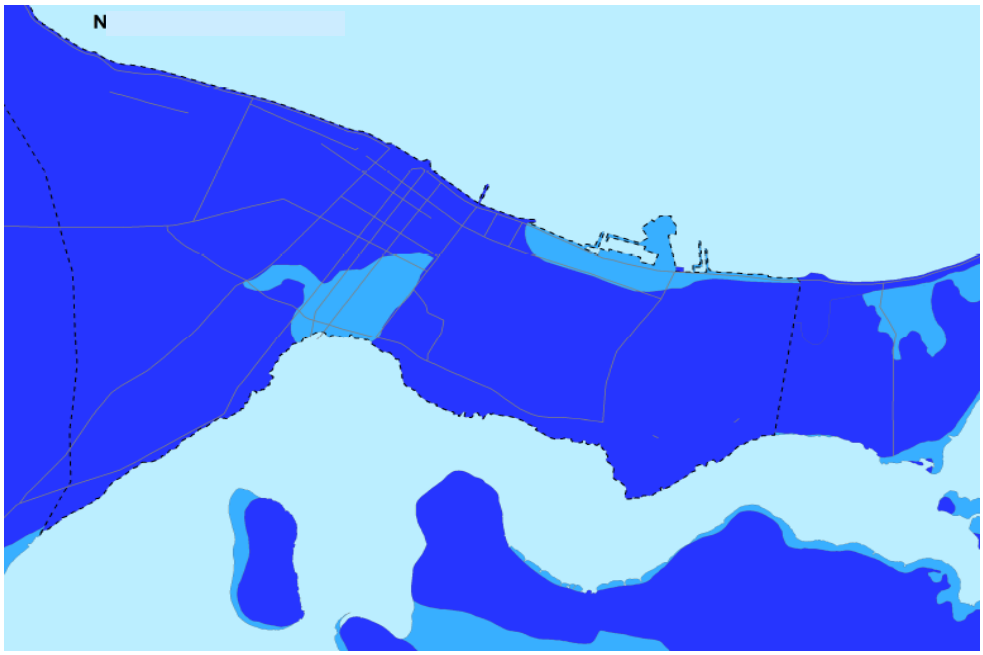
108. **Hazard and exposure.** Probabilistic seismic hazard calculations determined the peak ground acceleration (PGA) and the uniform hazard response spectra (UHRS) for a given annual probability of exceedance. The assessment included PGA hazard values at 10-year, 50-year, 100-year, 200-year, 475-year, 975-year, and 2,475-year return periods presented for different site conditions (Table 5.3).

Table 5.3: PGA (g) for site sub-soil classes C and D/E

Return Period	PGA (g), Soil Class C, 250m/s	PGA (g), Soil Class D/E, 150m/s
10 years	0.16	0.18
50 years	0.35	0.36
100 years	0.46	0.47
200 years	0.60	0.61
475 years (1/500 APE)	0.83	0.84
975 years (1/1,000 APE)	1.07	1.09
2,475 years (1/2,500 APE)	1.46	1.51

109. The PGA results for these return periods were then applied to the site class map to produce island-wide hazard maps. The 100-year return period map is shown in Figure 5.7.

Figure 5.7: Peak ground acceleration for a 100-year return period



PGA (g) as per table:

Site Class	Return Period (years)						
	10	50	100	200	475	975	2475
C	0.16	0.35	0.46	0.60	0.83	1.07	1.46
D/E	0.18	0.36	0.47	0.61	0.84	1.09	1.51

Source: Multi-Hazard Disaster Risk Assessment (2021)

110. **Vulnerability of power distribution assets.** Ground accelerations create forces on the utility poles, which are anchored into the ground.[13] Pole mounted equipment may fall to the ground, particularly if bolted to the cross arms. Overhead circuits can also be damaged by inertial shaking or in many cases due to "snap loads" when there is insufficient slack in the lines. Conductor burns and entanglement can also occur due to wire slapping. Where buildings collapse, this can also lead to damage to the distribution network, known as "pull down" damage.[14]

111. The fragility curves shown in Figure 5.8 were developed by the engineers who authored Hazus[15] have been adopted without modification. These functions apply to the entire distribution system, as opposed to the individual utility pole and power line components.

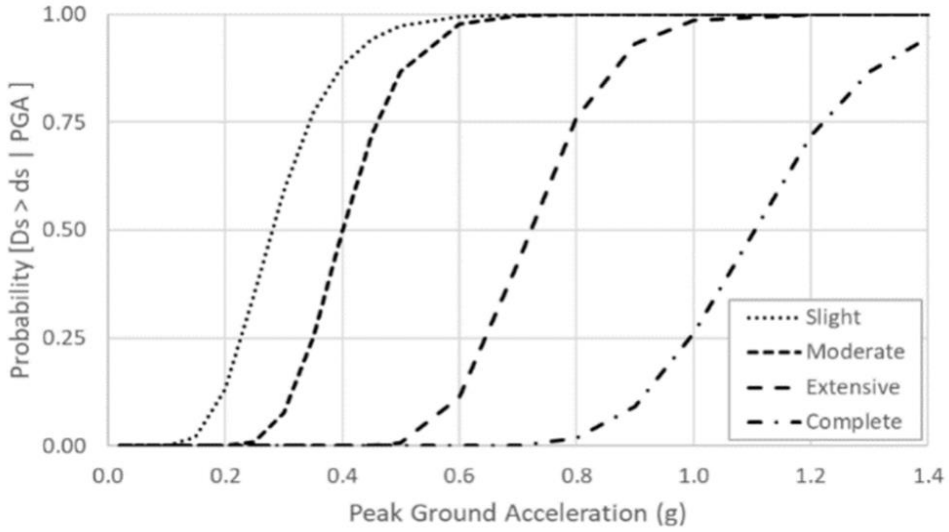
[13] Though only PGA is considered here, liquefaction can also impact utility poles.

[14] Eidinger, J. (2017). Fragility of electric power distribution systems.

[15] Hazus is a geographic information system-based natural hazard analysis tool developed and freely distributed by the Federal Emergency Management Agency (FEMA).

112. They encompass poles, cables, in-line components (e.g. transformers), and utility-owned equipment at customer sites.[16] They are applied to Tongatapu on a regional basis, taking into account any differential hazard experienced on the islands: Slight: 4% of circuits have failed; Moderate: 12% of circuits have failed; Extensive: 50% of circuits have failed; Complete: 80% of circuits have failed.

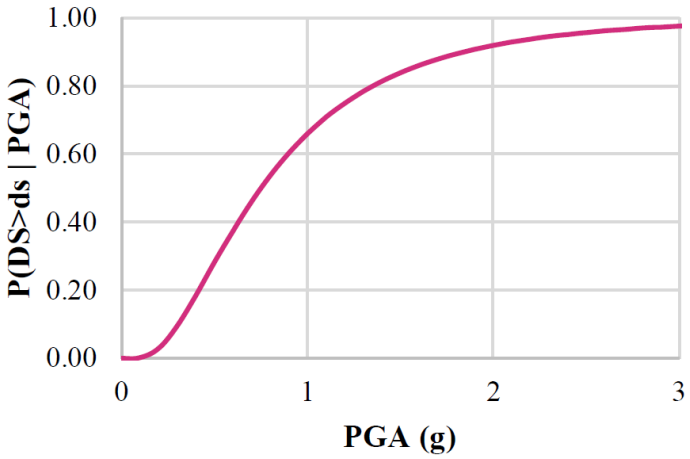
Figure 5.8: Utility pole and power line vulnerability to seismic hazards



Source: HAZUS

113. Ground-mounted transformers across Tongatapu are also vulnerable to seismic shaking, which may crack critical subcomponents or dislodge a ground-mounted transformer from its foundation. The fragility curve in Figure 5.9 was developed by the HAZUS engineers and has been adopted without modification. This function applies to the transformers present at small substations.

Figure 5.9: Transformer vulnerability for seismic



[16] FEMA. 2020. HAZUS Earthquake Model Technical Manual 4.2.

114. From photographs taken on site visits to Tongatapu, the transformers appear anchored to their concrete foundations. Strong accelerations could lead to shearing of the anchorage bolts or other failure modes that dislodge the transformer. Leakages of oil or from the radiator would require significant repairs or replacement of the entire transformer.

115. **Cyclonic wind**. Tropical cyclones are a critical hazard to Tonga, due to the potential for significant destruction and high likelihood of recurrence. Tropical cyclones in Tonga are slightly more frequent in El Niño years (19 cyclones per decade) than in La Niña and neutral years (16 cyclones per decade).

116. The year-to-year variability in the number of tropical cyclones in the vicinity of Tongatapu is large, ranging from zero in some seasons, to five in the 2003/04 season. This high year-to-year variability makes it difficult to identify any long-term trends in frequency, especially given the relatively short period over which measurements have been made.

117. Since the 1960s, six cyclones have severely affected Tonga, with four impacting Tongatapu: Flora in 1961 (Vava'u and Ha'apai); Isaac in 1982 (Ha'apai and Tongatapu); Waka in 2001 (Niua); Renee in 2010 (Tongatapu, Vava'u and Ha'apai); Gita in 2018 (Tongatapu and 'Eua); and Harold in 2020 (Tongatapu, 'Eua and Ha'apai). High winds and heavy rainfall associated with these cyclones caused severe damage (e.g. crops and food supplies, infrastructure, tourist resorts) and disrupted essential services and the wellbeing of affected communities for prolonged periods.

118. Of the six, Cyclone Gita was the most intense. Within Tonga's area of responsibility, maximum sustained winds were estimated at over 230kph. Based on a post disaster rapid assessment, the total economic value of the effects caused by Gita was estimated to be approximately T$356.4 million (US$164.2 million), equivalent to 37.8% of the nominal gross domestic product (GDP) of Tonga. Over 30% of the estimated recovery and reconstruction cost ($45.9m out of $148.7m) was for the energy sector. This included the cost of reconstructing the power grid infrastructure assets on Tongatapu to a higher standard of disaster resilience.

119. **Pluvial flooding.** According to a recently-completed flood management master plan (the summary of which provided most of the information for this section), rain-fed floods have affected Nuku'alofa's urban population more than any other type of natural disaster in terms of frequency and number of people impacted. More severe flooding events typically coincide with tropical cyclones. For instance, in the aftermath of Tropical Cyclone Jasmine (February 2012)[17] and Tropical Cyclone Gita (February 2018),[18] many of Nuku'alofa's 13 villages were covered by flood waters.

120. Because the soils are highly permeable, flood waters in higher areas of the city (1.6m above sea level) typically recede within two to three days in most areas. In lower-lying areas (about 60% of Nuku'alofa), longer-term and more frequent ponding occurs. In low-lying areas like Sopu (where Area 5 is located), significant flooding can be expected to occur two or three times per year.

[17] The peak 24 hour rainfall during this cyclone was 282mm. This is the maximum 24 hour rainfall recorded for Nukualofa equating to the 1 in 40 year return period event. The cyclone's rainfall was also preceded by 83mm of rain over the previous 4 days saturating ground ahead of the record rainfall.

[18] While high winds caused much of the destruction from Cyclone Gita, damages and losses were also attributable to heavy rainfall (200 mm over a 24-hour period) and the accompanying storm surge (which reached 1m above normal high tide levels). Several intermittent rain events in the months after the cyclone extended periods of inundation.

121. The nature of this flooding is different than conventional river flooding. Due to the high proportion of inundation area to catchment size and the flat ground, the rate of rise is slow and the depth of flooding is generally shallow (shin to ankle deep). After a heavy rainfall, rainwater runoff ponds on properties throughout the city until it eventually infiltrates, evaporates, or reaches such depth that it flows overland to lower ground.

122. After heavy rains, water levels can stay on roads for up to seven days and on lower-lying neighborhoods for even longer. This is generally the result of five factors:

- lack of slope, which slows the movement of water, extends periods of inundation, and limits engineering options to convey rainfall runoff and mitigate flooding;
- a water table that is close to the surface, which means that water cannot easily soak into the ground, and little can be done to facilitate an improved rate of infiltration.[19]
- roads that have been constructed higher than adjacent properties and without roadside drainage and culverts, thereby restricting natural drainage pathways;
- uncontrolled filling of land by property owners, which creates additional wetland areas and aggravates flooding to adjacent properties; and
- limited drainage infrastructure, which means that runoff from all other land has no direct link to drainage.

123. Due to these factors, flood depths and durations cannot be significantly reduced in some areas, while in other areas, potential solutions (e.g. wide drainage canals) are not viable due to their economic impracticality, extreme capital requirements, and/or maintenance implications.

124. **Storm surge.** Another cause of flooding is storm surge, which is typically related to tropical cyclones and widely recognized as one of the most destructive climatic effects. Storm surge can combine with other short-term climate variability factors, such as high tides and extreme rainfall events, to cause coastal inundation.

125. The sea wall that was constructed along the water front of Nuku'alofa in 1981 has successfully protected much of the city from storm surge during recent cyclones.[20] However, when TC Isaac hit in March 1982, Sopu was not protected by the sea wall. Approximately 30% of Tongatapu was inundated, resulting partly from a storm surge of 1.6m acting on top of a high spring tide.[21] Inundation reached 1 km inland in Sopu, where water depths were up to 1.5m, while all houses fronting Vuna Road were moved off their foundations a distance of about 10m. The sea wall was extended in 1989, thereby reducing inundation and erosion along the foreshore of Nuku'alofa. In addition, Hofoa road was built in 2010, and this now further limits inundation into Sopu during extreme events. Storm surge is therefore not a significant cause of current flooding in Nuku'alofa, but it could become more of a factor in the future due to sea level rise.

[19] The water table under Nukualofa reflects MSL with the lighter freshwater perched on top. The depth of this freshwater water varies (between .2 m and 1.9m) and is dependent upon ground level and depth available and the permeability of the ground and transmissivity rates and gradients available to MSL. The shallowest levels are adjacent to Fanga'uta Lagoon.

[20] This is a coronous rock armour sea wall with a crest varying between 1.6 and 2.6m that extends for the majority of the 6.6km ocean frontage on the north side of Nuku'alofa.

[21] Not all of this would have been by seawater, as flooding due to heavy rainfall would also have inundated many areas.

126. **Sea level rise.** The greatest long-term threat to Nuku'alofa is sea level rise due to climate change, which will lead to permanent inundation of low-lying areas. Since records began in the harbor in 1993, there has been an increase in sea level of about 6.5mm/year.[22] The global average during this period has been 2.5 to 3.4mm/year).[23]

127. Although sea level rise is a long-term process, the initial impacts are already observable. In the low-lying districts of Popua and Sopu, rising sea levels have led to inundation during spring tides and storm surges, while half the island of Nukunukumotu is now inundated by spring tides. Inundation is exacerbated by the fact that previous development of plots has been haphazard, and no coherent plans have been made to allow drainage and water flow.

128. Sea level rise will result in an increasing mean sea level (MSL). The water table under Nuku'alofa is perched on this mean sea level, with the fresh water lens sitting above the saline water underneath. Due to the highly permeable underlying Pliocene and Pleistocene limestone, sea walls and other coastal measures will not be effective long-term against rising sea levels.[24] The saline level will rise in direct proportion to MSL and will eventually inundate Nuku'alofa.

129. In addition, there is high confidence that the frequency and intensity of extreme rainfall events will increase with climate change, so Nuku'alofa's rain-fed flooding problems will likely worsen if significant measures are not taken.[25]

130. **Hazard and exposure.** The results from the MHDRA modelling support the findings of the flood management master plan, namely that large areas of Nuku'alofa are inundated by surface flood in both frequent and extreme rainfall events. From the modelling, the MHDRA concluded that while the smallest pluvial flood event assessed in this study has a 10-year return period, it is likely that there is extensive urban flooding in these areas for more frequent events.

131. However, there is only minor change to the extent and depth of pluvial flooding predicted for events rarer than the 50-year return period under both current climate conditions and with increased intensity of rainfall for future climates. In other words, there is little change in the pluvial flooding with increasing return period. The 50-year, 100-year, and 200-year events show similar levels of inundation.

132. Inundation under SLR scenarios is more extensive and demonstrates deeper maximum flood depth in flooded areas compared to extreme pluvial flooding events. This is especially true of SLR greater than 1 meter. With rises in sea level, areas affected by coastal inundation will be affected for greater durations due to decreased soil infiltration rates due to the higher sea levels. Figure 8 (pluvial flooding only) and Figure 9 (combined pluvial flooding and coastal inundation with 0.5 SLR) show a similar pattern of flooding in low-lying Nuku'alofa (including parts of Area 5). While pole-mounted equipment is too high to be damaged by this flooding (see next section), the bottom of the power poles are exposed. However, the difference between Figures 5.10 and 5.11 is also apparent, with the latter showing greater flood depths.

[22] Tide gauge data from the Australian Bureau of Meteorology.

[23] https://climate.nasa.gov/news/2680/new-study-finds-sea-level-rise-accelerating/

[24] However, it should be noted that the sea wall along the north side of the city provides a useful function in Nuku'alofa to protect against coastal erosion and extra high tides and wave action. It can also protect against small storm surges and tsunamis.

[25] Australian Bureau of Meteorology and CSIRO, 2014. *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports*.

Figure 5.10: Pluvial flood (100-year return period)

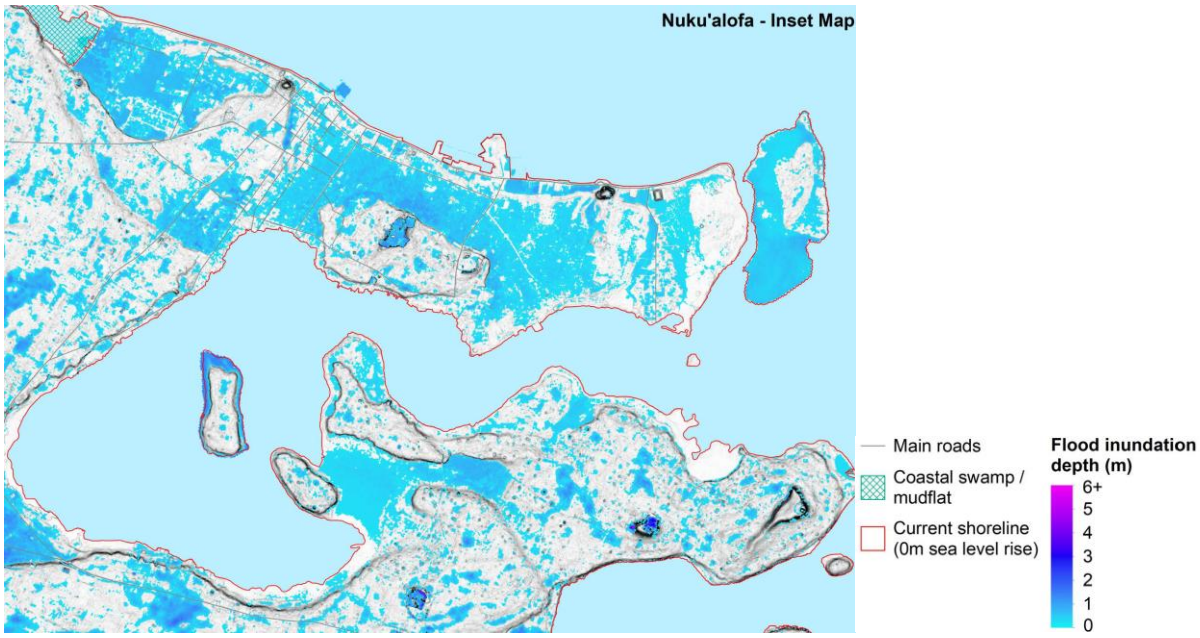
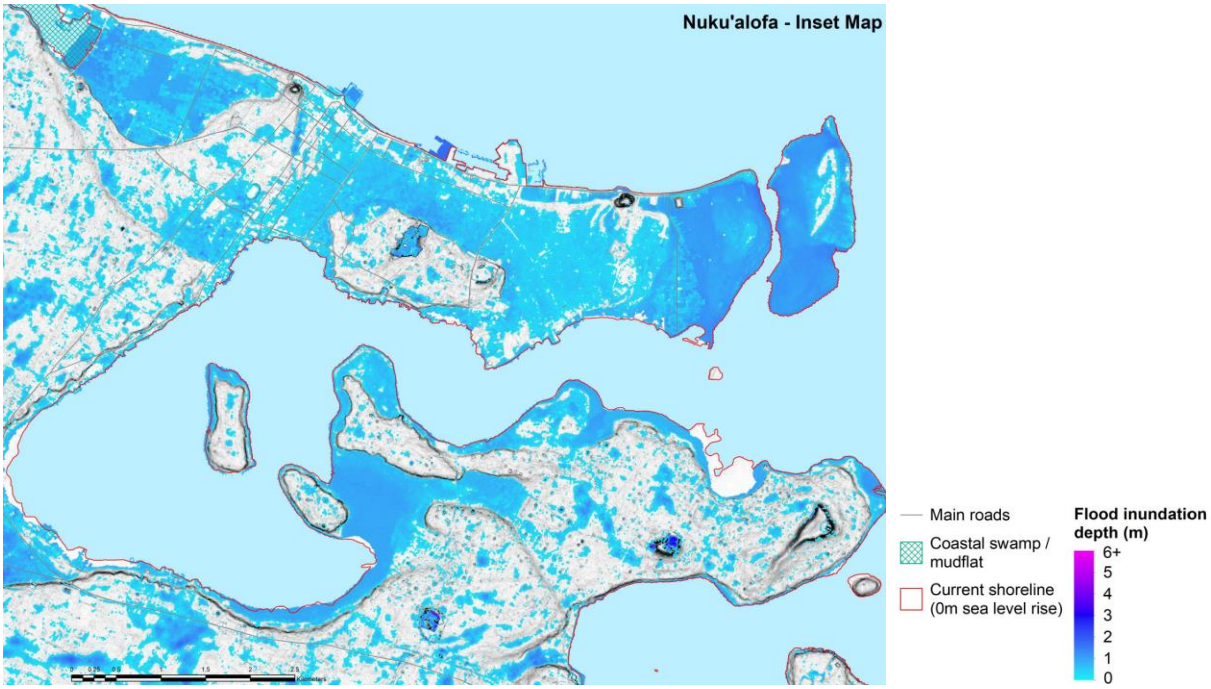


Figure 5.11 : Combined pluvial flood (50-year return period) and coastal inundation (10-year return period) with 0.5 SLR and climate change impacted rainfall

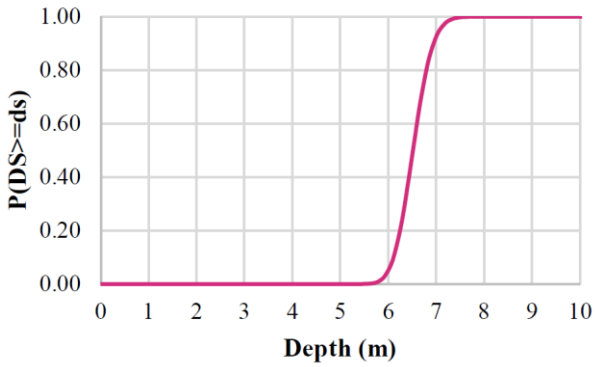


133. Rising sea levels will eventually start affecting drainage capacities and effectiveness, leaving low-lying Nuku'alofa inundated more frequently and for longer periods. This will not only impact the power infrastructure, but the users themselves, as parts of Nuku'alofa will become uninhabitable unless significant adaptation measures are taken (note the limitations of improving the drainage system in paragraphs 132 and 133). Although not within the scope of this document, plans for further improving power supply and distribution in Nuku'alofa should consider the longer-term impacts of sea level rise.

134. **Vulnerability of power distribution assets**. Several damage mechanisms can impact utility poles and power lines in a flood, including debris impact, floatation, and drag on poles and lines. However, for significant damage to occur, floodwaters must reach the sensitive electrical equipment attached to utility poles. Capacitors and transformers are rugged to rainfall but susceptible to damage in inundation. The power lines themselves are rugged to inundation, as they are weatherproofed against water intrusion through the cable housing.

135. As shown in Figure 5.12, Arup developed a fragility curve for pole-mounted equipment based on the elevation of the equipment on the pole, determined to be between six and seven meters, depending on the type of utility pole (HV and LV). The assumption is that once inundated, the equipment would need to be replaced.

Figure 5.12: Pole-mounted equipment flood vulnerability



136. Although not covered in the MHDRA, more frequent floods can impact power distribution in another way – by speeding up the process of wood decay and failure at the ground line section of power poles. The incidence of wood decay is directly related to the moisture content of the wood. Over long periods, wood preservatives are lost as a result of migration to the soil, which usually happens first at the ground line.[26] Since time-dependent decrease in strength due to decay is usually not considered in the design (to withstand strong winds), risk management strategies are needed to consider the impact of decay.[27]

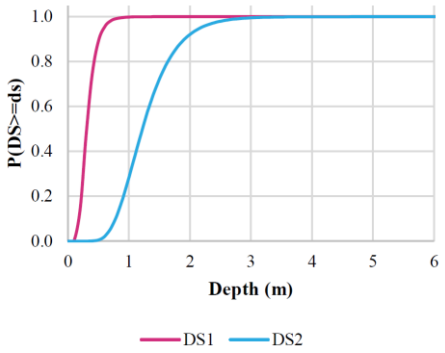
137. Ground-mounted transformers, though typically weatherproofed to some degree, are also vulnerable to flood inundation. Individual components are susceptible to water damage, like the coils in oil-filled transformers as seen in Tonga.

[26] https://polesaver.com/blog/why-do-wooden-utility-poles-fail/

[27] https://www.frontiersin.org/articles/10.3389/fbuil.2020.00073/full

138. As shown in Figure 5.13, two damage states (DS) for transformers were developed at Arup from interviews with electrical engineers and other subject matter experts with flood reconnaissance experience. The first damage state (DSI) corresponds to water entering the transformer and damaging individual subcomponents, which would require replacement. The second damage state (DS2) leads to total replacement of the transformer and occurs once water has almost completely inundated the interior. Damage would not be expected until floodwaters exceed the height of the plinth on which exterior ground-mounted transformers are typically found.

Figure 5.13: **Ground-mounted transformer flood vulnerability**



139. **Tsunami.** Tonga is highly vulnerable to tsunamis. The island group is situated at the subduction zone of the Indo-Australian and Pacific tectonic plates and within the Ring of Fire, where intense seismic activity occurs. It is about 200km to the west of the Tonga Trench, which is a potential source of tsunami. At most risk of tsunami inundation are Tonga's atoll islands, along with the low-lying areas of the main island of Tongatapu, including Nuku'alofa.

140. Historically, some 20 tsunamis have affected Tonga. The most recent followed the Great Samoa/Tonga Earthquake of September 2009 near Niuatoputapu. This was followed by three tsunami waves with a maximum height of 16.9m and inland penetration of >1km. About 46% of the island of Niuatoputapu was inundated, resulting in the deaths of nine people and damages estimated at about USD10 million.[28] This included the destruction of 85 houses and the partial destruction of 56 others.

141. In addition to earthquake-induced tsunamis, volcanic eruptions have also caused destructive tsunamis in Tonga. The January 2022 massive volcanic eruption generated tsunami waves that wreaked havoc on the western part of the main island Tongatapu and the Ha'apai islands that resulted in four casualties. Coastal developments, residences and farms located on the west coast were completely destroyed. The World Bank Disaster Assessment report estimates damages at $USD90.4 million (TOP 208 million) with damages to agricultural sector alone estimated at about $USD39 million. The government has taken steps to mitigate the risk posed by tsunami, which includes the installation of early warning systems, evacuation routes and designated shelters and increased public awareness. While these are important measures, it should be noted that Tonga's close proximity to a fault line and Nuku'alofa's flat topography with the lack of protective reef systems on some coastal areas means that tsunami risks can only be truly mitigated by relocating people and assets further inland and to higher ground.

[28] https://www.pdc.org/the_kingdom_of_tonga_post_tsunami_reconstruction_project/.

142. **Hazard and exposure.** A deterministic assessment of tsunami inundation was conducted based on a range of subduction zone thrust earthquake sources occurring on the Tonga Trench. A total of 10 earthquake scenarios were tested with Mw of 9.0, 8.7 and 8.3, with variation in the source location and/or slip distribution within each magnitude. Scenarios representing a range of maximum tsunami amplitudes were selected for inclusion in the assessment. The scenarios were run at present day MSL and for SLR scenarios of 1.0, 2.0, 4.0 and 6.0m above present day MSL.

143. Due to the low-lying topography, the northern coast of Tongatapu is most vulnerable to tsunami inundation. Particularly vulnerable are the villages on the north-facing portion of the island to the east of Nuku'alofa (across the entrance of Fanga'uta Lagoon). Sensitivity testing showed the strong dependence on source location in predicting tsunami amplitudes at Nuku'alofa, with the strongest effects associated with sources directly east of Tongatapu and falling off rapidly with distance north or south along the Tonga Trench Subduction Zone. The arrival times showed a similar strong dependence on source location. The Mw 8.3 scenarios were located to the east of Tongatapu and all had arrival times in the order of 0.5 hours or less.

144. The modelling results suggest that as the magnitude of the source events increase from Mw 8.3 to Mw 9.0, the areas inundated and the depth of inundation increases (Figures 5.14 and 5.15) show a tsunami emanating from a Mw 8.7 earthquake with 0m and 1m SLR). The source location influences the maximum offshore amplitude height, which in turn influences the areas inundated and the depth of inundation. When sea level rise is considered, the northern coast of Tongatapu remains most vulnerable to tsunami inundation.

Figure 5.14: Maximum overland flow depth (magnitude 8.7 north source with 0m SLR)

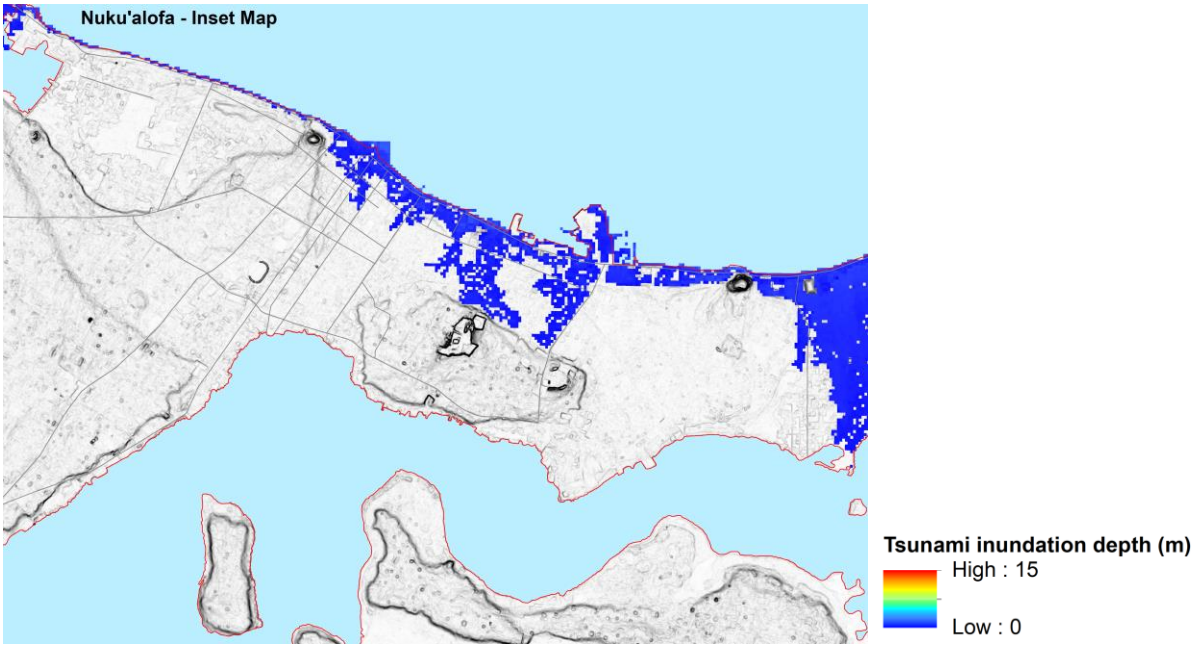
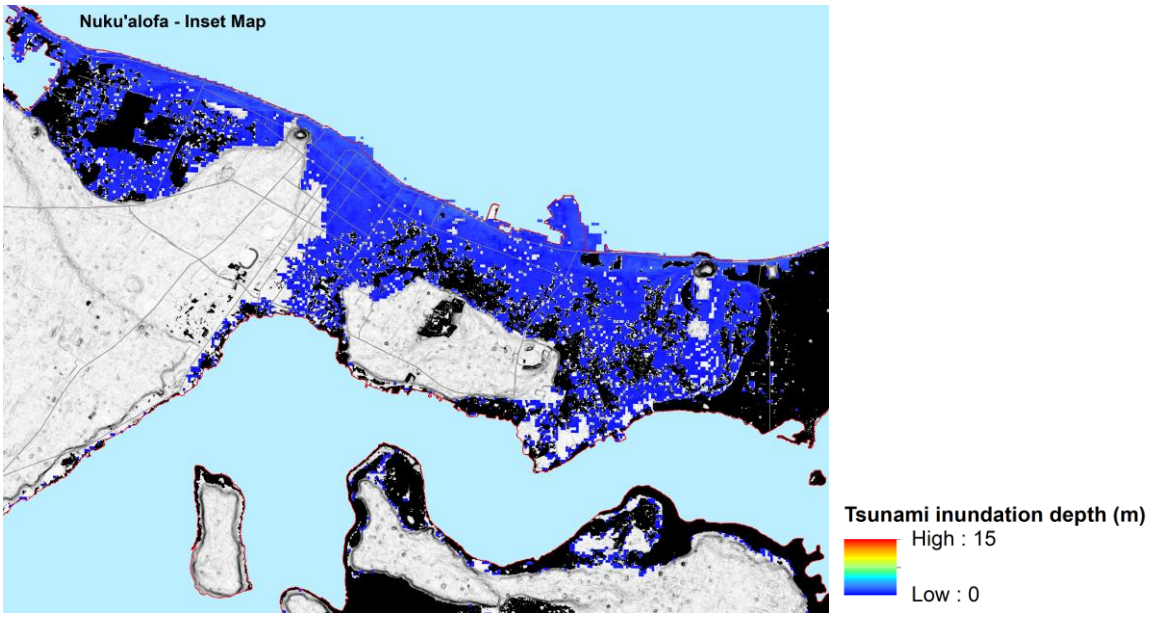


Figure 5.15: Maximum overland flow depth (magnitude 8.7 north source with 1m SLR)



145. **Vulnerability of power distribution assets.** Tsunamis often have higher energy flows compared to coastal or pluvial flood. This can result in increased structural damage and damage resulting from debris. Tsunamis cause damage to distribution systems in several ways. The fast-moving water can scour the base of the utility poles and undermine the foundation. This damage can cause the pole to lean or topple.

146. Debris strikes also pose a significant hazard to utility poles and power lines. If the water level reaches the height of the power lines, floating debris can sever cables from the utility poles. This type of damage is difficult to predict and model, but the empirical data that informed the development of these fragilities included this type of damage.

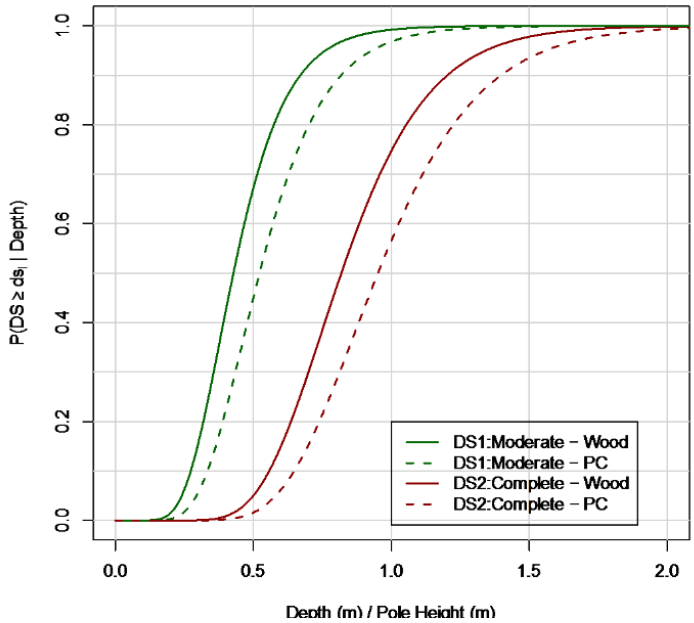
147. Hydrodynamic forces that undermine the structural integrity of utility poles would impact the pole-mounted equipment. If a utility pole topples, the pole-mounted equipment could be damaged in the fall or by the floodwaters. In this case, once the poles are damaged, a complete replacement of any mounted equipment is expected.

148. The fragility functions shown in Figure 5.16[29] were adopted without modification for wood utility poles. The poles on Tongatapu are typically constructed of pine, and the two damage states presented[30] were assumed to apply, as they are based on expert judgment and a review of post tsunami damage reports from Samoa, the Andaman Islands, Chile, and Japan. Where utility poles are damaged, the connected lines will also be considered damaged.

[29] Horspool, N. A., & Fraser, S. (2016). An analysis of tsunami impacts to lifelines. GNS Science Report 2016/22.

[30] DS 1: Moderate damage to pole, leaning or needs repair; DS 2: Complete damage to pole, washed away.

Figure 5.16: Utility pole vulnerability to tsunami

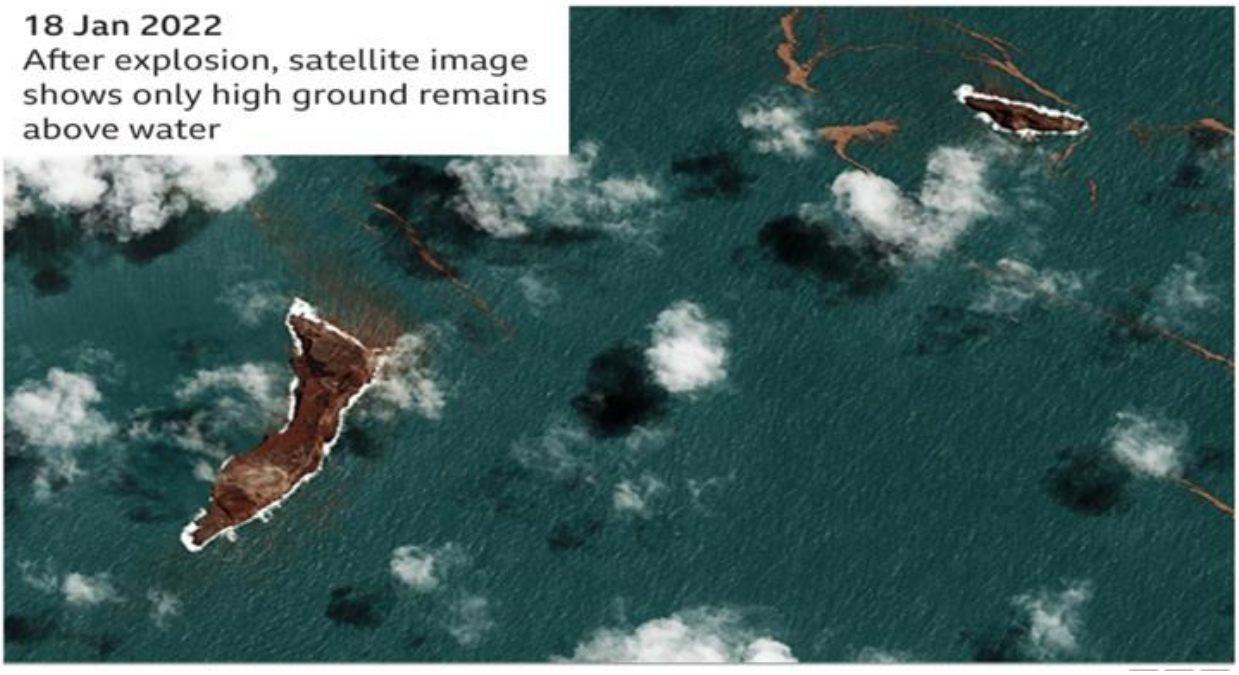


149. **Volcanoes** Tonga's volcanic activity has been recorded since 1839, and includes submarine eruptions, and emerging and disappearing islands. The last major eruption occurred in 2014 which resulted in the formation of a new island named, Hunga Ha'apai, 1.3km long and 800m wide (Division of Natural Resources, MLNR, 2015). However, the most recent major eruption on 15 January 2022 completely obliterated the new island and only fragments of the island can be seen on satellite imagery (see Figures 5.17 and 5.18).

Figure 5.17: Tonga volcanic eruption – before and during

Source: Sentinel Hub, Planets Lab, Maxar per BBC

Figure 5.18: Tonga volcanic eruption – after



Source: Sentinel Hub, Planets Lab, Maxar per BBC

150. The massive volcanic eruption was recorded by NASA and detected by Meteorology stations across the globe. Tonga located closest to the epicenter of the eruption estimated to have occurred 65km north-west off the coast of Nuku'alofa. The eruption generated tsunami waves that reached up to 7m high in the central coastal area and were much higher in the western and eastern coastlines of Hahake and Hihifo. As a coral atoll surrounded by fringing reef systems, the island was afforded some protection and aided in dissipation of wave height and strength.

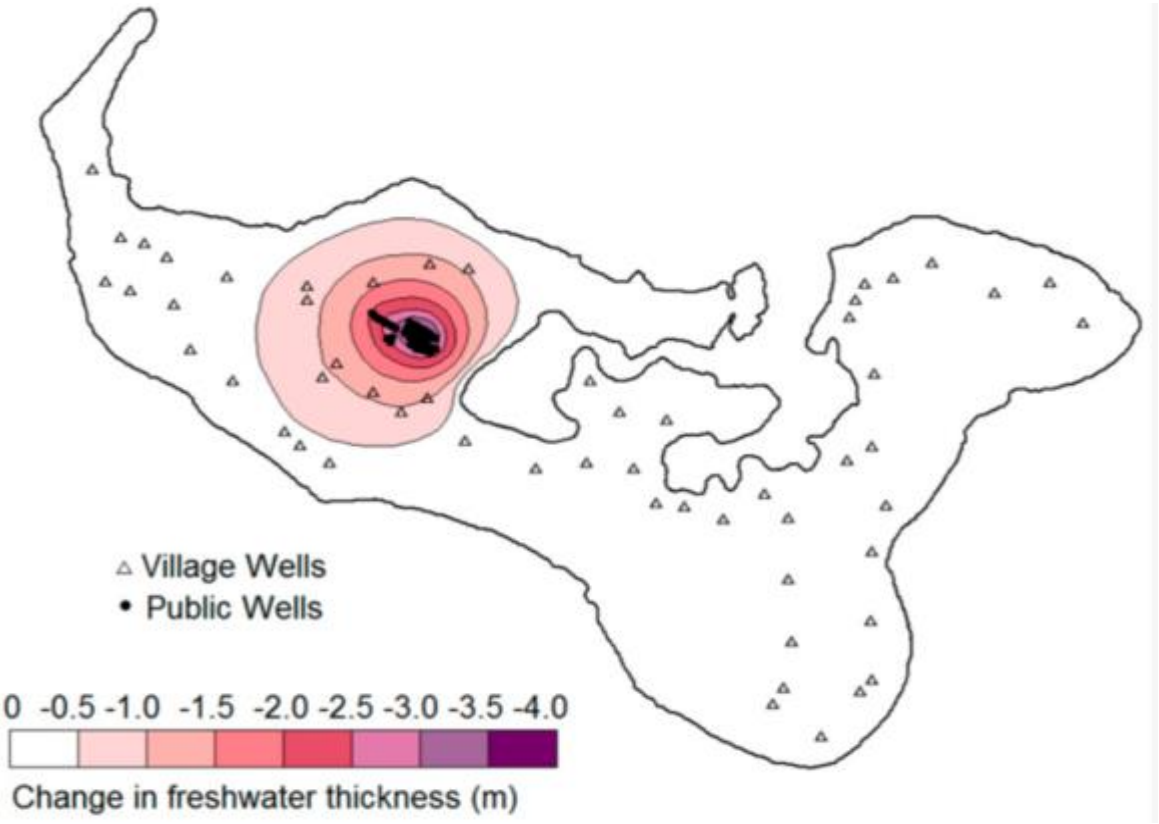
5.2.4 Water resources

151. **Surface water resources.** The island of Tongatapu has no surface water resources. Freshwater is supplied from underground aquifers stored in a freshwater lens. This lens varies in depth from 1.0 - 2.5 m below sea level in the west, and approximately 5-8 m below sea level in the central and eastern part of the island. The main drinking water source is rainwater, with utilization of underground water in urban areas. However, due to the hardness of the ground water, most Tongans supplement their drinking water supply with rainwater catchment system and purchase filtered ground/ rain water from local suppliers.

152. **Groundwater resources.** A well-field based at Mataki'eua extracts water to supply the capital city, Nuku'alofa. The water table is estimated to be approximately 13metres below ground level. A study in 2009 on the vulnerability of groundwater in Tonga[31] found that due to the conditions of the individual wells, parameters such as pH, salinity and temperature were only acquired for 31 out of 39 wells in Mataki'eua.

[30] SOPAC. 2009. Vulnerability of Groundwater in Tongatapu - Groundwater Evaluation and Monitoring Assessment.

Figure 5.19: Groundwater development and freshwater lens



Source: Water – Sharp interface approach for well-scale modeling of small island freshwater lens: Tongatapu Island (2018, 10[11])

153. Concerns around oil spills in the pump engine base has allowed for more efficient design incorporating concrete bases as bunding sites to contain oil leaks and spillage. This implies that maintenance of the existing wells is a challenge and warrants support for the Tonga Water Board and the Geology Unit of Ministry of Lands, Survey and Natural Resources (MLSNR) to monitor and maintain these wells.

154. The Water Resources Act 2020 provides for the sustainable management, protection and conservation of water resources in Tonga. Under the Act, the National Water Resources Committee comprising the chief executive officers for MLSNR, Ministry of Health, Tonga Water Board, MEIDECC, Director-Hydrology and Water Resources, and representatives from NGOs. The Committee has functions to support the dissemination of information about water resources to government agencies and the general communities as well as declare an area to be a water protection zone.

5.3 Biological Environment

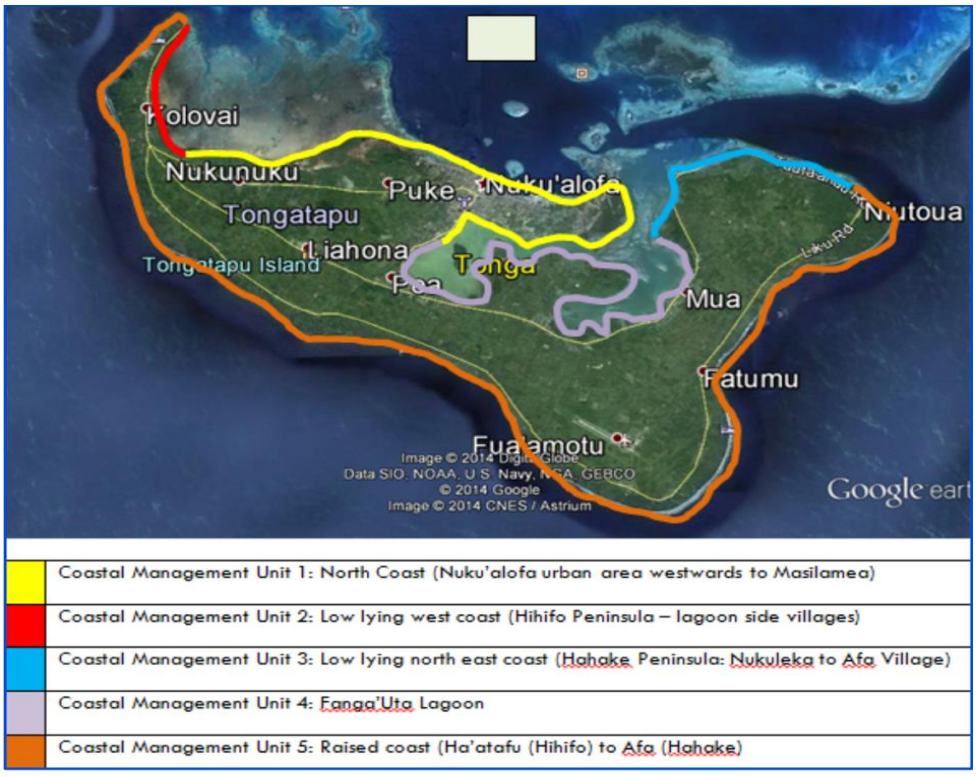
5.3.1 Protected areas and threatened species

155. **Protected areas**. In total, there is one Marine Reserve, one Sanctuary, five Marine Protected Area Parks and 11 Reserves in Tonga. Two of the 11 reserves are classified as a SMA-Reserve and FHR-Reserve. Despite the establishment of these MPAs, they are often referred to as 'paper-park' due to lack of compliance enforcement of compliance. However, measures to strengthen enforcement are currently being pursued under the Marine Spatial Plan.

156. In addition to the established MPAs and SMAs, there are currently 90+ offshore marine protected areas seeking establishment under the Marine Spatial Plan project implemented by the DOE in order to meet Tonga's national commitment of protecting 30% of its EEZ by 2030.[32]

157. The MPAs and SMAs are designed to be managed by communities living along the coastal areas of Tongatapu, Ha'apai and Vava'u. Figure 5.20 illustrates coastal management units that comprise the Integrated Coastal Management Strategy Planning to support decision making and managing the human activities along the coastal and marine environment. The section highlighted in yellow delineates the two coastal villages in Area 5; Sopu and Hofoa.

Figure 5.20: Coastal management units



Source: Kingdom of Tonga - 3rd National Communication on Climate Change Report

[32] Kingdom of Tonga. 2020. Sixth National Report to the Convention on Biological Diversity

5.3.2 Terrestrial habitats, flora and fauna

158. The terrestrial habitats of Tongatapu, Nuku'alofa and the project area include a mix of natural vegetation types which are predominantly agricultural crops that are essential for food security. About 70 percent of the population[33] are involved in farming activities of food crops such as yams (*Dioscorea spp.*), cocoyam taro (*Xanthosoma sagittifolium*), swamp taro (*Colocasia esculenta*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), and giant taro (*Alocasia machorrhiza etc.*

159. Fruit trees such as avocado, oranges, soursop, mandarin, coconuts, tamarind etc can also be found in Tonga. Banana crops are also common due to the tropical climate. It is assumed that banana varieties were all derived from the seeded species of *M. acuminata* and *M. balbisiana.* The three main types of Banana crops in Tonga are the hopa (*Musa balbisiana*), pata (bluggoe types) Pata cavendish types (siaine).[34]

160. **Modified habitat.** The terrestrial habitat observed in Area 5 is a modified environment due to significant land use changes attributed to farming practices. Along the pole alignments on the main road of Hihifo linking to Sia'atoutai, Hofoa and Tu'atakilangi settlements, root crops plantations such as taro, cassava etc were present throughout the area. Coconut trees, breadfruit and fruit trees such as papaya trees, mango trees and banana plantations were also observed. Trees of cultural and economic significance such as mulberry trees, kava plants, Heilala tree and sandalwood trees were also observed in the project impact area.

161. The vegetation in Sopu, Halaovave, Isileli and Maui are predominantly coconut trees, pine trees, mango trees, papaya and fau trees and coastal trees scattered throughout the settlements (as shown in Plates 5.1 a – f). This area is a flood prone area and located closer to the coast and thus not suitable for farming.

[33] Ministry of Agriculture, Food, Forestry and Fisheries and Tonga Statistics Department and Food and Agriculture Organization of the United Nations. (2015, December). *Tonga national agricultural census main report.*

[34] Kingdom of Tonga 2020, 6th National Report to the Convention on Biological Diversity

Plates 5.1 a-f: Examples of vegetation types in modified habitat of Area 5

Kava plant (Tu'atakilangi)

Banana plantation (Hofoa facing east)

Taro plantation (Tu'atakilangi)

Cassava plantation (Hofoa)

Mature mango tree hanging over power poles (Mui Sopu facing north)

Mature Hibiscus tiliaceus (fau tree) (Halaovave facing east)

5.3.3 Aquatic flora and fauna

162. **Overview**. Mangrove ecosystems are fundamental in providing coastal protection against storm surges and provide habitats and nursing grounds for fish species such as milk fish, mud crabs, shellfish etc. They play an important role in carbon sequestration and therefore vital for climate change adaptation and mitigation. According to Salcone J et al. 2015, carbon sequestration from mangroves in Tonga contribute to an estimated 1.4 million pa'anga per annum in terms of cost evaluation of this vital ecosystem service. Tonga's wetlands comprise mangrove forests which covers about 1,800ha (3 percent) of the total land area for Tonga.[35] The total mangrove areas in Tongatapu is approximately 1450ha found mostly in the Fanga'uta lagoon area but also in other coastal areas in the northwest of Tongatapu in Sopu (282ha), northeast in Popua and Patangata (54ha) and western coastlines in Hihifo district, Kolovai (108ha).[36]

163. Despite the importance of mangroves as mechanisms for climate change adaptation and mitigation, the mangrove areas in Tonga are declining.[37] This is attributed to the unsustainable harvesting of mangroves to meet community demands for making traditional tapa cloths, medicinal cure for fever, stomach ailments etc and firewood for cooking. Moreover, increase in land demands has resulted in reclamation of these wetlands, further exacerbating the degradation of the mangrove ecosystems, affecting species diversity and stability in providing essential services for climate change adaptation and mitigation.

164. **Ecological survey and methodology**. An ecological survey was conducted as part of assessment of potential impacts of this project. A desktop review of baseline information available in several environmental and survey reports on mangroves was conducted to identify areas of ecological importance in the project area of influence. Visual counting and observations of mangrove species, avifauna and arthropods over 60 minutes were recorded in three sites as shown in Figure 5.21.

Figure 5.21: Aquatic sites surveyed

35 Kingdom of Tonga. 2018. State of Environment Report

36 Ministry of Environment and Climate Change. 2012. Distribution of Mangroves on the Island of Tongatapu

37 Kingdom of Tonga 2020, 6th National Report to the Convention on Biological Diversity

165. The aquatic habitat in Sopu and Hofoa are defined as modified habitats due to extensive reclamation works and the presence of a Department of Fisheries (DOF) milk-fish farm in the mangrove areas in Sopu.

166. **Site 1 Hofoa - general observations.** The area is at higher elevation than Sopu, drier and landward with lower salinity. Flora and fauna is typical of the modified habitats in the area (Table 5.5). This area is being reclaimed with evidence of gravel rock being piled in the area to construct a road through the mangroves (Plate 5.2). Thin poles marking the road path were observed. This suggests that new network extensions are likely to be installed in the area. One of the main concerns would be to ensure that power poles installed are treated well and chemicals used in the treatment process such as arsenic etc are not leached into the surrounding mangrove habitat.

Table 5.4: Flora and fauna species observed in mangrove areas in Hofoa and Sopu

Tree/shrub species	**Description**
Rhizophora samoensis (Tongolei)	Good firewood
Exceocaria agalloca (Feta'anu)	Sap can cause blindness
*Acrostichum speciosum (*Hakato*)*	Not many uses and abundant throughout
Avifauna	
Kingfisher	1 seen and few others heard
Mynah	Two seen
Arthropods	**Rate of abundance**
Mud crabs	Many crab burrows

Plate 5.2: Reclamation and new access road through mangrove area

167. **Site 2 - midsection between Sopu and Hofoa.** This is a flat tidal area with a road constructed through the mangroves to connect the Sopu and Hofoa villages. Flora and fauna is typical of the modified habitats in the area (Table 5.6). As this is not a protected area, reclamation is high due to land subdivision by government to accommodate families moving into Tongatapu from the outer islands. Moreover, high degree of rubbish dumping in these mangrove areas can be seen throughout (Plates 5.3 a-c).

Table 5.6: Flora and fauna species observed in mangrove areas in midsection area

Tree/shrub species	**Rate of abundance**
Rhizophora samoensis (Tongolei)	Predominant species present due to fine mud sediment
*Acrostichum speciosum (*Hakato*)*	Abundant - evidence of dieback in most clusters. Rising sea levels have changed the morphology of this ecosystem.
Avifauna	**Rate of abundance**
Aerodramus spodiopygius (swiftlet- pekepeka tea)	Very common, more active in morning than midday.
Egretta sacra (Reef heron - Motuku)	1 spotted in the morning
Sula leucogaster (Brown booby- Ngutulei)	1 spotted
Anas superciliosa (Pacific black duck - Toloa)	3 spotted
Fregata minor (frigate bird – Lofa)	2
Acridotheres fuscus (jungle mynah- ngutu'enga)	More than 20
Todiramphus chloris (white collared king fisher- Sikota)	2 spotted
Flora	**Rate of abundance**
Bidens alba	Invasive weeds common on oadside
Derris Trifoliata	Creeper or climbing plant found in mangrove swamp areas.
Solanam torvum	Needs dry substrate to establish themselves
Stachytarpheta jamaicensis	High tolerance to disturbed sites with high traffic volume.
Hibiscus tiliaceus (fau)	Well adapted to coastal environments. Tolerates saltwater
Pluchea Carolinensis	Grows well in both dry and wet environments.
Tecoma stans (yellow elder)	Commonly found
Ricinis communis	Common in waste land areas

Plate 5.3 a:Modified habitat in mid-section area - aerial view Hofoa facing south

Plate 5.3 b-c: Modified habitat in mid-section area

Waste dumping

Dominant mangrove (Hakato species)

168. **Site 3 – Sopu.** This area is located on the coastline towards the open sea. Some elevated dry areas and other small ponds and swamp patches. Roads have been constructed through these mangroves and therefore have disturbed the natural habitat. New settlements emerging in this area. Flora and fauna is typical of the modified habitats in the area (Table 5.7 and Plates 5.4 a and b)). Some species *Clerodendrum inerme* (Lalahina) and *Calophylum inophylum* (Feta'u) are used as traditional medicine.

Table 5.7: Flora and fauna species observed in Sopu

Tree/shrub species	**Rate of abundance**
Rhizophora samoensis (Tongolei)	Common throughout Hofoa and Sopu wetlands
*Acrostichum speciosum (*Hakato*)*	Common in Hofoa wetlands
Lumnitzera littorea (Hangale)	Rare species due to exploitation for firewood and medicine.
Rhizophora stylosa (Tongofeta'u)	Prefers rocky and sandy substrate
Clerodendrum inerme (Lalahina)	Not many observed.
Colubrina asciatica (Fiho'a)	Common
Hernandia nymphaefolia (Fotuluna)	Grows in coastal area.
Calophylum inophylum (Feta'u)	Medicinal plant
Pandanus tectorius	Common landward coastal plant species that has fruits
Ipomoea pes caprae	Creeper vine that grows along the coastal area.
Leucaena *leucocephala (siale mohemohe)*	Predominant in coastal areas. Good firewood.
Avifauna	**Rate of abundance**
Tongan doves	3
Kingfisher	2
Arthropods	**Rate of abundance**
Crabs	Burrow holes are bigger than those observed in other sites

Plate 5.4 a and b: Flora of Supu area

***Lumnitzera littorea* (Hangale)**

***Prenma serratifolia* – medicinal plant**

169. In 2015, a milk-fish farm was established in Mui Sopu by the DOF located about 200m west from the DOF office (Plate 5.5). Through the assistance from FAO, the project imported 500 milkfish fry which were cultured at the Sopu culture pond aimed to revive milk-fish populations of Nomuka, Ha'apai. The community based operation managed by the DOF successfully transferred 500 milk-fish juveniles to Nomuka. In 2018, rediscovery of milkfish in Nomuka was reported on the island. Although not in use for milk-fish farming at present, the Ministry of Agriculture, Food, Forestry and Fisheries (MAFFF) is currently using the area for trialing prawn farming before transferring to the communities. There are plans to also develop the areas behind the pond for fish farming, which will require the setting up of a cage and pen culture system. The pond is used as a base for community-based fishing developments and training.

Plate 5.5: Milk-fish farm in Mui Sopu

170. **Conclusions on aquatic habitat**. The aquatic environment in the vicinity of the project area consists of modified habitats, in surveyed areas site 1 and site 3, ongoing development, establishment of the milk-fish farm and use of the area for community fishing development and training contribute to impacts on its ecological function. Site 2 has largely been modified as a result of extensive reclamation works and construction of access roads throughout the mangrove ecosystems. Invasive species of plants were also found most abundant here and waste dumping suggests that this is a modified environment.

171. The aquaculture pond at Sopu needs to be protected and precautions must be taken when working in this area. Some rare species of mangroves and medicinal plants that are decreasing in number (*Lumnitzera littorea* and *Prenma serratifolia*) were identified. TPL will explore efforts with DOE and communities towards increasing numbers of the species through replanting programs as part of mitigation measures to minimize further disturbance to these habitats from the construction works involving clearing and removal of this and other vegetation in order to replace power poles.

5.4 Socio-economic Environment

172. This section presents an overview of the socio-economic situation in the project area. Detailed consideration of land tenure issues and household survey results, are developed in stand-alone documents, refer to the Land Due Diligence Report.

5.4.1 Population and demography

173. Population. According to the last census conducted in 2016, Tonga's population now stands at 100, 651 compared to 103, 252 in 2011. This shows a decrease of 2,601 people over a span of five years. This decrease can be attributed to an increase in migration of Tongan families overseas. The urban area of the total population of Tonga has 23,221 people; 11,529 males, and 11,692 females while 77, 430 people constitute the rural population.[38]

174. The total population of the seven villages is 5,107 (Table 5.8), ranging from 460 in Sia'atoutai to 1,173 in Hofoa. The total number of households is 1,080, and the occupied number is 894. Of the seven villages, Sopu has the highest number of total households (279) and occupied households (221), with Tu'atakilangi (144) the lowest number of total households and Sia'atoutai (98) the fewest occupied households. The average household size is six people; Sia'atoutai and Tu'atakilangi have slightly smaller households with five people per household. The female population accounts for half of the population (2552) and males (2555). According to the current available data of two villages, 11% of households in Sia'atoutai and 18% in Hofoa are female-headed households. The working age population (15-64 years) for all 7 villages is 3,127 people, or 61% of the total population. This ranges from 58% in Sia'atoutai to 64% in Tu'atakilangi.

[38] Tonga Statistics Department (2017): Tonga 2016 Census of Population and Housing.

Table 5.8: Demographic characteristics of seven villages

Village	Total population	Female population (no.)	Female population (%)	Working age (15-64 years) population (no)	Working age population (%)
Sia'toutai	460	213	46.3	266	57.8
Halaovave + Maui	903	474	52.5	562	62.2
Sopu	1,166	567	48.6	739	63.4
Isileli	666	327	49.1	421	63.2
Hofoa	1,173	563	48.0	670	57.1
Tu'atakilangi	739	408	55.2	469	63.5
Total	**5,107**	**2,552**	**50.0**	**3.127**	**61.2**

Source: Tonga Statistics Department, 2016

175. **People with disability**. According to Tonga Census 2016, 5% (269) people in Area 5 have been classified as disabled people, having major health issues. 0.45% (23) people are not able to see, 0.43% (22) people are not able to hear, 1.12% (57) people are not able to walk, 0.49% (25) people have mental health issues, 1.98% (101) people are not able to control themselves and 0.80% (41) people are not able to walk. More females suffer from disabilities (86), compared to males (57).

5.4.2 Livelihoods, employment, and income sources

176. **Livelihoods.** The economy of Tonga is largely based on agriculture and fisheries. Subsistence agriculture plays an important role throughout Tonga. In addition, remittances sent from relatives working abroad also contribute significantly to the Tongan economy as a whole, and in the economy of individual households.

177. Many women are actively engaged in an informal handicraft trade for ceremonial purposes and private sale. Kātoanga (mat exchanges) take place several times a year and can be quite lucrative if held for wealthy expatriate families living overseas who are celebrating weddings (Nelson and Fukofuka 2016). Seasonal outmigration is increasing amongst men, but women's participation is considered a disruption to family life and frowned upon (Chattier 2019). The domestic work burden of women left behind from male migration is considerable, which limits their ability to participate in productive work outside the household (Chattier 2019).

178. Women's farm activities can include subsistence cropping of taro, yam, tapioca, sweet potato, spinach, cabbage, tomato, onion, capsicum, fishing, pigs and poultry, of which surplus is sold at markets (FAO and SPC 2019). Community development has been directed at assistance for raising poultry and cropping vegetables for local markets. These schemes include micro-credit, training and cash transfers for 'vulnerable' women such as single mothers and the unemployed (Jolly et al. 2015). The FAO and SPC (2019) report women are not consulted on government extension services to develop exports, but they do engage women on programs for food security and nutrition, as well as value-added products such as taro chips. Extension services for women focus on local markets.

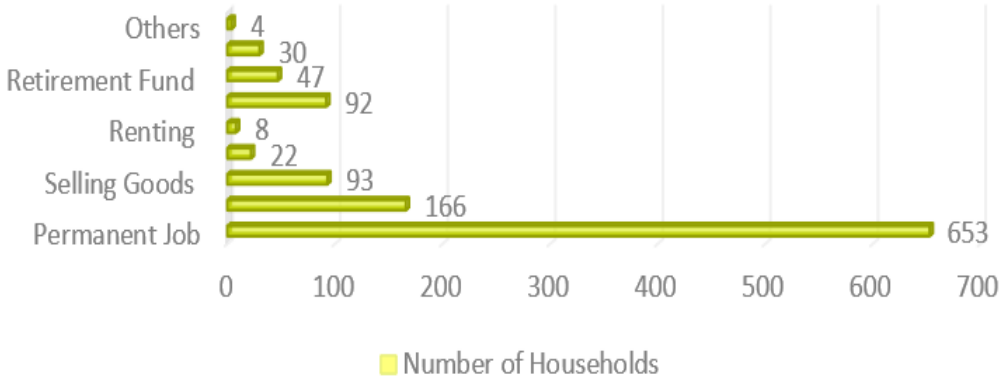
179. **Employment**. The labor force participation rate is 71.2% for men and 56.7% for women. Men are more active economically (22,058 men and 18,565 women) and across every region. The higher proportion of men is fairly consistent across all forms of work (paid work, subsistence work, unpaid family work and volunteer work) and across all regions. Women's participation in economic activities has stagnated over the last few years, with the gap between men and women's participation widening (Lee 2017). Women also do a lot of the voluntary community work through church and kin networks which can involve considerable donations (Lee 2017).

180. Census data also identifies the sectors where men and women are most active. Nearly 98% of the 8,080 skilled workers in agriculture, forestry and fishing are men and only 2% are women. The majority of craft and related trade workers are women (66.6%), the remaining 33.4% are men. There are slightly more women than men in the services and sales sector (53% and 47% respectively) but slightly more men than women professionals (51.7% and 48.3% respectively). There is a high proportion of informal Employment in the non-agricultural sector (73.5%) of which 75.2% is female (UNDP 2020).

181. **Unemployment.** According to the 2016 Census, the unemployment rate in Tonga is 16.4%. A total of 6,650 people were not working but willing to work, of which 1,668 (7.6%) were men and 4,982 were women (26.8%). Unemployment is higher in urban areas (10.4% men and 28.5% women) than rural areas (6.7% men and 26.3% women) which is likely due to subsistence workers not registering as unemployed. This trend is reflected in the data for the island regions in which unemployment rates dip down, particularly on Ongo Niua where 3.9% of men and 6.4% of women are unemployed.

182. **Household income for Area 5.** According to the Tonga 2016 Census, within the project area some 59% (653) of the household income is from permanent jobs while 39% (432) rely on private businesses, selling goods, land leased, leasing properties, remittances, retirement fund for income, and the remaining 3% (30) stated that they had no income (Figure 5.22).

Figure 5.22: Area 5 households by source of income



Source: Department of Statistics – Census (2016)

183. **Poverty.** In Tonga, 22.1% of the population were living below the poverty line in 2015. To compare with other Pacific Islands countries, Fiji has 28% living below the poverty line, and Samoa 18.8%, and the Solomon Islands 12.7%.

184. Tonga is traditionally a cashless society where family, community and church networks provide relations of reciprocity for basic needs such as food and shelter (WHO, 2015). These have weakened as socioeconomic classes have formed over time, leading to social difference between groups of women based on access to government, education, formal Employment, family size and socioeconomic factors. Socioeconomic difference is also a function of geography with the outer islands and non-urban areas of Tongatapu the most vulnerable to poverty (Nelson and Fukofuka 2016).

185. The government provides detailed statistics on extreme and multi-dimensional poverty. In 2016, approximately 3% of Tongans (about 3,200 people) lived in extreme poverty on less than 3.1 Pa'anga (equivalent of $1.90 PPP) per day.

186. The levels of extreme poverty are fairly equal between men and women but that children, urban and people not in paid work are more vulnerable to extreme poverty. In terms of income poverty, 27% of Tongans lived in low-income households. Rates for children are greater with 33% living in poverty compared to 23% of adults. Multidimensional poverty is characterized by experience of deprivation (social or economic) which inhibit participation in society e.g. can't replace household items or eat certain types of food. Twenty-four percent of Tongans fit into this category. There is also a very small proportion (<1%) of Tongans that have very little income but avoid deprivation by relying on kin and community relations and subsistence production. Female headed households make up nearly a quarter (24.6%) of poor households (ADB 2018). However, similar to extreme poverty, vulnerability to deprivation is fairly equal between genders (14% males and 13% females), as is vulnerability to low income (24% males and 25% females).

5.4.3 Health and education status

187. **Health**. According to the WHO (2017) non-communicable diseases are the main cause of premature illness and death and the provision of services to support diagnosis and treatment (monitoring, screening, referral and medicine) is a challenge. There is a high prevalence of risk such as smoking, alcohol, unhealthy diets and physical inactivity that is driving the high incidence of NCDs. Diseases include cancers, circulatory system diseases, respiratory diseases and diabetes which account for 74% of all deaths across all ages (WHO 2015). The following 22% of deaths are from communicable diseases, maternal, perinatal and nutritional conditions and injuries account for 4% of deaths (WHO 2015). Tongans are vulnerable to epidemic disease outbreaks, environmental and food related emergencies, and the health consequences of natural disasters (WHO, 2017).

188. **Prevalent health concerns of women.** There are health and maternal services for women however changing diets that include cheap imports of certain foods is leading to high rates of obesity and diabetes (Nelson and Fukofuka 2016). Food insecurity and undernutrition is increasing (Emberson-Bain 1998). This highlights the importance of maintaining women's traditional subsistence vegetable gardens (Nelson and Fukofuka 2016). Reproductive and child health clinics and outreach services provide a high level of immunization and antenatal services (WHO 2015). However, there is a high level of overweight and obese children under five, which increases in prevalence amongst wealthier households (WHO 2015). Insufficient government funded health care is leading to a care burden for women who must fill the service shortfall (Jolly et al. 2015).

189. **Education**. Adult literacy in Tonga is high for both sexes at 99.4% of males and 99.5% of females (Commonwealth of Learning 2017). Table 5.9 shows rates of secondary school completion for males and females across Tonga. The total rate of completion is 75.8% with fairly equal numbers of males and females completing secondary school (76% males and 75.7% of females). Interestingly, from the data, for the total population, rural and regional islands have higher rates of secondary completion (between 74.5% and 81.8%) compared with urban areas and Greater Nuku'alofa (69.8% and 70.1%). In some island regions females have higher completion rates than males (Vava'u, Ha'apai, 'Eua and Ongo Niua).

Table 5.9: Completion of secondary education by gender and region

Region	Total population completing secondary education (%)	Male population completing secondary education (%)	Female population completing secondary education (%)
Tongatapu	74.5	74.9	74.1
Vava'u	81.8	81.1	82.4
Ha'apai	76.8	76.3	77.4
'Eua	78.7	77.8	79.7
Ongo Niua	74.5	73.5	75.6
Greater Nuku'alofa	70.1	70.4	69.7
Urban	69.8	70.4	69.3
Rural	77.7	77.7	77.7
Tonga	**75.8**	**76.0**	**75.7**

Source: Commonwealth of Learning (2017)

190. **Education characteristics of Area 5.** Ninety per cent of the school-age population (5-19 years) for all seven villages totals go to school (1,502), slightly higher for females (90%) than males (89%) (Table 5.10). Hofoa has clearly the lowest proportion in school (81%), with the next lowest in Isileli (89%). The highest is in Sia'atoutai and Halaovave & Maui (94%). In individual villages, the proportion of females going to school is higher than males in three villages: Sia'atoutai female 97% vs male 91%, Sopu 94% vs 91% and Isileli 93% vs 87%; in two villages the figure is higher for males than females: Hofoa male 83% vs female79%, Tu'atakilangi 94% vs 92%. In Halaovave & Maui, the proportions for both sexes are the same (94%).

Table 5.10: Area 5 population aged 5-19 years who are in school

Village	Total		Male		Female	
	No.	%	No.	%	No.	%
Sia'toutai	143	94	79	91	64	97
Halaovave + Maui	273	94	131	94	142	94
Sopu	323	92	164	91	159	94
Isileli	195	89	107	87	154	79
Hofoa	343	81	189	83	154	79
Tu'atakilangi	225	94	115	94	110	92
Total	**1,502**	**90**	**785**	**89**	**717**	**80**

Source: Commonwealth of Learning (2017)

5.4.4 Access to services

191. **Access to electricity**. From the 2016 TPL statistics, only 83% (935) of the households in Area 5 were connected to electricity with active meters. In the seven villages, households connected to electricity ranges from 77% to 84% (Table 5.11).

Table 5.11: Number of household connections

Village	Total household connections	Active meters	Disconnected meters
Sia'atoutai	187	157	21
Sopu	294	241	39
Hofoa	155	130	18
Isileli	96	81	10
Maui	62	48	11
Halaovave	155	123	25
Tu'atakilangi	181	155	17
Total	**1,130**	**935**	**141**

Source: Tonga Power Limited

192. **Gender issues.** A reliable energy supply is essential for productive activities in the household. Women require an affordable and reliable energy supply in the domestic sphere for cooking, lighting, refrigeration, transport, clean water and sanitation. Lighting in the evening enables women to make handicrafts for sale and children to do homework (ADB 2018). The ADB (2018) identifies the benefit for rural areas of a reliable energy supply, such as support for local medical facilities to operate day and night and to develop local businesses which create employment. Agricultural development will also be supported by a secure and cost-effective energy supply to increase food security. Mobile phone networks allow households to communicate with friends and family on other islands and overseas. While a large proportion of households (89%) have electricity, 90% of this power generation is fuelled by imported diesel, which exposes supply to fluctuating prices on international markets and transport costs (ADB 2018). Women face additional constraints than men in accessing finance and energy related services (ADB 2018). Renewable energy has the potential to increase energy security and decrease costs and emissions (ADB 2018).

193. The Tonga Renewable Energy Master Plan mentions equality of low cost energy supply and creating employment opportunities for women in the energy sector (UN Climate Technology Centre and Network 2018). The Tonga Energy Road Map 2010 – 2020 makes reference to including the needs of vulnerable groups such as youth women and religious groups in environmental and social impact assessments for energy projects (Kingdom of Tonga 2010). However, no formal gender mainstreaming plans have been provided and the Government of Tonga Gender mainstreaming handbook makes minimal mention of the energy sector.

194. **Lessons from energy projects;** Important progress has been made in integrating gender equality interventions in some energy sector projects. The Tonga Cyclone Gita Recovery Project built social and institutional resilience through a series of interventions to enhance gender equality. These included measures to develop a more gender inclusive and hence diverse workforce, better equipped to respond to future disasters.

195. Capacity building included training and coaching for TPL to meet gender equality targets and strengthen implementation and coordination capacity for future emergencies. As a result of these efforts, TPL now has several female line crew, including an all-women line crew. Interviews conducted with the women indicate that the breaking down of gender stereotypes has instilled confidence in the women that they can do the same job as the men.

196. **Access to water.** Out of 894 households in the project area, 94 use tap water as their main drinking source, 174 depend on community water supply, followed by 475 households using their own rain water tanks. Some 129 households purchase bottled water for their source of drinking and a few households consume bottled water. Table 5.12 shows the sources of drinking water source in each of the seven villages that will benefit from this project..

Table 5.12: Sources of drinking water in Area 5 households

Village	No. of households				
	Pipe + tap	Rain collection	Community pipe	Purchased	Other
Sia'toutai	11	36	40	11	0
Halaovave + Maui	24	86	18	23	1
Sopu	17	116	42	46	0
Isileli	42	45	12	5	0
Hofoa	10	113	48	22	0
Tu'atakilangi	10	79	14	22	1
Total	**94**	**475**	**174**	**129**	**2**

Source: Statistics Department, month, 2016

197. **Access to sanitation.** From the 2016 Census, 70% (761) of the total HHs in Area 5 have access to flush toilets, 4% (46) of the total HH have access to pour toilets and 2% (18) are using pit toilets (Table 5.13).

Table 5.5: Sanitation facilities

Village	No. of households with access to toilet by type			
	Flush	Pour	Pit latrine	Total
Siaatoutai	94	3	1	156
Halaovave + Maui	145	6	1	167
Sopu	145	6	1	279
Isileli	101	3	0	120
Hofoa	155	24	14	214
Tu'atakilangi	121	4	1	144
Total	**761**	**46**	**18**	**1,080**

Source: Department of Statistics (2016)

198. **Cultural and historical values.** Within the seven village areas, there are several cultural sites and historic buildings such as churches, cemeteries, and kava clubs. Tonga has a rich sense of history and living traditions around family values, church and religious practices and cultural values that are upheld and practiced as part of Tongan culture.

199. The impacts of noise on cultural practices when observing mourning periods during funerals are discussed in Section 7. The proposed project works were assessed for impact on physical cultural resources, and none were identified. However, there is always the possibility of chance finds during excavation works, with a procedure developed and documented within the ESMP in the event that archeological items are discovered during construction works.

5.4.5 Land ownership

200. The land in Area 5 is a mixture of residential and agricultural (used and vacant) allotments owned by individual households, state ownership of land used for public uses such as roads including rights-of-way (ROW) and riparian access to lagoons and lakes. Land specifically affected by project works will be state land, alignments of existing poles and lines follow ROW.

201. According to FAO and SPC (2019) women make up 51% of the agricultural workforce but do not inherit land and have no land rights. All men from the age of 16 are entitled to an allotment in town and in the bush for farming. Lack of land rights undermines women's ability to invest in income earning opportunities as they need land as collateral for loans, in addition to growing crops.

5.4.6 Noise

202. Baseline noise measurements were carried out in March 2019[39], supplemented with spot monitoring in January and February 2020, to characterize the ambient noise environment in Area 5. The noise monitoring sites are shown in Figure 5.23 and the results are reproduced in Table 5.14.

Table 5.14: Background noise in Nuku'alofa March 2019

Location & time period	Site Measurement						Influencers
	Date	Start	End	LA_{max}	LA_{eq}	LA_{min}	
Taufa'ahao Road – morning peak	27th	07:40	08:00	85.5	64.8	48.5	Heavy flow into city [1,020 veh/hr]. Split 71%inward 29% outward.. Primarily cars and SUV (84%)
Alaivahamama'o Bypass road (south) – non-rush hour	28th	10:30	10:51	86.4	59.8	44.6	Intermittent flow [350 veh/hr inward / 400 veh/hr outward]. Traffic primarily cars and SUV (73%). Inward traffic higher commercial content.
Alaivahamama'o Bypass road (North)	28th	11:00	11:22	85.1	60.9	50.5	3 container trucks + 7 flatbed HGV. 60% inward / 40% outward flow.
Nukuhetulu – non-rush hour	27th	08:31	08:51	67.5	44.8	39.4	Only 3 vehicles (SUV) in sample period
Alaivahamama'o Bypass road (south) – night		23:15	23:25	79.4	49.3	46.8	Spot sampling (10 minutes) – Minimal night-time traffic (max – single vehicle -car)
Niuloa Road		22:45	22:55	78.3	48.4	46.5	Spot sampling (10 minutes) – Minimal night-time traffic (max – single vehicle -car)

Source: TA 9331-REG (Cardno, 2019)

Note: using a CEM Instruments DT-8852. The unit complies with IEC61672-1 class 2 for Sound Level Meters

[39] Undertaken for Fanga'uta Lagoon Bridge Project EIA between Monday 25th and Thursday 28th March 2019. Presented in Fanga'uta Lagoon Bridge Project EIA Volume 2 Annex D – Noise Monitoring Report.

Figure 5.23: Location of background noise monitoring sites

Source: TA 9331-REG (March 2019)

6 Consultation, Disclosure and Grievance Redress

203. This section describes the approach and rationale behind consultations undertaken for the project. A number of site visits and consultations with relevant stakeholders in government, business sector and communities were conducted between 19 October and 10 December 2021. Tonga Power Limited facilitated the consultation undertakings with the communities. Minutes of these meetings, photographs and participants in each of the village consultations are provided in Appendix 4. Table 6.1 is a summary of the meetings held during the due diligence process.

Table 6.1: Summary of consultations

Date	Party consulted	Name of person(s) met	Designation/role	No. of people
25-Oct-21	TPL	Mr. Timote Tuipulotu	NNUP Project Manager	2
		Mr. Andrew Kautoke	Communications Officer	
26-Oct-21	DOE	Mr. Tukia Lepa	Chief Environmentalist	3
		Mr. Hoifua Aholahi	Senior Conservation Officer	
		Mr. Penikoni 'Aleamotu'a	Senior Marine Officer	
17-Nov-21	Aotearoa-Tonga Forest Products - Tongatapu	Mr. Fepale Mafua	Technical Operations Manager	2
		Ms. Patiola Mapukava	Finance and Procurement Manager	
1-Dec-21	MLSNR	Ms. Rosamond Bing	Chief Executive Officer	1
3-Dec-21	Dept. of Forestry	Mr. Heimuli Likiafu	Head of Forestry Division	1
8-9 Dec-21	ATFP –'Eua	Ms. Mele Paea	Manager	1
13 -Dec-21	ITS Pacific Ltd	Ms. Estrellita Fulivai	Environmental Safeguards Specialist	1
Nov/Dec 21	Communities	Various men + women	Community members	104
March-22	MOF	Mr. Poasi Ngaluafe	Head of Aquaculture	1

Source: Project consultations (Nov/Dec 2021 – Feb 2022)

6.1 Consultations

204. **Government.** Consultations with relevant government departments were essential in defining cumulative impacts from other development proposals and projects within Area 5 project area. The EIA Unit-DOE was consulted in relation to the scope of the works for the project and if it would fall under a major project category. Concerns raised by EIA Unit around the treatment process of poles and leaching of arsenic from the preservative chemical were investigated. Moreover, the method of trimming of branches hanging over power cables and the disposal of these cuttings were also raised as an issue that TPL needs to work through with the communities and the EIA unit and are further addressed in the ESMP.

205. The MLSNR was consulted to ascertain the potential cumulative impacts from the proposed drainage project also funded by ADB under the Tonga Integrated Urban Resilience Sector Project.

206. The Department of Forestry was consulted in terms of understanding government regulations and controls around forest resources in 'Eua island where most power poles are sourced from.

207. **Aotearoa Tonga Forest Products**. In addition to consultations with key stakeholders from government, a site visit to the timber processing plant of the main supplier for timber poles for NNUP, Aotearoa-Tonga Forest Products was conducted on the 17 November 2021. Details and observations are provided in section 7. The main issues of investigation were around the preservative treatment process of the poles using Tanalith C oxide (active ingredient: copper chromium arsenate) and the possible leaching of arsenic into the ecological surroundings of poles installed as part of preceding projects (Area 2 and 3) and upcoming projects under NNUP.

208. Moreover, issues around cumulative impacts and sustainability of timber pole resources were also examined. A site visit to the 'Eua National Park identified that current harvesting and replanting processes are in place by the Aotearoa Tonga Forest products (ATFP). However, securing of harvested poles in storage areas need to be improved as highlighted by communities and businesses located close to the open storage area. Shipping timeframes from 'Eua to Tongatapu of the harvested poles need to follow a strict timeline. The time taken from harvesting to processing is critical to avoid rotting of trees that would result in discarded forest resources.

209. **Affected Communities.** Public consultation is a fundamental component of the due diligence process. ADB and TPL conducted meetings with 5 of the communities in the project impact area to inform the communities in the vicinity of Area 5, about the project details and collected opinions and comments from beneficiaries and potentially affected people. The public consultations process were conducted as follows:

- TPL requests town officer for respective village for suitable meeting date and time with community.
- Meeting convened in church or community halls normally commences with a prayer, followed by welcoming remarks from the town officers. TPL then presents project proposal and advises communities of the information required by local and international consultants to determine impacts on environmental, social and economic parameters.
- Consultants distribute questionnaire and explain the questions and how to answer them. Participants are given up to 15minutes to complete the questionnaire and these are collected at the end of the meeting for analysis.
- Questions are then invited from the participants regarding any aspect of the project that they wish to clarify and responses are offered by TPL and ADB safeguards team.
- Minutes, photographs and participants name, gender and contact details are recorded and provided in Appendix 5 of this report.

210. Table 6.2 identifies the participants by group or institution they represent and the main comments raised by communities. A detailed description of discussions and response are tabulated in Appendix 5. The main issues raised are summarized below and have been addressed through measures included in the CCP and ESMP.

- Process for new power connections
- Support from the project for new household connections
- Safety of the underground cables
- Protection of assets from excavation works
- Reduction in tariff.

Table 6.2: Summary of community participants consulted

Village	Date	Participants		
		Males	Females	Total
Sia'atoutai	16 Nov-21	28	12	40
Hofoa	23 Nov-21	7	13	20
Sopu	30 Nov-21	12	4	16
Halaovave	01 Dec-21	4	9	13
Tu'atakilangi	02 Dec-21	6	9	15
Total		**57**	**47**	**104**

Source: Project consultations (Nov/Dec 2021)

211. **Environmental Concerns.** There were three questions around environmental issues that were integrated into the questionnaire. The first question was to identify if there were trees that were overgrown and hanging over or entangled with the power lines. About 30 percent of the respondents in all the communities confirmed that there were trees hanging over the power lines in their area with 10 percent indicating trees of cultural and economic significance (sandalwood, Heilala) that they did not want to be cut. Out of these respondents, 70 percent wanted to be informed prior to cutting any trees in their compound. None of the respondents indicated the presence of any bird nests or rare birds that needed protection.

212. The second question was to determine the dependence of the communities on the mangroves/ marine habitat as a source of livelihood for food, tapa-making, medicine and firewood. The most common use of the mangroves was for tapa raw materials (35 %), followed by firewood source (28 %). The mangroves are also used as medicine (17%) and fishing (16%) while a small percent of the communities do not have any reliance on the mangrove habitat for their livelihood. The results suggest that traditional tapa-making is a major activity that women engage in and thus indicates the importance of the mangrove habitat in providing these services. The second most common use for mangroves as a source for firewood indicates that the communities in Area 5 are still reliant on biofuel compared to cleaner cooking methods (LPG). Overall, the analysis suggests that the mangroves in Area 5 are important in their ecological functions to provide habitat for fishing grounds and meet social and economic needs of the communities. This data is important in project design and suggesting precautions when working in these natural habitats particularly in Sopu and Hofoa area.

213. Community access to these services may be temporarily disrupted during the day but these may be mitigated with proper communication on daily work schedules to be included in CEMP and CCP.

214. The last question was to gauge the precautions around replacing overhead cables with underground cables. About 76 percent of the respondents were in support of the project and did not have any objections to replacing their overhead cables. However, 4 percent of the respondents indicated that they have concrete driveways that may not allow the installation of underground cables while the remaining 20 percent indicated their preference for precautions not to damage trees, fixed structures and water pipelines within their land boundaries. These have been noted to guide the development of the CCP and guidance for directions in the CEMP.

6.2 Process for Consultation During Implementation

215. A consultation and communications plan (CCP) has been developed for the project. The CCP will be updated as required, early in implementation. Consultation and information disclosure will continue during subsequent project stages as per the CCP—that is, during detailed design, again immediately before the start of the civil works, and then during construction. The most significant activities are listed in Table 6.3 in their expected order of occurrence.

Table 6.3: Summary of consultation and information disclosure during implementation

Activity	Responsible Parties	Indicative timeframe
A clear and detailed process for new household connections to the Tonga power network in both English and Tongan. Brochures, Video/ TV spot to include the following information: - Name of personnel to consult, department within the TPL including contact and processing time - Cost and fees for each step of the process - Checklist of requirements to complete the application process	TPL – PMU	Preparation, design finalization, following government and ADB approval, pre-construction
Radio announcements and regular updates on the sections of the road/ village that will be under construction	TPL – PMU	Pre-construction and ahead of construction activities
Consultation meetings with villages consulted in this project prior to commencement of construction works to include the following: - Consent form for access to property to allow excavation works - Hotline to allow communities to raise concerns about the project - Turnaround time for concerns to be addressed should be within a week (depending on nature of problem) - Markers on trees that should be trimmed with reasonable care as to ensure it will survive	TPL – PMU	Pre-construction and ahead of construction activities

6.3 Grievance Redress Mechanism

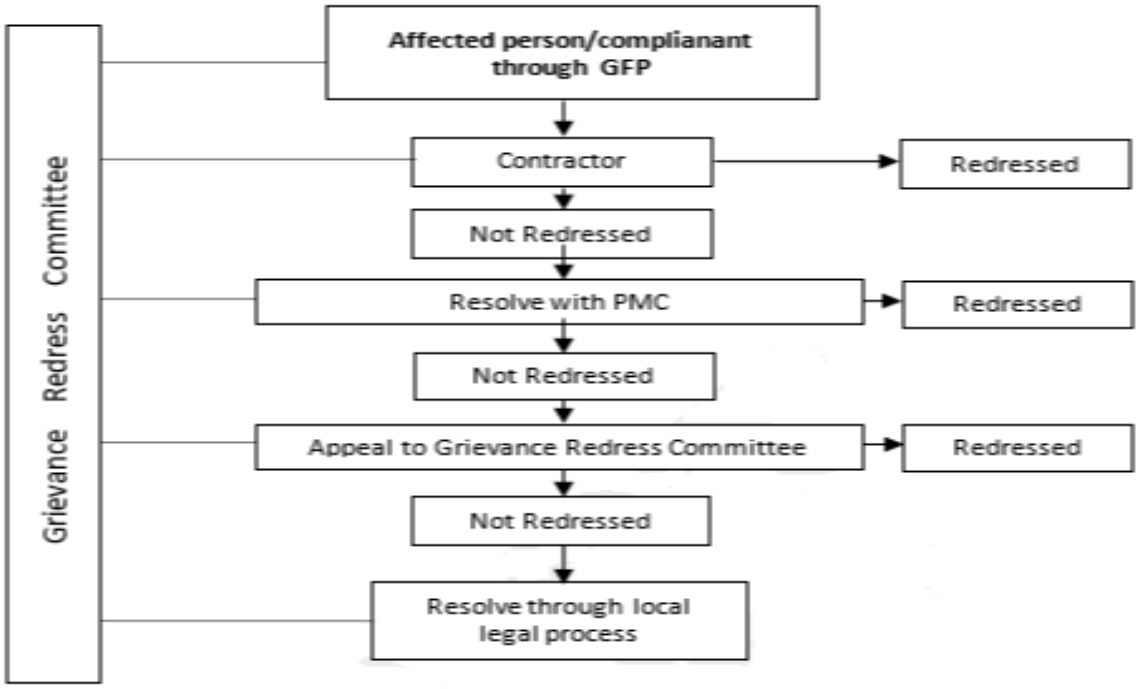
6.3.1 Overview

216. Every project should, and is required by the SPS and good practice, to establish as early as possible, and implement, a project-specific grievance redress mechanism (GRM) to receive and facilitate resolution of any concerns or grievances that arise during the course from project initiation through implementation and operation. A single project GRM is used for both social and environmental grievances. Since all the proposed project works would be carried out by or under the guidance and authority of TPL and its PMU for receiving and dealing with any project-related grievances. TPL has an established process for establishing and implementing GRM through delivery of other projects for ADB and World Bank.

217. The procedures for, scope of, the GRM will be commensurate with the risks and potential impacts of the project and is to address issues related to involuntary resettlement, social and environmental performance, and information disclosure. Under ADB policy any affected person or complainant has the right to file complaints and/or queries on any aspect of the project, including land acquisition and resettlement, and appeal any decision, practice or activity related to the project. The PMU is charged with ensuring that grievances and complaints about any aspect of the project are acknowledged and addressed in a timely and effective manner.

218. When and where the need arises, this mechanism will be used for addressing any complaints that may arise during the implementation of project. The GRM is scaled to the risks and adverse impacts of the project. It addresses affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no cost and without retribution. The mechanism does not impede access to the Tongan judicial or administrative remedies. The PMU will appropriately inform stakeholders about the mechanism before start of commencement of any civil works. A simplified GRM is illustrated as a flow chart in Figure 6.1.

Figure 6.1: Simplified flow chart of the grievance redress mechanism



6.3.2 GRM during construction phase

219. During the construction phase affected persons or complainant may have site specific concerns about the construction activities (e.g. levels of construction noise, destruction of assets and plants, elevated dust levels, water pollution, speed of construction vehicles on public roads, road safety concerns, etc.) The TPL will be required to set up a site specific GRM so that members of the public have a clear and direct ability to comment on the way the project is impacting upon them.

220. Through the consultation process TPL will advise members of the community of the GRM process. In addition, the site access and at any point determined by the TPL/PMU, signs will be erected identifying the GRM process is in place for the project and the contact information: physical address, phone contact; and internet access if available.

221. TPL will engage a community liaison officer (CLO)[40] as the formal point of contact. The CLO will be from the community and be responsible for recording the complaint, assessing the validity of the complaint and identifying actions to address the compliant. This may require escalation of the complaint to more senior members of the PMU or TPL including the Independent Engineer.[41]

[40] An alternative term may be used but shall be identified in the CEMP .

[41] The CLO will not have delegated powers to instruct site staff to initiate actions and therefore the issue will need to be elevated to higher levels in the management chain.

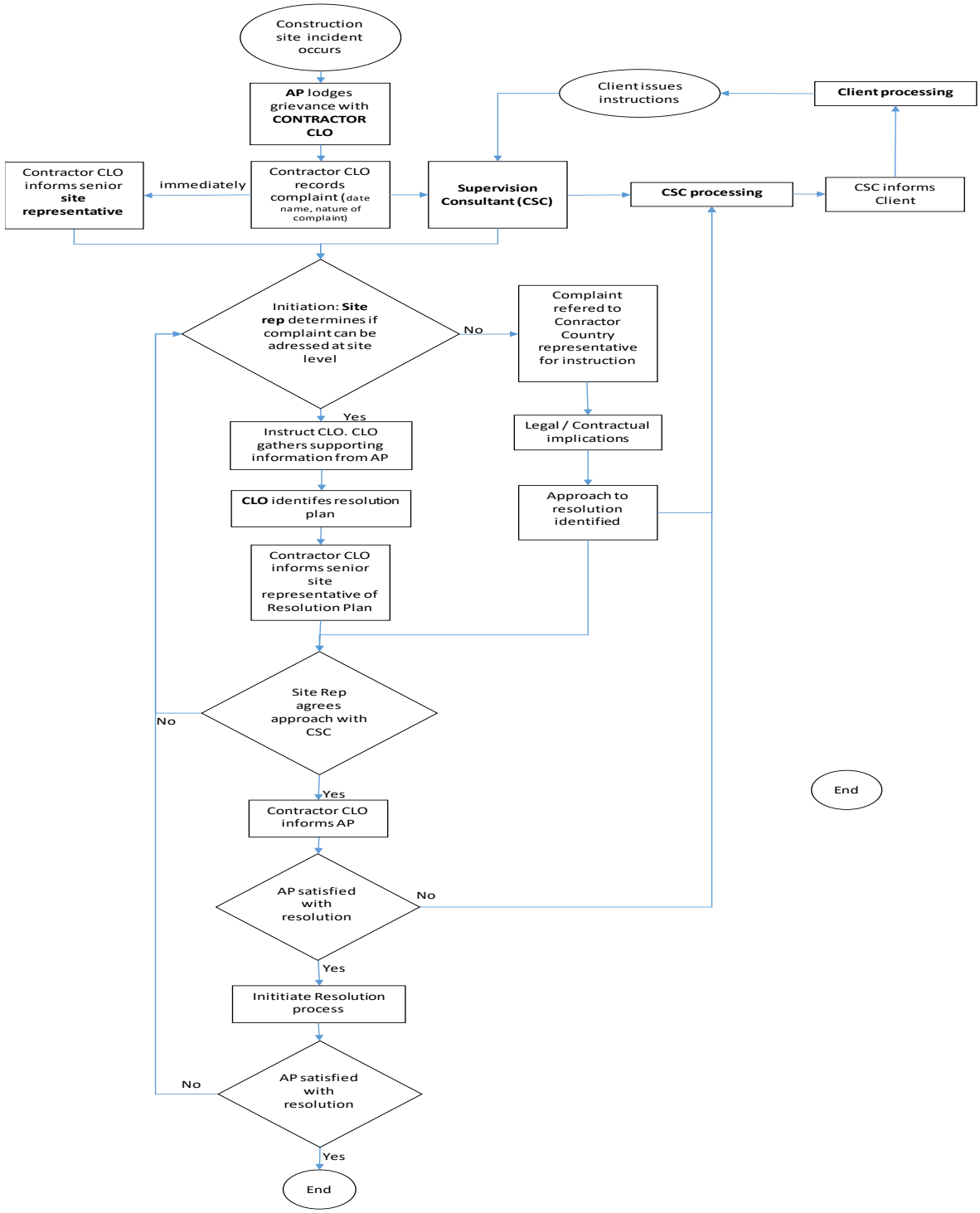
222. Experience suggests that many issues identified by affected person/complainant can be swiftly and effectively addressed at site level by the CLO, but that the CLO must be clear on the registration of a complaint and how information on that complaint needs to enter the site management procedure. The CLO does not, normally, have delegated powers and therefor any complaint must be immediately referred to the project manager on site in order to determine how the complaint can be addressed. Some cases may be too complex for addressing at site level (e.g. sexual harassment; on and offsite violence, etc.) This may require senior management intervention and the site process is illustrated in the Figure 6.2.

223. The grievance redress process will be disseminated to all affected persons (APs) during project consultations. It will promptly address and use an understandable and transparent process that is gender responsive, culturally appropriate, and at no cost and without retribution, to the complainant.

224. The GRM has been developed in accordance with government policies and procedures, as well as the SPS. The GRM is designed to work within existing legal and cultural frameworks, providing an opportunity to resolve grievances at the project level. Specifically, the project GRM has been designed to:

- be understandable, culturally appropriate, and accessible to project-affected persons, with its availability communicated to residents of the island;
- address a wide range of grievances and concerns – both those based in factual data and those arising from perceptions or misperceptions;
- be transparent and allow persons to submit a grievance at no cost and without retribution to the party that expressed the issue or concern;
- protect the identity of the persons raising the grievance;
- resolve concerns in a timely manner, via consultation with stakeholders, or forward any unresolved cases to the relevant authority;
- report back to the community (through the PSC) periodically on the types of cases and how they were resolved; and
- be evaluated periodically to ensure that it is working effectively.

Figure 6.2: Construction phase GRM - site level responsibilities



Note: TPL = TPL

6.3.3 Grievance coordination

225. Like other development projects, the grievance focal point (GPF) will be the town officer in each project site (Sia'atoutai, Halaovave, Maui, Isileli, Sopu, Tu'atakilangi, Hofoa) and will coordinate and address all complaints and concerns arising from the project. The GPF contact details will be provided to all APs.

226. The GPF will be assisted and supported by the PMU, who will maintain a register of complaints, keep track of their status and report to the PSC or its equivalent. They will regularly monitor complaints received, actions taken and the status of resolution. In the initial stages, complaint forms will be distributed to the GFP to facilitate recording of complaints. The PMU will enter these complaints into a customized database, such as that which has been developed by the project manager. By using an electronic database, reporting on complaints and actions will be systematic, and summaries from the database can be easily incorporated into monitoring reports.

227. **Grievance procedures**. Complainants will be informed of their rights to ask any questions or discuss grievances with their community leader (the district or town officer) by phone or in person, or to project staff visiting the project sites. If their questions/grievances are not answered within one week, they will be advised to prepare their grievance/complaint in writing with the assistance of their GFP. Complainants will also be informed of their rights to seek assistance from the national and international project staff to produce written complaints/ grievances, if necessary.

228. The complainants can lodge complaints at any level of the project phase through the submission of a written grievance letter to the district GFP. The turn-around time for addressing the grievance shall be one week within which, the GFP will be expected to propose or provide a resolution to the complainant.

229. If the complainant is not satisfied with the resolution provided by the GFP, the complainant will be given the opportunity to proceed to the next level of resolving their grievance with the PMU. A response must be provided by the PMU within seven days. If the complainant is not satisfied with the response from the PMU, the complainant will be informed of their rights to take the dispute to the CEO of TPL or the Minister of Public Enterprises, who will also be given seven days to respond.

230. If the situation is not resolvable and the complainant rejects the resolution or decisions made regarding their complaint, the complainant may proceed to take the matter to court. All court costs incurred by the complainant (preparation and presentation) will be paid for by the project unless it can be demonstrated that the complainant actions were unreasonable, and the court decision or outcome illustrates the resolution provided by the Minister of Public Enterprises.

231. During implementation, a grievance register will be held at each project site, maintained, and monitored by the project manager. All complaints arriving at a site office are to be entered in a register (by, date, name, contact address and reason for the complaint) and kept at project site. A copy of the entry will be given to the complainant for their record at the time of registering the complaint. The register will show who was directed to deal with the complaint and the date when this was made together with the date when the complainant was informed of the decision and how the decision was conveyed to the complainant.

232. The register will then be signed off and dated by the person who is responsible for the decision. The register is to be kept by PMU project manager and will be public document. The duplicate copy given to the complainant will also show the procedures to be followed in assessing the complaint, together with a statement affirming the rights of the AP to make a complaint. No registration costs will be charged to the complainant.

233. If grievances cannot be resolved at the local level, TPL will hold the compensation amounts in escrow or trust account. Compensation will be paid in full upon final resolution of the case in the courts or other forums, in accordance with the entitlements of the complainant (Table 6.4).

Table 6.4: Grievance Resolution Procedure

Stage in response handling	Required activities
Town officer/GFP	Verbally responds to questions and/or complaints If no response in 1 week or response is unsatisfactory, AP prepares grievance in writing (standard forms to be made available
TPL installation team CLO	Receives grievances on site Registers complaint (including verbal) provide feedback, immediately, if possible
PMU – social safeguards/CLO	Review and response as required, if not resolved through above May require action instruction issued through Independent Engineer Registers complaint in project GRM register, attempts to resolve within two weeks if still outstanding
Grievance redress committee	To be invoked to resolve complaints not resolved at foregoing levels Will try and resolve within two weeks of complaint being raise to this level Issue raised to GRC communicated to AP and community, along with proposed date for resolution
Local legal processes	Court will hear a case and make final decision to be binding on all parties

7 Assessment of Impacts

7.1 Overview of Assessment

234. This chapter of the IEE sets out approach to impact assessment and mitigation that can be easily understood by design engineers, construction contractors and implementing agencies. The IEE document is designed to serve the objectives of several stakeholders, including:

- The public – including directly or indirectly affected individuals, individuals and groups with interests for the population and environment (government agencies and NGO);
- The authorities in Tonga – to ensure that the project can be designed, constructed and operated to meet all environmental legislation applicable to Tonga;
- International financial institutions – in this case the ADB who needs to be assured that the project will be designed, constructed and operated in compliance with the policy requirements in order that funds can be released for the project.
- TPL, following implementation of other projects under the program, will conduct surveys, excavation works and install network upgrades (poles and HV and LV lines). The IEE will be used by TPL to confirm the environmental, social, health and safety factors that they must be incorporated into their working processes.

235. As part of this IEE, an ESMP has been prepared and this will be developed further by TPL as it is taking o the role of 'TPL' for this project, reflecting their approach to the works and timing of activities as identified in the construction program, and incorporated into the CEMP it will develop. The CEMP will link with the construction program, work method statements and include all the sub-plans identified in this section of the IEE and site-specific plans as required for specific activities or components of the works. The CEMP will be updated as required during the construction phase as further details of specific construction techniques become available. All updates will be reviewed by the PMU and approved.

236. TPL's CEMP will detail how it will carry out the works in accordance with the project's ESMP (in this assessment report). This CEMP will be reviewed by PMU, DOE and ADB, and advice provided to the Independent Engineer when it can be considered approved and works may commence. The CEMP will be a binding document and TPL's environmental performance will be audited against this document.

237. In terms of the assessment the public, government authorities and ADB look to confirm that environmental "aspects" are being addressed i.e. noise and air quality impacts, water quality impacts, ecological and social impacts, etc. Therefore, this impact section of the IEE assesses the project under these topics.

7.2 Design and Pre-construction Impacts

238. This section assesses impacts and identifies impacts and mitigation that will need to be addressed in the detailed design phase and pre-construction phase of the project.

7.2.1 Risk of climate change and disaster effects compromising project outcomes

239. **Impacts.** The likelihood of current and future climate and disaster risk reflects the exposure of power distribution assets to each hazard based on historical occurrences and trends and also on climate projections and level of confidence in projections. Extreme events, such as a Category 5 cyclone, Mw 8.5 earthquake, or a destructive tsunami will prove catastrophic to the power distribution system. Coastal inundation with sea level rise will also become catastrophic at a certain point (when inundation becomes a frequent enough to make low-lying parts of Nuku'alofa uninhabitable).

240. As noted in Section 3, in response to the damage caused by the January 2020 tsunami, the project proposes to realign a section of the HV network along the secondary road where the existing LV network has been installed. The proposed realignment, although slightly longer than the original alignment, deviates from the waterfront area along Vuna Road and traverses a secondary road further inland to avoid future risk of tsunami or inundation impacts for approximately 1.3km of HV network. In addition, the realignment will contribute to strengthening the resilience and security of supply for one of the essential communication services entities, Tonga Cable Limited.

241. The future risk of damage caused by cyclonic wind is rated as extreme. This is for two reasons. First, while projections tend to show a decrease in the frequency of tropical cyclones in the Tonga region, cyclones are projected to become stronger, as the fuel that drives intense winds – moisture from warming oceans – is increasing with climate change. Second, as time goes on, the ground line section of the existing poles, often the point where utility poles fail during high winds, will continue to decay. This decaying process will be assisted by increased flooding due to more intense rainfall and more frequent coastal inundation that is projected with climate change (this risk is rated "high" on its own).

242. Another longer-term risk is posed by the combination of sea level rise, high tides, and storm impacts (extreme rainfall and coastal inundation). Inundation will eventually reach a tipping point, likely slightly after the end of the project's design life. At that point, the low vulnerability of the power distribution network to flooding will become immaterial, as lower-lying areas will become uninhabitable due to frequent inundation.

243. **Mitigation** The proposed project will address climate and disaster risks and enhance the physical resilience of Nuku'alofa's power system by building a more decentralized network with strengthened distribution assets. Specific measures will include:

- Replacing existing power poles with new poles with the latest technical standards from Australia and New Zealand. The project will replace the existing utility power poles with treated timber power poles – 9m for LV and 11m and 13m for HV. All power poles will be located at the household legal boundaries.

- The poles will be constructed in accordance with New Zealand standards, including treatment with Copper-Chrome-Arsenate (per AS/NZS4676:2000 and NZS3640:2003) which makes the timber highly resistant to pests and fungi.
- Replacement conductors, for both LV and HV lines, will be ABC, which is more reliable, efficient, and safe. ABC is more resilient to cyclones and storms, as it addresses the tendency of multiple conductors (the traditional design) to contact and short-circuit during strong winds. ABC also allows for switching of power that is a feature of ring systems.
- Proposed siting has addressed climate change effects and avoidance of disaster-related risk.
- Project detailed design and bidding packages to ensure equipment selected is resilient to climate change.
- Equipment selected for low emissions.

7.2.2 Updating the IEE and preparing the CEMP

244. **Finalizing the IEE and application for development consent**. Any issues arising during updating and finalization of the IEE may largely be mitigated and/or managed by: (i) ensuring that good practice is observed in terms of detailed design incorporating recommendations on environmental matters; (ii) the IEE being further updated, as required, based on the detailed design and the ESMP reflects the updates and changes made during detailed design; (iii) all permits and consents under CSS are applied for and obtained; and (iv) the requirements (conditions) of development consent and any permits and consents and the updated ESMP are incorporated into the bid and contract documents.

245. The finalization of the IEE will need to address any comments or concerns raised during the public disclosure period. TPL's PMU will assist in preparing the application for the project clearance under the CSS and this IEE will be submitted in support of that application for development consent.

246. **CEMP requirements**. The PMU will ensure that the finalized IEE and its ESMP , updated, as required, based on detailed design and incorporated, along with any conditions of project clearance/development consent are provided to TPL to help inform CEMP development. This IEE and project legal agreements clearly identify the need for TPL to manage the risks around sourcing and supply of construction materials that are resilient to climate change.

247. The CEMP will specify environmental management requirements such as: (i) all mitigation and management measures identified in the IEE be incorporated into the detailed plans to be developed by TPL; (ii) requirements to comply with applicable standards and the COEP; (iii) TPL designating a staff on the installation/construction team as responsible for CEMP implementation, CLO from the local community; (iv) monitoring and reporting requirements and the reporting/communication lines and channels; and (v) delivery of induction, training and awareness sessions for the workforce and the community.

248. Prior to any works commencing, including any clearance for surveys and investigations, associated laydown or materials stockpile areas or quarries, TPL will prepare and submit the CEMP to the PMU for review and clearance. The CEMP will also be provided to ADB for comment. Support will be provided to the PMU's environment officer through PARD's regional safeguards technical assistance[42], this will include an independent review of the CEMP prepared by TPL. The environment officer will advise the PMU project manager and Independent Engineer when the CEMP has been approved, and notice to commence works can be given.

249. The CEMP will be based on the project ESMP and detail the construction methodology and program to be undertaken, identify the risks associated with that construction methodology and detail mitigation measures to avoid or reduce the risks. The CEMP will include site-specific plans, construction methodology for all key elements of the project, sub-plans and the like, prior to any construction activities commencing.

250. Once works commence, the staff designated by TPL will conduct monitoring of compliance of activities with the approved CEMP and the PMU and Independent Engineer will undertake inspections and audits of the effectiveness of TPL's implementation of the approved CEMP. The PMU will devise the checklist to be used for the inspections and audits and will consolidate the inspection/audit findings along with summaries of TPL's monthly reporting. As noted above, support can be provided to the PMU's environment officer for this and related tasks through the technical assistance. ADB will undertake review missions which will report on, inter alia, overall implementation of environmental safeguard requirements.

251. As early as practicable after commencement, the project will establish the GRM to address concerns and resolve complaints and issues raised on any aspect of project implementation (refer also Section 6). Safeguards concerns will be addressed through the GRM. The CEMP will outline how TPL will implement the relevant elements of the GRM and how and when they will provide information about construction activities and timing to the community. TPL will be expected to provide information about the works, impacts and mitigation/control measures to the community in a timely and effective manner. The CLO will be guided by the project's CPP. Workers and sub-contractors will be inducted to the site, and this will include awareness and training on the provisions and requirements of the CEMP and how it is to be implemented.

252. Procurement of consultants and equipment and plant for the project will comply with the prohibited investment activities list in the SPS.

253. The relevant COEP will apply during detailed design, construction and operation and have been referenced as mitigation measures where applicable and tracked through to the ESMP.

7.2.3 Worker code of conduct

254. The CEMP will detail the protocols to govern workers' behavior. The worker code of conduct will be discussed and agreed with village and settlement leaders and the PMU. The code will be adhered to by both expatriate and local staff on acceptance / understanding of national cultural differences and governing behavior relative to: fraternization; conduct in villages; behavior around women and children; penalties/sanctions on worker use of alcohol and/or drugs; and awareness-raising for, prevention, and reporting, of sexual harassment and bullying.

[42] Approved in 2020. *Sustainable Capacity Development for Safeguards in the Pacific*. (TA 6597-REG).

255. TPL will agree, in consultation with village and community leaders, to an appropriate code of conduct which will govern the behavior of workers on and off-site and provide 'rules' for work in villages and guide culturally sensitive and gender appropriate behavior around women, the elderly, and children. The code is to be strictly followed by all workers and any of TPL's sub-contractors. The agreed protocols will be included in the worker's contracts and will be discussed during awareness raising as well as part of the mobilization process.

7.2.4 Material sourcing

256. Equipment such as transformers, conductors, cables and other hardware and will be sourced from international suppliers. Timber power poles will be sourced locally with any shortfalls to be sourced from New Zealand. Concrete aggregates and other physical materials required to restore damaged sites from excavation works will also be sourced from local quarries and hardware companies.

7.2.5 Biosecurity and invasive/alien species control

257. This project requires sourcing of equipment and building materials from international suppliers which may introduce invasive species. The PMU will adhere to all laws governing importation and customs clearance requirements through seeking advice from border control agencies and using licensed brokers. Biosecurity laws that regulate and control the introduction of invasive species require checks at the borders with declaration of any high risk items of import. All materials and equipment imported for the project to follow Quarantine Act and Quarantine regulations and requirements of Quarantine and Quality Management Division – MAFFF, phytosanitary certificates will be obtained as required. The CEMP will cover control and prevention of spread of alien and invasive species.

258. Moreover, as part of Tonga's efforts to manage and control the spread of the COVID-19 pandemic, all imported equipment and consignments are subject to a mandatory quarantine period of three days. The PMU will also adhere to all national protocols and requirements to ensure that procurement of materials are processed promptly to meet expected timeframes for commencement of construction.

7.2.6 Land access

259. The project is identified as Category C as there will be no land to be acquired for the project. Proposed network rehabilitation will be carried out within the existing network. There were no identified crops, trees, and fixed assets such as fences and driveways to be affected by the project as the proposed repair and upgrade will be within the existing network which is located on state owned land and right of ways (ROW) as summarized in Table 7.1.

Table 7.1: Summary of land access and involuntary resettlement impacts

Output	Activities	Land requirements	Involuntary resettlement impacts
Output 1: Network Rehabilitation and Upgrade – Area 5	Rehabilitation of 14 km of 11 kilovolt HV electricity network; and upgrade of 44 km of 0.4 kilovolt LV distribution network in 7 villages	Yes Network and poles rehabilitation will be within the existing old network which is currently on government properties.	None - there will be no physical or economic displacement impacts. All activities will be within the existing old network.
Output 2: Institutional Capacity	Comprehensive program to reduce the identified remaining capacity gaps in project management, financial management, gender, and other relevant areas.	None Capacity strengthening and technical advice. No civil works.	None - there will be no physical or economic displacement impacts. All activities will be within the existing electrical network corridors

7.3 Construction Impacts on Physical Environment

7.3.1 Air quality – dust and other emissions

260. **Impacts**. Adverse air quality impacts can occur due to: emission of inorganic dust from digging / loading works; emission of harmful substances; dust from combustion of diesel used by transportation vehicles.

261. The amounts of vehicle-emitted pollutants will depend on the technical condition of the TPL fleet vehicles, fuel quality and travel speed. Older vehicles usually have lower fuel consumption efficiency and cause higher emissions of combustion by-products. Increasing speed of the vehicle demands higher fuel supply and therefore results in larger amounts of emitted pollutants. TPL is required to pay attention to the age and status of technical maintenance of vehicles/machinery used during construction.

262. The scale of dust and exhaust emissions related impacts will depend on the prevailing wind direction in the project area, traffic speed and the status of technical maintenance of the vehicles/machinery and organization of works.

263. **Mitigation**. Application of COEP 5. Dust-suppression measures aimed at prevention of air pollution will include enforcement of reasonable vehicle speeds during construction. Where applicable, anti-dust breathing facemasks are to be used by the staff working in high dust areas particularly on gravel roads.

264. All machinery, equipment and all vehicles used should be well maintained and emission levels should be kept low. The general requirements for air quality mitigation are identified in the ESMP section of this IEE. The precise mechanisms will be identified in the CEMP, but will include a traffic management plan

265. The post mitigation risk is assessed as "low", and the effect is not considered significant.

7.3.2 Water resources

266. **Impacts.** Minimum impacts are anticipated on water resources and hydrology. Earthworks for trenches and pole planting will have very small footprint and will not affect hydrologic processes (i.e. run-off, percolation, evapotranspiration, etc.) However, excavation works to install underground connectivity cables may pose risks to water pipes that have been laid to connect households to water meters and groundwater supply in their villages. Damage to water pipes may cause disruption to the water reticulation system.

267. **Mitigation** Scheduled earthworks by TPL within community residences must only proceed after prior consent and approval of land owner on the appropriate excavation site within their land boundary. Any damages to water pipes must be rectified immediately and reported to contract manager and PMU before proceeding with underground cable installation.

7.3.3 Soil stability, erosion, and run-off control

268. **Impacts** Soil stability issues in Tonga is generally considered low risk in electricity reticulation projects. Area 5 is relatively flat and on free draining coral or volcanic soils and thus soil stability in terms of anchoring power poles is not a major concern. Power poles are installed up to a depth of 1.5m to 2m depending on the rocks at installation site using cement and coral aggregates.

269. Earthworks and stockpile management activities may generate erosion impacts and run off control if stockpiles have been exposed to diesel spillages. Stockpiles may be tampered with by domestic animals and children if left uncovered or not designated in a safe marked area. This poses a safety risk to children, should there be sharp instruments, glass or hazardous substances that may be present in stockpiles. Restoring these excavated sites will be difficult if not contained in a designated area. This may result in complaints by land owners and trigger the GRM procedures if TPL does not follow CEMP, CCP and ESMP procedures.

270. **Mitigation.** Application of COEP 5 to ensure that topsoil will be preserved and reinstated after installation of underground cables. Earth excavated for footings and facility platforms will be stockpiled at designated areas within the site and re-used if possible.

271. Stockpile material that cannot be re-used will be distributed around the site and levelled, excess material will be removed to a designated off-site area approved by the Independent Engineer (with permission of local government and/or land owner). Vehicles transporting loose materials will be covered and secured with tarpaulin to prevent dust or spillage.

272. The impacts are considered minimum, if all mitigative measures are implemented

7.3.4 Waste and materials

273. **Impacts**. The construction phase of the project will generate wastes including the anticipated waste streams including: (i) 'green' waste will be generated during site clearance; (ii) hazardous wastes, including oils, lubricants, oil filters, absorbents and rages, paints / solvents, and batteries; and (iii) contaminated soil - polluted with petroleum hydrocarbons from fuel / oil spills or leaks.

274. Poorly managed solid and / or liquid waste can result in contamination impacts on the water environment and soil, leading to impact on flora and fauna and health risks to local residents.

275. **Mitigation**. Application of COEP 11 and CEMP to include measures and conditions such as follows:

- TPL to prepare and implement a waste management plan as part of the CEMP.
- The site will be kept in a tidy and hygienic condition. TPL will discuss disposal and reuse/recycling firstly with the communities or landowners should they wish to use the green waste.
- TPL to discuss options with the Waste Authority Ltd and GIO Recycling and include any agreed arrangements in the site-specific CEMP.
- Waste that cannot be reused will be stored on site in appropriate bins, and removed off-site by TPL to a designated/approved disposal site.
- Final disposal of waste will be transported to Tongatapu for safe disposal at the Tapuhia landfill.

276. In terms of hazardous substances and pollution control, application of COEP 12 and CEMP to ensure that an appropriate spill kit/spill containment material will be kept on site and designated workers will be trained in its use. Refueling of vehicles and plant to be undertaken on concrete pads adjacent to the bunded fuel and oil storage area.

277. Moreover, TPL is to consult DOE to ensure safe storage of fuel, other hazardous substances and bulk materials and follow internationally recognized good practice. Soil or water contaminated with oil may be disposed at disposal sites and methods approved by DOE.

278. The post mitigation risk is assessed as "low", and the effect is not considered significant.

7.4 Construction Impacts on Biological Environment

7.4.1 Potential impacts on terrestrial habitat

279. **Impacts**. The construction phase of the project will involve excavation works which will disturb the surface of the land and affect soil habitats of annelids and possibly result in uprooting of plants which may be of value to the property and land owners.

280. Replacing transformers will entail the trimming of branches that are overhanging over the power cables. Mango trees, coconut trees, faux mimosa, breadfruit trees etc were identified in the project area. About 40 trees were counted in project impact area needing to be trimmed. This may result in increased tree mortality on which bird species depend on as habitat. Birds will naturally move on to other nearby trees for foraging and habitat. The impact on bird species is therefore considered minimum.

281. Trees are of ecological importance and serve as a habitat for many other living organisms such as birds nursing their young in nests and many species of arachnids and arthropods such as insects. The impact of trimming and cutting of well-established trees would be significant if there are rare or endangered species of birds living in them. The ecological survey identified no species of endangered birds and therefore, the impact on birds species from tree trimming is considered minimum.

282. Consultation with communities identified trees of cultural and economic significance (sandalwood and Heilala) that the land owners do not want to be trimmed. The method of cutting trees will determine the severity of impact to the trees. Cutting at incorrect angles or near the bud or stalk of the branches may result in irreparable tree damage.

283. **Mitigation**. Application of COEP 8 and COEP 2. TPL will adhere to the community consultation plan which contains an effective communication procedure that will allow landowners and property owners to communicate their needs to the PMU in a timely manner to ensure that all trees of importance are well protected.

284. The community consultations highlighted the importance of the communities to be kept informed and be further consulted prior to TPL undertaking excavation or trimming trees on their property. TPL will he TPL will not be liable for miscommunication between the communities and TPL that may result in destruction of assets. In the event that property and land owners are not satisfied with TPL, the GRM process will be implemented.

285. Prior to trimming or cutting of trees that have been identified or marked by community the relevant authorities such as the Department of Forestry-MAFFF and DOE-EIA Unit will be contacted to instruct the TPL on the proper cutting method in order to retain the tree as much as possible.

286. In terms of excavation works, TPL will take extra precautions when digging around trees and plants to avoid affecting the dripline.

7.4.2 Potential impacts on aquatic habitat

287. **Impacts**. The construction phase will have medium impact on the modified mangrove habitat in Sopu and Hofoa. This area is under development to accommodate new settlements for migrants from other islands. Reclamation works already underway in this area and subdivision of the land by the MLSNR indicate that new connections will be established in this area. The impacts of reclamation works is significant as it will result in the destruction of the mangrove swamps. Ecological survey conducted in the mangrove area found many crustaceans and birds species that depend on the mangrove swamps for shelter and food. However, this project will not impact on the wetlands, as project activities will be limited to the network lines only.

288. The installation of new power poles in new roads and settlements close to the mangrove areas will have some impacts due to noise disturbance and disorder to the natural landscape of the area. The main concern however is around the leaching of arsenic and copper to the water resources and mangrove habitat due to the treatment process using Tanalith C Oxide.

289. The assessment of the treatment process at the ATFP workstation found that the risk of arsenic leakage is high and soil testing results have yet to be completed from New Zealand. Harvested pine trees are peeled and subjected to a steaming process maintained at 120 degrees Celsius before they are dried and put through a closed chamber treated with Tanalith C Oxide. Treated poles are allowed to dry for up to two days before they are transferred to the storage area to be sold. Therefore, copper and arsenic leaching is contained only within the timber processing yard and not likely to affect the seven villages in Area 5.

290. The DOF has a milk-fish farming project located in Mui Sopu. The farm is located about 20m from the nearest power pole alignments on the access route to the new settlements. There will be no impact from the project as installation (and subsequently maintenance) works will be well away from the milk-fish farm.

291. **Mitigation**. Application of COEP 8 and CEMP to ensure that electricity distribution lines or upgrade works must avoid critical habitats such as the milk fish farm and other nesting grounds or foraging corridors. Application of COEP 8 and CEMP to ensure that electricity distribution lines or upgrade works avoid as far as practicable marine habitats such as the milk-fish farm and other nesting grounds or foraging corridors. TPL will ensure that contractors implement COEP and CEMP and ensure that excavation works will not cause silt runoff into marine environments. TPL will work with DOE and MAFFF to develop a mangrove replanting plan to be implemented by communities.

292. Managing the concerns around copper and arsenic poisoning include ongoing consultations and follow up with ATFP, MAFFF and EIA Unit on soil testing and further analysis on the risks and environmental impacts of Tanalith C Oxide 670 to determine the best approach and remediation measures to take.

7.5 Impacts on Socio-economic Environment

7.5.1 Site construction access and haulage routes

293. **Impacts**. Haulage or transformers and new power poles and other project materials to and from project sites will create issues around pedestrian safety and traffic congestion. This is particularly a concern in the village areas where government primary schools are located. Small children often walk along the network upgrade roads to and from school and also during lunch breaks.

294. In addition, the roads in the village are narrow and the TPL trucks will likely create traffic congestion and obstacles that may cause traffic accidents when children are using the roads.

295. **Mitigation**. Application of COEP 7 and CEMP to include a traffic management plan as part of the CEMP to ensure that traffic management and safety measures are identified and implemented including speed limits for trucks and construction equipment, spotters and flaggers on haulage routes, signage is installed to notify community of construction sites, detours are identified with community police and inputs and notified widely. All workers to be extra cautious and vigilant when working in high density community areas and where schools are located.

7.5.2 Interruption of electric power supply

296. The upgrade works will require shutting down of electric supply in work sites. The communities in Area 5 will have to bear these interruptions, including residences, commercial establishments, schools, churches and other institutions. The power interruption will affect the activities of these consumers and may even cause disruption of activities particularly church choir practices and meetings conducted usually at night time. This will also affect public safety if streetlights are cut off.

297. **Mitigation** measures for power supply interruption should include scheduling of power interruptions and the public announcement of the schedule. This way, the consumers will be able to prepare and take the necessary steps to cope with the interruption.

298. TPL has currently a system in place for announcing scheduled power outages through the different media, including a post in on their Facebook page and text messages to consumers.

299. Unplanned power outages may also occur during the works and this can have adverse impacts on the consumers particularly schools and residences that rely on water pumps and internet. This is particularly crucial during lockdown periods where most communities are confined to their homes to carry on with work and school through online platforms. TPL will need to quickly respond to such contingencies without compromising health and safety of the field crew.

7.5.3 Workplace and community health and safety

300. **Impacts**. Construction activities are inherently hazardous, due to the activities they involve, and the constantly changing nature of operations, work locations and site conditions. The large size of this work site present an additional risk factor. Risks to safety can occur due to violation of proper health and safety practices and may lead to injuries and accidents.

301. Risks from construction activities apply to both to Project personnel and the community in the areas near the project. Hazards associated with construction activities include:

- Construction traffic and mobile work equipment;
- Lifting operations;
- Interaction between vehicles and pedestrians;
- Excavations;
- Working over and/or adjacent to water;
- Temporary works;
- Work at height, particularly on temporary access structures;
- Exposure to noise, dust, vibration and other hazardous agents;
- Hazardous materials, including fuels and bitumen;
- Exposure to heat and/or extreme weather conditions;
- Electrical and other equipment; and

- Unauthorized access – a particular hazard in work sites spread over a large area.

302. Though unlikely, the implementation of the project may result in impacts on the health and safety of the community as a result of: noise, dust and other emissions from earthmoving and operation of equipment and vehicles.

303. Failure to implement robust safety procedures and develop a positive safety culture could lead to injury and illness and therefore health and safety will require robust management by TPL through the measures in the health and safety plan (HSP).

304. **Mitigation**. Application of COEP 6. Safety impacts will require management by the TPL in the form of a management plan in their CEMP. The precise mechanisms will be identified in the CEMP, but TPL will develop the HSP which will be approved and monitored during construction by the PMU. The HSP will address community impacts and management measures in addition to worker health and safety. The HSP will meet the requirements of good engineering practice, national law and regulations and comply with the EHSG and include an agreement on consultation requirements, establishment and monitoring of acceptable practices to protect community safety, links to the complaints management system for duration of the works (in accordance with the GRM) and system for reporting of accidents and incidents;

305. TPL will coordinate directly with the grievance focal point(s) (GFP) appointed for the project and ensure adequate training is administered before construction comments to inform workers on environmental safety, health and hygiene including recruitment of an approved service provider to deliver of the communicable diseases awareness and prevention (STIs including HIV/AIDS, COVID-19, malaria, dengue etc) training and the workers' code of conduct. Protective and preventative measures will also be undertaken to prevent the spread of COVID-19.

306. The CEMP is to include an emergency response plan that will include measures and resources for prevention, mitigation and response to all foreseeable emergency scenarios (road traffic accidents, spills, fire, etc.) associated with construction activities, and should consider the suitable response resources (medical, fire-fighting, etc) for all related foreseeable emergencies, which are necessary to mitigate the location of the work sites, daily traffic and consequent increased response times.

307. With the mitigation and management plans in place, residual risk is assessed as low and the effects considered not significant, following the implementation of the proposed ongoing mitigation.

7.5.4 Cultural and physical resources

308. In particular, the SPS notes that the project will not remove any physical cultural resources unless the following conditions are met:

(i) No alternatives to removal are available

(ii) The overall benefits of the project substantially outweigh the anticipated cultural heritage loss from removal

(iii) *Any removal is conducted in accordance with relevant provisions of national and/or local laws, regulations and protected area management plans and national obligations under international laws, and employs the best available techniques.*

309. **Impacts**. The area within which the works will be conducted in is highly modified, and no specific cultural resources or sites were identified during the consultations. Disturbance and chance procedures for handling archeological findings will be included in the CEMP.

310. **Mitigation**. A chance find procedure is included in the CEMP and will be implemented during construction. In the case of discovery of buried archaeology, cultural artefacts or items of cultural or ecological value during construction activities, the works shall be immediately stopped, and the relevant authority is to be informed.

311. Works will proceed following discussion and guidance obtained from the Committee of Tongan Traditions[43] and other relevant authorities such as the town officer, Ministry of Internal Affairs and EIA Unit. The need for TPL to include chance find procedure is included in the ESMP.

312. The post mitigation (residual) risk is assessed as low and insignificant

7.5.5 Noise

313. **Impacts**. Equipment and vehicle operations and movement during construction may generate noise pollution that may disturb communities within the project areas. The project working hours begin at 8am and can extend up to 8pm at night. Noise is not considered a significant impact as the nature of operations are not anticipated to produce high decibel levels. Noise impacts include disturbance of cultural gatherings such as funerals or church services. Many cultural activities require silence to be preserved as a mark of respect.

314. **Mitigation.** Application of COEP 5 and CEMP to ensure that the noisiest activities are scheduled around hours that would not disturb community church programmes or funerals on site. It is critical for TPL to work with the CLO to communicate and be made aware of any cultural activities that may be affected when planning daily or weekly work activities.

315. Other mitigative measures include regular maintenance of machinery and vehicles, with particular attention to silencers and mufflers, to keep movement noise levels to minimum. Machinery to be equipped with silencers as far as practicable. Protective devices (ear plugs or ear muffs) will be provided to the workers operating equipment/machinery or in-high noise generating activities and notifications to neighboring residences shall be made in advance through clear signage and announcing work activities on the radio, Facebook or text message blasts, especially if work will be undertaken outside normal working hours.

316. From this assessment, noise impacts are deemed low and insignificant if all mitigative measures are followed.

[43] Preservation of Objects of Archeological Interest Act 1970.

7.6 Operation Impacts

7.6.1 Hazards residual risk and future planned measures

317. The project will reduce present and future risks to the power distribution system, particularly to the utility poles. The future risk of utility pole damage is scored as "high", even after new poles and ABC are installed under the project. This is because the power distribution system will still be radial, which means a power failure, short-circuit, or a downed power line would interrupt power in the entire line. Thus, the network would still be vulnerable to high winds in a strong Category 4 or Category 5 TC.

318. To further boost resilience of the system, the network must be converted to a ring system. As the name implies, such a system loops through a service area and returns to the original point. By placing switches in strategic locations, a power utility can supply power to customers from either direction. Thus, in the event of a power failure due to a fault on the line, the utility only needs to find the fault and switch it to restore service. The fault can then be repaired with a minimum of customer interruptions. Ring systems are commonly tied into an alternate power source, which offer even more flexibility and resilience.

319. Much of the power distribution on Tongatapu is already configured to accommodate a ring system, although there are still several points that need to be filled in the network before the ring is complete. TPL is planning two ring systems – the western ring and eastern ring. The former will cover Area 5 to enable back feeding and rerouting of energy supply. The ABC that will be installed as part of the project will enable this.

320. The solar farms being built to the west will contribute to the supply of energy covering Area 5. As these and other renewable energy projects increase, the decentralized locations of the sites will require a more resilient and integrated network design to minimize disruption of supply due to unforeseen events along the network route. The planned western and eastern rings will provide this for Tongatapu, thereby further reducing residual climate and disaster risks to the power distribution system.

7.6.2 Waste, dust, potential for oil or fuel spill

321. TPL to implement similar management and mitigation measures to those of construction stage and application of COEPs 11-15 and 19, 20 to mitigate against any matters arising. No health and safety issues are anticipated.

7.6.3 Soil erosion and runoff

322. Over time, natural disasters such as tsunami, earthquakes and flooding may have an impact on pole stability in project site. This is particularly relevant coastal locations (Sopu, Halaovave and Hofoa). To mitigate against these, the planting of poles should be at a depth of 1.5m to 2m to ensure stability of poles.

7.6.4 Aquatic habitat

323. The DOF milk-fish farming project (in Mui Sopu) will not be impacted by maintenance works as the closest poles and power line alignment is 20m away. Provided that TPL implement the COEP, residual impacts will be low.

7.6.5 Health and safety

324. **Health and safety risks – workers.** TPL has existing HSP and good practice as part of its current operations in Area 3. These will be implemented in Area 5.

325. Occasional maintenance works during operations will be conducted with prior notice to the town officer and communities will be notified of any traffic disruptions/ hindrance or expected power outages as a result of scheduled maintenance works.

326. **Health and safety risks - communities.** A number of health and safety risks to communities is described as follows:

- TPL has dealt with a number of drink driving cases that have resulted in the destruction of power poles. This has caused unplanned power outages and disruption in power supply to residences in affected areas.
- Trees that are overgrown may pose threats to power supply particularly during windy or cyclone seasons.
- Bush fires that may affect power poles and compromise power stability and access and danger to communities.

327. **Mitigation.** Measures to prevent accidents in Area 5 from careless drivers include installing fluorescent tape to make power poles more visible at night. Imposing hefty fines to discourage motorists from careless driving. TPL to conduct quarterly monitoring of sites to trim hazardous branches. Communities should be encouraged to report any overgrown trees in their areas and this is to be made clear in CCP. TPL to include in CCP safety and precautions for communities to understand the risk of bush fires from their land allotments. This is particularly relevant to communities in Hofoa, Tu'atakilangi and Sia'atoutai where many plantations were observed throughout the villages. Moreover, TPL to conduct quarterly monitoring to ensure that the areas around power poles (1metre radius) is clear of any risks that may cause the power poles to catch fire particularly in the drier months of the year (Nov-March).

328. **Noise**. No operational noise impact is anticipated from the project. Daily vehicles accessing for maintenance and or repair will be limited to normal road vehicles (4WD) required for maintenance purposes.

7.7 Decommissioning

329. **Impacts.** Dismantling of cables and power poles, transformers and switchgears may pose health and safety risks to workers and generate pollution or waste problem if they are not disposed correctly and safely.

330. **Mitigation.** Application of COEP 19 and 20. TPL, ADB and EU to ensure that contract agreements and project documents require a mechanism for suppliers of the transformers, power poles and switchgears to provide disposal agreements after use. Re-usable equipment such as power poles to be recycled with communities as necessary.

7.8 Cumulative Impacts

7.8.1 Sustainability of forest resources

331. The extensive logging of pine trees by local supplier of timber poles to meet the demand for TPL to facilitate power poles for Areas 1-3 and other outer islands electrification projects is a major environmental concern for the project. An assessment of both operations of ATFP, located in Tokomololo Tongatapu and harvesting and milling site in 'Eua were conducted between 17 November – 10 December. This was to ascertain the health impacts associated with arsenic from the chemical process and to assess the supply chain to determine the sustainability of forest resources to continue supplying the power poles for this Area 5 project (Plate 7.1 a-c).

Plates 7.1 a-c: Site visit to ATFP Tongatapu

De-barking area

Bark material used to feed steamer

Chemical treatment process using Tanalith C Oxide 670

332. **ATFP Tongatapu.** A site visit to the timber processing site was conducted to investigate the concerns around the chemical treatment process that was potentially leaching arsenic to the surrounding environment.

333. Discussions with the current operations and procurement managers of the ATFP indicate that arsenic poisoning are real concerns in the industry. Former workers had approached the new management team after they took over operations in 2016, seeking compensation for their health care. The former workers attributed their poor health to exposure to the chemical Tanalith C Oxide 670 as a result of poor disposal of treatment sludge directly on the open ground. Under the new management and regulations, the current disposal system involves the collection of treatment sludge in barrels that are sealed and kept at a separate location on site.

334. Moreover, consultation with the Head of the Department of Forestry also highlighted concerns around the poor growth of banana trees located in the areas located on the boundary facing the ATFP. Further investigation is warranted to determine the level of encroachment of arsenic to the surrounding soils as well as the water table within a 100m radius.

335. Following complaints received by surrounding communities on the steaming process that was assumed to be emitting harmful substance, the DOE conducted an investigation on site. Following their site inspections, DOE requested ATFP to conduct soil testing to ascertain the level of arsenic poisoning within the vicinity of the timber processing area. Soil samples were taken from multiple locations within the ATFP compound and sent to New Zealand for analysis. At the time of writing this report (December 2021), the results of the soil testing were still being processed.

336. Given that this a significant concern on the environment and human health, the results of the soil testing and further investigation into the impacts of arsenic poisoning is an item to be followed up and audited to fully ascertain the cumulative impacts of using local forest resources.

337. TPL's collaboration and ongoing follow up with relevant government departments such as the Division of Natural Resources, Public Health, EIA Unit and Department of Forestry, is imperative to determine the level of health and environmental risks and prescribe immediate measures to mitigate and reduce further compounding issues as necessary.

338. **ATFP 'Eua Island.** Assessment of the harvesting site, milling site and replanting in 'Eua were conducted on the 8-9 December. The rate of harvest of Caribbean pine (*Pinus caribaea*) varies monthly due to factors such as weather conditions and availability of manpower and equipment. Figures provided for the months of July to November indicate an average of 430 Caribbean pine trees are harvested per month compared to the rate of replanting which is an average of 1300 per month over the same period.

339. A total of 16 acres have yet to be accessed in the contract boundary. There are plans to construct new roads to this area where an estimated 4000 trees that are of the required height and thickness will be harvested to supply the power poles for TPL network upgrade projects.

340. There is a replanting system in place where a supervisor oversees the work of about eight staff in planting seedlings throughout 17 plots in the ATFP contract boundary estate. A visit to the nursery found an estimated 5000 seedlings ready for replanting. Many factors affect the replanting schedule, including weather conditions that can make it difficult to access the harvested sites for replanting.

341. A visit to plots 13, 14 and 15 show mixed cropping of pine trees and kava plants. Concerns around chemical treatment of kava plants and how this may affect soil conditions and properties were highlighted in a report by Forestry Division.[44] Kava plants have a harvest schedule of four years compared to rotation rate of 20 – 30 years for Caribbean pine. This implies that the cumulative impacts of continuous kava planting may affect Caribbean pine tree growth. Further assessments on these impacts need to be conducted as part of the review of ATFP business contract with government (Plate 7.2 a and b).

Plate 7.2 a +b: 'Eua replanting staff and seedlings

ATFP replanting staff

Caribbean pine seedlings in the nursery

342. Overall, the current rate of replanting will not be able to sustain the project for more than 5 years. It is recommended that the pine trees planted in 2016 are allowed time to grow to maturity and allow recovery for over 15 years more years prior to resuming harvesting of pine trees (Plate 7.3).

Plate 7.3 a + b: Replanting sites 'Eua Forest Estate

Inter-cropping pine trees and kava plants (plots 13-15)

[44] MAFFF. 2020. Report on the assessment of the 'Eua Forest Plantation state of harvesting and replanting.

343. Despite a system in place for harvesting and replanting in 'Eua Forest, the lack of regulations and measures to secure and store logs on site prior to shipping to the main processing site at Tongatapu implies that some logs may not be in optimum conditions for processing. It is imperative that monitoring and regulation assistance and enforcement is implemented by relevant authorities to ensure that harvested logs are well secured and transported promptly to minimize rotting and wasting of these resources (Plate 7.4 a and b).

Plate 7.4 a + b: Harvesting sites in 'Eua

Harvesting sites	
	

344. From the assessment, it is clear that the company is positive that there are sufficient resources available for Area 5 project requirements. However, this is pending access to the 16 acres of unharvested Caribbean pine trees as there are currently no access roads to the site.

7.8.2 Tonga Integrated Urban Resilience Sector Project

345. With support from the ADB, the MLSNR and the Ministry of Infrastructure are implementing the Tonga Integrated Urban Resilience Sector Project (TIURSP) which includes proposed drainage upgrading in the same project area of influence as the project. The TIURSP has four anticipated outcomes to: i) Implement effective flood risk management infrastructure; ii) improve water supply service in Nuku'alofa; enhance public and environmental health and; iv) strengthen urban resilience. The main villages of overlap with activities to be undertaken in Area 5 are Sopu and Hofoa.

346. The proposed route for Area 5 may affect the drainage plans and this was carefully evaluated with the TIURSP project team, currently undertaking preliminary surveys to finalize the drainage design to improve drainage in the low lying areas of Kolomotu'a. This project will contribute to alleviating the impacts of flooding in these flood-prone areas. The proposal is to install drainage systems to pump flood waters out through the Sopu area to sea. The existing culvert at Hofoa village is likely to be widened to allow water to flow naturally through the mangrove wetlands out through Sopu.

347. Discussions and analysis of project documents[45] indicate that there will be minimum overlaps with the project since network upgrade works will follow existing road routes and project activities such as excavation works, will be within land boundaries of the beneficiaries.

348. Ongoing collaboration and discussions between TPL and MLSNR, Ministry of Infrastructure and IT Solutions consulting company over the course of the project design, construction and operational phase, is important, particularly to address community concerns that may arise throughout the concurrent project timelines.

[45] ADB. IEE Report. 2019. Tonga Integrated Urban Resilience Sector Project.

8 Environmental and Social Management Plan

8.1 Introduction

349. The objectives of the ESMP and monitoring plan are:

- To ensure project components are conducted in compliance with the national laws and regulations as well as the requirements of the ADB;
- To measure the success of proposed mitigation measures in minimizing and/or reducing potential environmental, health, safety and social impacts;
- To continuously control the changes to baseline environmental, health, safety and social conditions during pre-construction, construction and operation activities;
- To facilitate a continual review of activities based on performance data and consultation feedback; and
- To implement corrective actions or new adaptive management programs, as required

8.2 Institutional Arrangements

8.2.1 Executing and implementing agencies

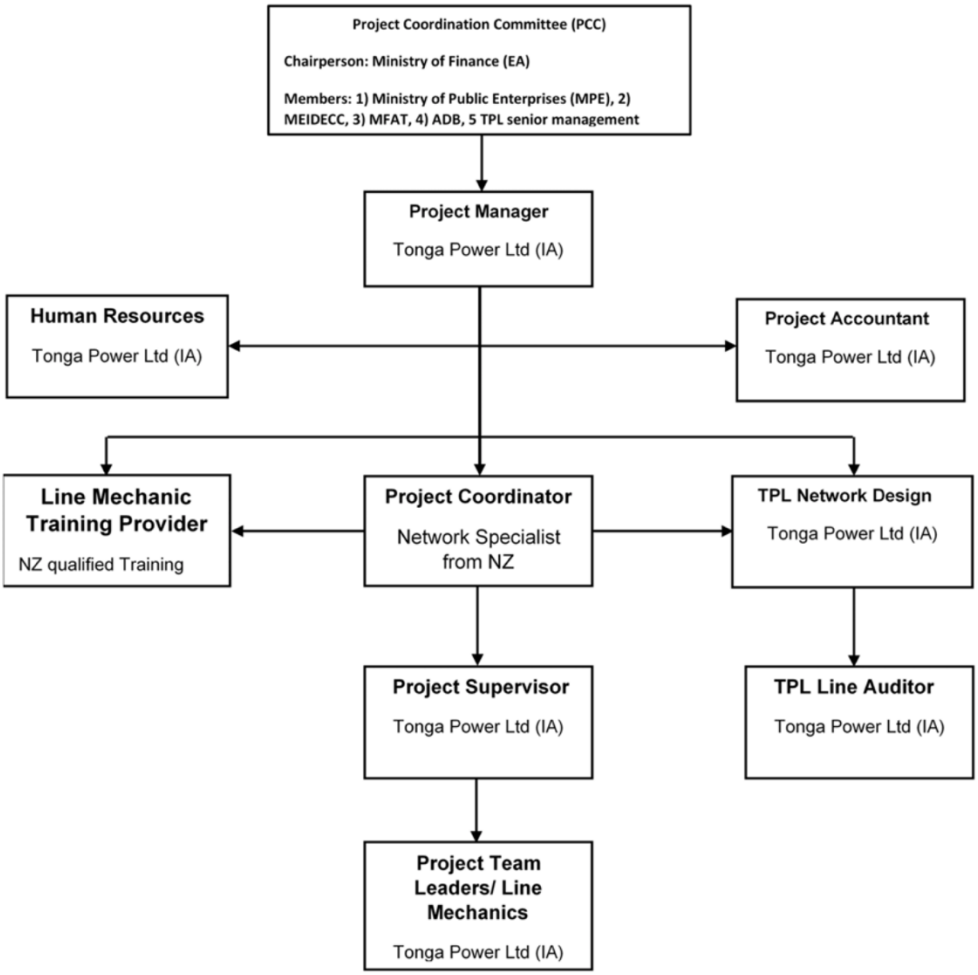
350. **Executing agency**. This project will be executed by the Ministry of Finance. In fulfilling its role, the ministry has responsibilities that include supervising the implementation of the project and establishing and managing the project steering committee (PSC). The PSC will consist of TPL and the national policy sector bodies (MEIDECC and MPE) and will be responsible for overall direction, guidance, and providing an oversight role for the project. The PSC will meet on a quarterly basis to discuss the progress of the project. Members will include a representative from MEIDECC in particular to review and provide inputs for the environmental aspects of project implementation and quarterly monitoring reports. The ministry will also play a role in coordinating the effective transfer and issuing of financial assistance from the ADB to TPL and relevant authorities throughout project implementation.

351. **Implementing agency**. The implementing agency will be TPL through its PMU. TPL has the necessary resources, experience and technical and commercial services to ensure a successful outcome. TPL intends to implement the project with their current staff completing the works for Area 3 by June 2022. An environment officer will be recruited to the PMU and be full-time over the period of the project. The environment officer, as required, will be supported through an ongoing technical assistance. The environment officer will monitor compliance with the CEMP and deliver, and received as necessary, safeguards capacity building support.

352. All project compliance will be managed through capacity building support under the project to the TPL and PMU. The PMU will include environment and social safeguards focal point who will be responsible for all policy actions, administration, and maintenance of records and will prepare quarterly project progress updates for the PSC and all safeguard reporting requirements such as screening, preparation of assessments and stakeholder consultations.

353. All PMU staff working on this project will be funded by TPL. An overview of the institutional arrangements for project implementation is presented in Figure 8.1. It is envisaged that the project will be implemented between Sept 2022 and June 2023.

Figure 8.1: Project organizational structure



8.2.2 TPL - project management unit

354. TPL as implementing agency will be responsible for ensuring compliance with and implementation of all national and international environmental, health, safety and social policies, guidelines and performance requirements of both Tonga and ADB and any others who are subsequently involved in the project.

355. The TPL's PMU will be responsible for the overall implementation of the mitigation measures and requirements specified within the IEE disclosure package for the project. They will be required to oversee implementation of the ESMP developed by TPL to ensure it fulfils all identified environmental, health, safety and social requirements under the grant agreement for the project. The PMU are responsible for ensuring roles and responsibilities are clearly identified and allocated for environmental, health, safety and social, gender, both within the PMU itself, within TPLs' arrangements and for the handover to operations.

356. The PMU will be responsible for the implementation and conformance of the GRM to ensure that all grievances and/or objections (if any raised by the local community and/or workers) are received, acknowledged and addressed as per the grievance procedure presented in the CCP.

357. The PMU will require environment and social specialists to provide project experience and developing safeguards capacity within the broader PMU and TPL. The PMU will be supported by the international environmental specialists already recruited under the regional safeguards technical assistance.

8.2.3 Development of the CEMP

358. TPL will be responsible for constructing the project and installing the poles, lines and transformers as required under the contract. TPL will also be responsible for developing and implementing their CEMP covering the pre-construction and construction stages of the project in line with ADB and CSS requirements and good practice.

359. The CEMP is to be developed and approved by the PMU, and ADB, prior to commencement of any activities on site and must be aligned to the ESMP (see Section 8.3.1). The CEMP will be subject to independent review, prior to approval, undertaken by one of the international environmental specialists already recruited under the regional safeguards technical assistance.

360. TPL will be responsible for submission of relevant reports to the Independent Engineer. The PMU must ensure the ESMP and approved CEMP is implemented by competent individuals, using approved methods of monitoring, and calibrated equipment (field testers and hand-held equipment) where appropriate.

361. TPL shall designate a staff as responsible for undertaking health, safety and environmental management tasks as set out in the ESMP and lead the compliance monitoring. This staff will be supported, as required, by additional personnel with specific EHS responsibilities.

362. The responsibilities of the responsible staff include:

- Ensuring TPL implements the environmental protection and management specifications set out in the ESMP and the approved CEMP ;
- Undertaking day-to-day environmental and safety management tasks as required for the project and weekly environmental and health and safety audits;
- Maintaining a daily Site Diary recording all relevant matters concerning environmental and safety management on the Site including protections and controls, audits, inspections, and related incidents. Making the Site Diary available for inspection by the Independent Engineer upon request;
- Participating in joint inspections to be undertaken by PMU, ADB and any other organizations; and
- Preparing and submitting the reports as required by the IEE, project administration manual and the CEMP

8.2.4 Department of Energy

363. The Department of Energy oversees the implementation of Tonga's energy programs and designs and manages the country's policies, plans in meeting renewable energy and energy efficiency targets. The Department of Energy works closely with TPL in ensuring the implementation of the TERM and TERM plus post 2020. In addition, the Department of Energy works closely with the Department of Climate Change in meeting Tonga's second NDC targets. Mitigation targets for the energy sector include 13% (16Gg) reduction in greenhouse gas emissions (GHG) from energy by 2030 compared to 2006.[46]

364. This requires considerable financing for upgrading the electrification network made possible through this project and preceding financing assistance for Areas 1-3 of the NNUP.

8.2.5 Department of Environment

365. The main focus of the DOE is on ensuring conservation and sustainable use of the natural environment, while maintaining biodiversity and ecosystem services. This is through community engagement in conservation work, emphasizing pollution free environment, sustainable development processes and capacity building and institutional strengthening for effective management.

366. The mandate of the DOE within the auspices of the Environmental Management Act 2010 and Environmental Impact Assessment Act 2003 and its corresponding EIA Regulations 2010 is to ensure all due compliance and enforcement of all legislation pertaining to environmental management and protection. The DOE comprises a number of units:

- As required, the EIA unit will be involved in the scoping and monitoring of the project area before, during and post construction phases of the project.

[46] Department of Climate Change, MEIDECC. 2020. Tonga' Second Nationally Determined Contributions Report.

- The Islands and Ecosystems Division is responsible for conservation and biodiversity issues including habitat and ecosystem restoration in wetlands (mangrove areas), coral reef areas and protected area management.

367. **Summary**. An organization chart for environmental management responsibilities is presented in Figure 8.1 and Table 8.1 is a summary of the roles and responsibilities during the project phases.

Figure 8.2: Organisation chart for environmental management

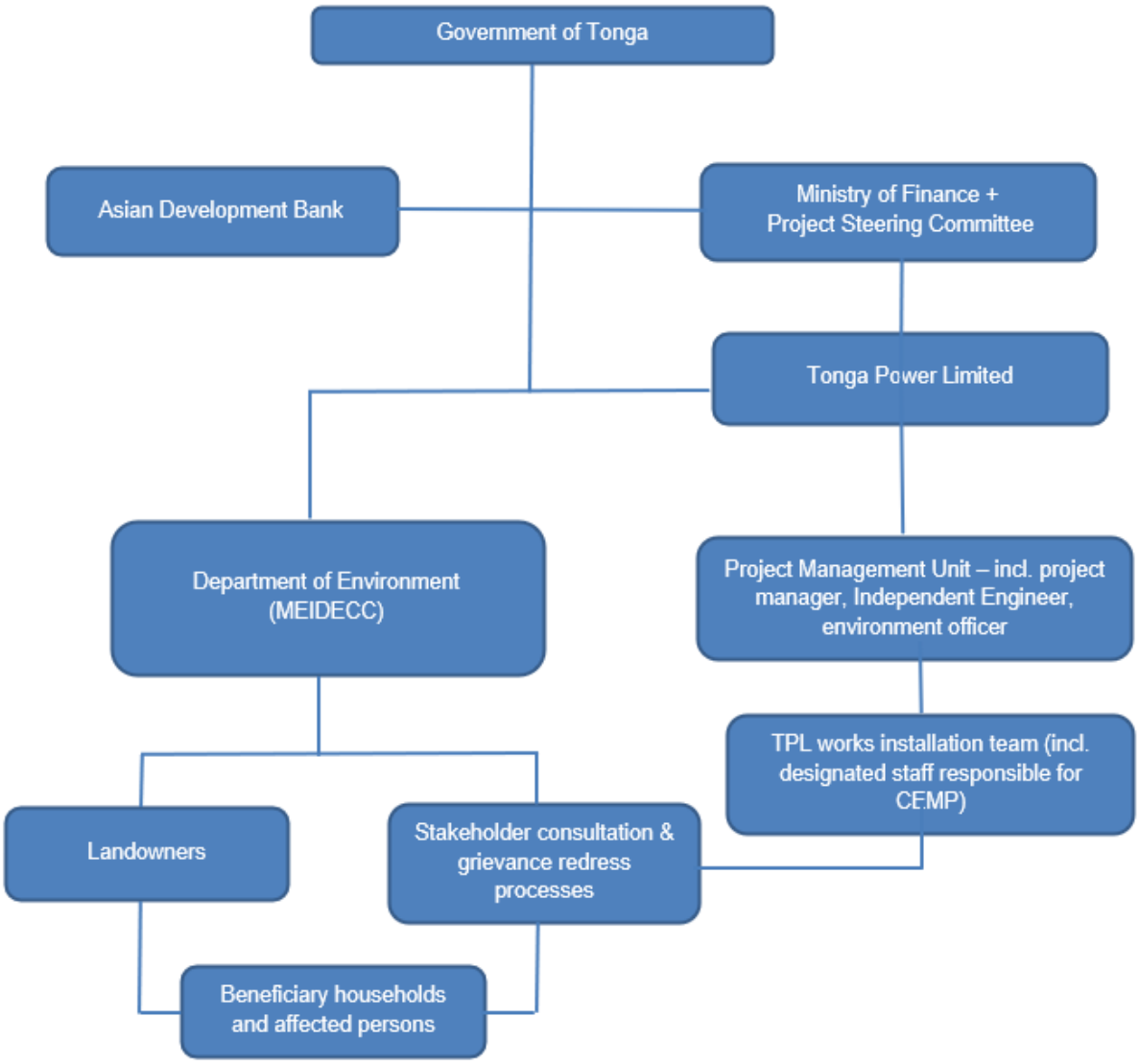


Table 8.1: Summary of roles and responsibilities for environmental management

Organisation/Agency	Responsibility
PRE-CONSTRUCTION PHASE	
Ministry of Finance – executing agency	Overall responsibility for project implementation as per legal agreements and PAM
Tonga Power Ltd – implementing agency	PMU will manage the upgrade activities under the project and coordinate with MEIDECC, EIA Unit to supervise and monitor TPLs responsibilities as prescribed in ESMP throughout the pre-construction, construction and operation phase. The PMU will include staff from TPL and MEIDECC supported by supervision consultants. The PMU will be responsible for the project's contract management, supervision, and day-to-day implementation, including safeguards compliance, financial management, monitoring, and evaluation. Review and clear TPL's CEMP (following independent review).
Project Steering Committee – overall supervision and overview	Supporting the executing agency Overview of project progress
ADB – financing partner	Review and clear updated safeguards documents. Provide comments on the ESMP and proposed monitoring checklists.
TPL installation team	Prepare CEMP in alignment to the ESMP, GRM and CCP Implement approved CEMP
CONSTRUCTION PHASE	
TPL	Adhere to CEMP and provide monthly reports to PMU
PMU	Continuously engage and liaise with communities and EIA Unit when trimming vegetation and ensure TPL follows through with requests for trees to be preserved and disposal of cuttings.
ADB	Provide support and guidance for due diligence procedures as described in this IEE study (Table 8.2) Undertake regular review missions. Review monitoring reports. Disclose project information as required.
EIA Unit-DOE	Ensure compliance with government EIA requirements. Assist in reviewing and addressing environmental and social issues as they arise. Conduct monthly or quarterly monitoring with TPL through on-site visits and prepare inspection notes (as per the ESMP).
OPERATION PHASE	
TPL	Provide budget to undertake maintenance activities and environmental monitoring as required by environmental audits and the operational phase measures identified in the ESMP. Undertake maintenance as required. Conduct quarterly site visits with EIA Unit and prepare, as required, environmental monitoring reports. Prepare maintenance reports to adaptively manage environmental and social risks related to operations (as per ESMP). Coordinate with community and TPL to ensure compliance with all ESMP and CCP
TPL or maintenance TPL	Ensure compliance with operational phases of ESMP and CCP Ensure compliance with GRM processes Provide update reports to TPL PMU on a quarterly basis
ADB	Conduct review of environmental and social safeguards monitoring reports

8.3 Environmental Reporting Requirements

368. The TPL and PMU will comply with the project reporting requirements as set out in the project administration manual. The TPL will produce monthly reports, and the PMU will produce quarterly progress reports which will include information on environmental performance, and semi-annual safeguards monitoring reports. Reporting will include but not be limited to:

- Status of the implementation of the approved CEMP
- Status of any other TPL prepared environmental and social documents
- Status of environmental, safety and labor permits
- Recording any environmental, health and safety and social monitoring results (e.g. air, noise, water quality, vibration audits / inspections)
- Results of TPL and joint TPL and PMU/DOE site inspections and audits
- Grievance redress mechanism
- Accidents and incidents
- Interaction with the public – public consultations and information disclosure and notices
- Training of site staff in environmental, health and safety matters.

369. The PMU will prepare semi-annual safeguards monitoring reports drawing on TPL's monthly and quarterly progress reports including environmental monitoring information and reporting the environmental and social performance of the project. This document will be disclosed on the ADB website.

8.4 Project ESMP

370. The ESMP (Table 8.2) is designed to assist the relevant parties of the environmental elements that have been identified in the IEE and need to be addressed. Appendix 3 provides an outline contents and guidance notes for CEMP development.

Table 8.2: Environmental and social management and monitoring plan matrix

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
Design and pre-construction phase						
Design and equipment selection	Risk of climate change effects compromising project outcomes	1. Proposed siting has addressed climate change risk; 2. Project detailed design and bidding packages to ensure equipment selected is resilient to climate change; 3. Equipment selected for low emissions; and 4. Transformers and other electrical system equipment to be free of polychlorinated-biphenyls	TPL PMU	1.Once - site selection report 2. Once - TPL submission/tender 3.&4. Once – equipment and feeder line installation (underground)	COEP applied; Technical specifications; Performance of equipment purchased and installed	TPL, PMU
TPL familiarizes itself with IEE, ESMP and development consent and conditions	Poor project environmental management if systems not established properly and from outset of project implementation	1. TPL to allocate staff and resources for effective operation; 2. PMU updated project ESMP and includes conditions of GOT approvals 3. ESMP requires TPL to: (i) comply with applicable COEP; (ii) designate full-time staff responsible for EHS functions and CLO; (iii) implement monitoring and reporting plan; (iv) provide induction and training for workers (and community) as specified); 4. TPL to prepare site-specific CEMP; and 5. CEMP reviewed and cleared by PMU prior to works commencing.	TPL, DOE, PMU, ADB (indep. Review of CEMP)	1. Once – post loan/grant effectiveness; 2.– 5. Prior to TPL commencing works; Upon workforce mobilization	Environment officer recruited to PMU; Updated ESMP and safeguards provisions; CEMP prepared and cleared; independently reviewed, no objection for works commencement; Notes of induction and training	TPL, PMU
Implementation of project's communications and consultation plan (CCP) and grievance redress mechanism (GRM)	Establishes effective channels for project information and complaints/grievances	1. CCP updated and GRM established; 2. Procedure for accessing GRM disclosed; 3. Grievance focal points (GFP) appointed; 4. TPL addresses relevant elements of CCP and GRM in CEMP ; 5. GRM registers established at site and PMU;	PMU, TPL	1.- 3. Post loan/grant effectiveness 4. & 5. After contract award; 6. Prior to site works	CCP updated and disclosed; GRM established, GFPs appointed, register maintained; Consultations undertaken	TPL, PMU
Materials sourcing and materials, plant/equipment import	Imported materials may introduce alien or invasive species. Local material sourcing creates resource or other impacts	1. All materials, plant and equipment imported for the project to follow Quarantine Act and Quarantine regulations and requirements of Quarantine and Quality Management Division – MAFFF; 2. Phytosanitary certificates obtained as required; 3. Locally sourced materials only obtained from sources agreed by resource/land owner. 4. Locally sourced materials to comply with GOT laws and obtain permits and consents as required; and	TPL, PMU	1.& 2. On arrival of materials in Tonga; 3.& 4. Prior to any extraction activities	Phytosanitary certificates for imports; Permits/consents for materials sourcing; Land/resource owner agreements; Cleared materials extraction plan.	TPL, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		5. Materials extraction plan to be prepared by TPL and approved by PMU (independently reviewed).				
Identification of number of poles to be replaced in mangrove swamps	Impacts on aquatic environment - soil stability issues and run off; possible impacts on mangroves	1. TPL to ensure that excavation works will not create silt runoff to adjacent marine habitat 2. Replace any mangroves required to be removed as part of power pole replacement in Mui Sopu and Hofoa 3. Develop replanting plan in conjunction with DOE, MAFFF and DOF 4. Estimated cost $3,500 = $300 -purchase of 200 mangrove seedlings $300/day for community replanting activities	TPL, DOE, MAFFF, DOF, communities	Monthly post planting – commenced upon removal of mangroves	Photos, reports	TPL, DOE, MAFFF, DOF
Construction phase impacts on physical environment						
Equipment operation and vehicle movements	Air quality, fugitive emissions, dust	1. Application of COEP 5 and CEMP to include the following; 2. Reduce the speed of all vehicles entering and working within the site to reduce potential dust; 3. Trucks carrying material will be covered with a tarpaulin so that any material will not be spilled during transportation between the project site and local material source; 4. Regular cleaning (washing) of construction vehicles in a dedicated location to reduce dust on site; 5. Anti-dust breathing facemasks are to be used by all staff working in high dust areas; 6. All machinery, equipment and all vehicles used should be well maintained and emission level should be kept low; 7. Cover storage and handling areas, where practicable; and 8. Minimize stockpile heights and contain stockpiles with perimeter wind break fencing (or at least covers).	TPL,	1-9 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; PPE allocated and worn; Washing of vehicles; Dust complaints	TPL PMU
Earthworks and stockpile management	Water resources	1. TPL to proceed only after prior consent and approval of land owner on appropriate excavation site within their land boundary. 2. Any damages to water pipes must be rectified immediately and reported to contract manager and PMU before proceeding with underground cable installation	IA, TPL	1-7 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ;	TPL PMU
	Stability of excavations and stockpiles, erosion	1. Application of COEP5 (section 6.3) and CEMP to include the following;	IA, TPL	1-7 daily and weekly;	CEMP ;	TPL PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		2. Topsoil will be preserved and reinstated at the end of the construction period.; 3. Earth excavated for footings and facility platforms will be stockpiled at designated areas within the site and re-used if possible; 4. Stockpile material that cannot be re-used will be distributed around the site and levelled, excess material will be removed to a designated off-site area approved by the engineer/site supervisor (with permission of local government and/or land owner); and 5. Vehicles transporting loose materials will be covered and secured with tarpaulin to prevent dust or spillage.		Overall CEMP implementation monitoring - monthly	Stockpiles according to site layout plan; Minimization of bare ground; Trucks hauling material are securely covered.	
	Discovery of items of archeological interest	1. Implement chance finds procedure developed as part of CEMP 2. Stop works immediately 3. Seek advice from Committee on Tongan Traditions	PMU, CSC, TPL, Committee on Tongan Traditions			PMU
Import of materials and equipment and all construction activities	Generation and management of waste	1. Application of COEP11 and CEMP to include the following; 2. The site will be kept in a tidy and hygienic condition. 3. TPL will consult community or landowners regarding re-use of green waste. 4. The TPL will discuss disposal and reuse/recycling options with the Waste Authority Ltd and GIO Recycling and include any agreed arrangements in the site-specific CEMP ; 5. Waste that cannot be reused will be stored on site in appropriate bins, and removed off-site by TPL to a designated/approved disposal site; and 6. Final disposal of waste will be transported to Tongatapu for safe disposal at the Tapuhia landfill.	IA, TPL	1-8 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; Condition of site; Number of receptacles; Waste segregation practices being implemented.	TPL PMU
Storage use and disposal of hazardous substances	Pollution, contamination and health and safety risks	1. Application of COEP 12 and CEMP to include the following; 2. Fuel, oil and hazardous substances must be secured safely at designated areas on site. The area for fuel and oil storage will be concreted and bunded for 110% capacity of the largest volume container stored on site;	IA, TPL	1-12 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; Bunds and concrete platforms at storage and refueling area; Labelling of stored chemicals; Spill kit use and training;	TPL PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		3. An appropriate spill kit/spill containment material will be kept on site and designated workers will be trained in its use; 4. Refueling of vehicles and plant to be undertaken on concrete pads adjacent to the bunded fuel and oil storage area; 5. Ensure that safe storage of fuel, other hazardous substances and bulk materials are agreed by DOE and follow internationally recognized good practice; 6. Discharge of oil contaminated water shall be prohibited; and 7. Used oil and other toxic and hazardous materials shall be disposed of off-site at a facility authorized by the DOE.			Condition of ground/soil at oil/fuel storage area.	
Construction activities	Run-off to or impacts on water resources (likely minimal if at all)	1. Review of applicability of COEP 9 and recommended measures to be included in CEMP if required.	IA, TPL PMU	As required	Items included in CEMP if required	TPL PMU
Equipment and vehicle operation, construction activities	Noise	1. Application of COEP 5 (section 6.4) and CEMP to include the following; 2. Machinery and vehicles will be maintained regularly, with attention to silencers and mufflers, to keep construction noise levels to minimum. Machinery to be equipped with silencers as far as practicable; 3. Protective devices (ear plugs or ear muffs) will be provided to the workers operating equipment/machinery or in-high noise generating activities; 4. Advance notification to neighboring residences and uses (including signage) announcing work activities, especially when work is being undertaken outside normal working hours; and 5. Scheduling construction, including noisiest, activities to normal working hours (8am – 5pm) Monday to Saturday. Earlier and/or later hours to be agreed locally. No work will be undertaken on Sundays.	IA, TPL PMU	1-6 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; Advance notices to community; PPE allocated and worn; Installation of noise barrier around site; Grievances citing noise; Records of work days and hours	TPL PMU
Construction phase impacts on biological environment						
Site selection, confirmation and final design decisions on	Visual and landscape impacts	1. Site selection, application of COEP 1 and COEP 14; 2. Careful selection of site close to residences and ensure available land for buffer;	IA, PMU, TPL	1. & 2. Once - site selection report and final design;	COEP applied; item allocated for revegetation of sites,	IA, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
placement of structures within site				3. Following works completion	tree retention/replanting around site	
	Land use changes and impacts for temporary access	1. Site selection and application of COEP 1; Timely and effective consultation;	TPL, PMU	1.Once - site selection report and final design; & 3. Prior to and during final design	Site selection report; Consultation minutes	TPL, PMU
	Arsenic leaching into environment	1. Follow up with ATFP, MAFFF, EIA Unit on soil testing results further arsenic impact analysis				
Tree and vegetation removal, land clearance, site preparation	Landscape and visual impacts	1. Consult land owner beforehand of proposed tree or vegetation removal 2. Careful site selection; 2. Application of COEP 1 and COEP 14; Retain vegetation as far as possible	TPL/PMU	1. & 2. Once - site selection report, final design; 3. Following works completion	Site boundaries replanted	TPL, PMU
	Ecological impacts – clearing beyond marked area Destruction of bird nests	1. Care taken to only clear and remove trees as marked on approved plan; 2. Trees to be protected clearly marked on site Consult EIA Unit, Forestry division and landowner before removal of overhanging trees that contain bird nests	TPL, PMU	During site clearance	Site plan, trees retained/replanted	TPL, PMU
Replacing power poles in mangrove swamps	Impacts on aquatic environment - mangroves	1. Implementation of replanting program (identified and commenced in pre-construction)	TPL, DOE, MAFFF, DOF, communities	Monthly post planting – commenced upon removal of mangroves	Photos, reports	TPL, DOE, MAFFF, DOF
Construction phase impacts on socio-economic environment						
Haulage of plant and materials to and from site	Pedestrian safety, traffic issues	1. Application of COEP 7; 2. CEMP to include a traffic management plan paying particular attention to areas where schools are located.	TPL, PMU	1-2 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP and traffic management plan; Traffic controls and measures	TPL, PMU
Construction activities, equipment operation	Health and safety risks for workers	1. Application of COEP 6 and EHSG and CEMP to include the following; 2. The TPL will prepare a health and safety plan (HSP) as part of the CEMP . The HSP will establish: (i) activity/job safety procedures and protocols; (ii) plan for HSP training and "toolbox" sessions for workers; (iii) first aid facilities (on-site and in vehicles), personal protective equipment (PPE) and medical evacuations; (iv) routine safety and accident prevention measures; (v) emergency response and preparedness; (vi) accidental environmental instance (e.g. spill) procedures highlighting the sizes and types	TPL, PMU	1-16 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; HSP and training plan; Designation of EHS staff First aid kits appropriately stocked; PPE allocated and worn; Records of training sessions; Records of age (and provenance) of workers; Accident register; Number of medivacs etc	TPL, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		of impacts that may occur, and the resources (onsite and/or offsite) that will be required to handle and treat the spill; and (vii) accident, near-miss and emergency registry, monitoring and reporting; 3. The HSP will cover both occupational health and safety (OH&S) and community health and safety. The HSP will meet the requirements of good engineering practice, national laws and regulations and the EHSG; 4. Before construction commences TPL/s will conduct training for all workers on environmental safety and environmental hygiene. The TPL will instruct workers in health and safety matters as required by the HSP, good engineering practice and national regulations; 5. The TPL will designate one full-time staff as EHSO to implement the HSP; 6. The TPL will engage an approved service provider to deliver a program of communicable diseases (including HIV/AIDS/STI) awareness and prevention training to workers and the community; 7. Conduct regular meetings to maintain awareness levels of health and safety issues and requirements; 8. Ensure that first aid kits and facilities, including access to trained medical personnel, is available on site and arrangements in place to ensure medical attention (including evacuation as necessary) of workers who have suffered an accident or sudden illness; 9. Ensure adequate spill response kits are provided, accessible and that designated key staff are trained in their use; 10. Workers will be trained in use of any special equipment or machinery. Workers will be instructed in use of safety equipment (harness etc) for working at heights or on scaffolding; 11. Observe working hours and official holidays as set out in national law and regulations;				

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		12. Excavated trenches must be effectively marked with approved safety signage and/or barrier tape to prevent any accidents; 13. Workers, at no cost to themselves, shall be provided (before they start work) with appropriate PPE suitable for the tasks and activities they will undertake. PPE will include safety boots, helmets, gloves, protective clothes, goggles, and ear protection. Instructions on their use around the construction site will be delivered as part of the safety procedures; 14. Provision of potable water supply and sanitary toilet and ablution facilities at the site; 15. Child and/or trafficked labor will be strictly prohibited for any activities associated with the project; and 16. All measures related to workers' safety and health protection will be free of charge to workers. The HSP, also covering include community health and safety, is to be submitted by TPL before construction commences and approved by PMU-ESU.				
Construction activities, equipment operation	Health and safety risks for communities	1. Application of COEP 6, EHSG and CEMP 's HSP; 2. The TPL's HSP will address community impacts and management measures in addition to worker health and safety. The HSP will meet the requirements of good engineering practice, national law and regulations and comply with the EHSG; 3. The HSP will include agreement on consultation requirements, establishment and monitoring of acceptable practices to protect community safety, links to the complaints management system for duration of the works (in accordance with the GRM) and system for reporting of accidents and incidents; 4. TPL will coordinate directly with the grievance focal point(s) (GFP) appointed for the project; 5. Before construction commences TPL/s will conduct training for all workers on	TPL, PMU	1-16 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; HSP and training plan; Designation of EHS staff; Designation of CLO; Designation of GFPs and implementation of GRM; Delivery of communicable diseases awareness and prevention program for Covid-19 and records of training sessions	TPL, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		environmental safety, health and hygiene including delivery of the HIV/AIDS/STIs awareness and prevention training and the code of conduct; 6. TPL will enforce preventative measures to stop the spread of Covid-19 as required by government 7. The TPL, following the requirements of the project's CCP, will inform the community of the works (likely impacts and control and mitigation measures), including the timeframe through information brochures and/or community meetings; 8. Tongan minimum wage requirements to be observed, if local staff are Employed. There will be proper enforcement of the labor laws at the work place; 9. Child and/or trafficked labor will be strictly prohibited for any activities associated with the project; 10. Children will be prohibited from entering the sites (including worker's accommodation, works area/construction zone) and prohibited from playing on any equipment or machinery; 11. All advisory and warning signage will be clear, secured on fences, gates and signboards and be posted in Tongan, the language of the main nationality of workers and repeated in English; 12. The TPL will implement the traffic management plan which will include traffic control and pedestrian safety measures; and 13. TPL will post warning signs at site to prevent public access during construction.				
Influx of labor and workers at site(s)	Conflict with local people, stress of local resources	1. Implementation of the project's CCP; 2. TPL to recruit CLO from local community; 3. Ensure that community and stakeholders are aware of the GRM and how to access the GRM; 4. PMU- to facilitate agreement of protocols--code of social conduct--between TPL and community leaders. The protocols will govern workers' conduct while in communities, implementation of awareness	TPL, PMU	1-10 daily and weekly; Overall CEMP implementation monitoring - monthly	CEMP ; CCP and code of conduct; Designation of CLO; Designation of GFPs and implementation of GRM; Contract with approved service provider;	TPL, PMU

Project activity	Potential impact	Management and Mitigation		Monitoring		
		Proposed measures	Institutional responsibility	Frequency/ interval	Verification means	Institutional responsibility
		programs, implementation of the GRM and handling of complaints, and implementation of the HSP; 5. TPL will erect notice boards and distribute information pamphlets regarding schedule of construction and activities causing disruptions or access restrictions; 6. All notice boards/signage to be in English and Tongan; 7. For unskilled activities, every effort to hire local people (including women) as priority: 8. Accidental damage to utilities will be minimized by (i) obtaining plans from public utilities identifying locations of pipelines, conduits and power cables and (ii) consultation with staff on the location of utilities prior to commencing excavation operations.			Records of training and awareness sessions	
Operation phase						
Operation of grids including maintenance and repair	Waste, dust, potential for oil or fuel spill	1. TPL implement similar mitigation measures to those of construction stage; 2. Application of COEPs 11-15 and 19, 20; 3. Poles to be planted at recommended depth (1.5 – 2m) to increase stability	TPL,	As required	Operations plan; O&M works plan; Grievance register	TPL, PMU
	Soil stability	1. Poles to be planted at recommended depth (1.5 – 2m) to increase stability 2. Implementation of COEP				
	Health and safety	1. Implementation of COEP				
Decommissioning						
Dismantling of cables, poles, transformers and switchgears	Pollution from improper disposal.	1. Contract agreements with transformer and switchgear suppliers for dismantling and disposal after use. 2. Application of COEPs 19 and 20.	TPL,	As required – end of life	As per COEP	TPL, PMU
KEY: BCD = bid and contract documents; BOQ = bill of quantities; CCP = communications and consultation plan; CEMP = construction EMP ; CLO = community liaison officer; DOE = Department of Environment; EA = executing agency; EHS = environmental, health and safety; GFP = grievance focal point; GRM = grievance redress mechanism; HSP = health and safety plan; IA = implementing agencies; PMU = project management unit; SC = supervision consultant						

9 Conclusions and Recommendations

9.1 Conclusions

371. This IEE has been prepared for the project to be undertaken in Area 5 and has considered the impacts of design/pre-construction, construction and operation of network upgrading. The IEE envisages that many of the potential adverse social and environmental impacts will be prevented and/or mitigated adequately, and the positive impacts strengthened in the result of implementation of mitigation and enhancement measures identified in the EMP.

372. Consultations with communities in the project area indicate that the positive socio-economic and environmental effects of the project outweigh any environmental and social risks associated with its implementation. Communities are in support of this project and anticipate the benefits from improved network connections and possible reduction in their power bills.

373. Overall, the proposed project is unlikely to cause significant adverse environmental or social safeguards impact. This is due to the following findings:

- Project specific surveys have been conducted and concluded that with identified mitigation, risks and impacts can be adequately compensated;
- A dedicated record and site survey concluded that there are no sites of cultural or heritage significance within the area of influence of the project. Most natural habitats have been modified and are subject for further reclamation and development;
- Typical construction impacts due to the operation of construction plant, processing areas, etc., and operation impacts can be readily mitigated by good site practise giving rise to negligible or at worst, minor temporary environmental impacts.

374. An ESMP matrix has been prepared for the project. The ESMP matrix includes (i) the various considerations, plans and measures to be developed as part of the CEMP ; (ii) mitigation measures for potential environmental impacts during implementation, (iii) environmental monitoring program, and (iv) the responsible entities for mitigation, monitoring, and reporting.

375. Mitigation will be assured by a program of environmental monitoring to be conducted during the construction stages. The environmental monitoring program will ensure that all mitigation measures proposed in the ESMP framework are developed and implemented and will determine whether the environment is protected as intended. Any requirements for remedial action will be reported to the ADB.

376. Project stakeholders were consulted during preparation of the IEE and invited to express any environmental and social concerns they had regarding the project. No significant environmental and social concerns were raised, and all stakeholders consulted, strongly support the project. The draft and updated IEE will be made available at public locations and will be disclosed to a wider audience via the ADB website.

377. The consultation process will be continued during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation

378. From the analysis in this report, environmental and social benefits of the project objectives far outweigh the minor and temporary inconveniences that will arise during project preparation and implementation. Provided the EMP is properly updated and implemented, there will be no irreversible impacts arising from the project. This IEE including EMP are considered sufficient in addressing possible social, environmental, health and cultural impacts.

9.2 Recommendations

379. TPL and PMU works closely with ADB and relevant government authorities (EIA Unit, MEIDECC, DOF, MAFFF) throughout the pre-construction and consultation phases to establish understanding of project impacts and roles in managing issues that may arise throughout project construction and implementation.

380. TPL and PMU continues to follow up with the relevant government authorities (DOF, MAFFF, EIA Unit, MEIDECC) to ascertain the significant concerns around the arsenic poisoning and results of the soil test to fully comprehend the environmental and health risks and impacts of continuing operations of ATFP. Alternative sources for power poles may be considered should the arsenic impacts be considered detrimental to the health and safety of the workers as well as the impacts on soil and plants growing within a 100m radius of the timber processing site.

381. The PMU will recruit a full-time environment officer. A terms of reference has been prepared an id included in the project administration manual.

382. TPL develops and implements (including setting aside $3,500 budget as line item) a mangrove replanting plan in coordination and consultation with DOE, DOF, MAFFF ad communities.

383. The PMU adequately communicates the EMP and GRM to TPL to ensure that all impacts and prescribed mitigation measures are adhered to throughout all phases of the project.

384. Any unforeseen circumstances that arise and potentially impede the effective implementation of the project will be promptly communicated to ADB and relevant government authorities by the PMU.

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- 2022 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW Washington DC 20433 Telephone: 202-473-1000 Internet: www.worldbank.org

Appendices

Appendix 1- International Treaties, Conventions and Agreements

Tonga has ratified or signed the following international protocols and treaties:

Treaty, Convention, Agreement	Year came into force
ILO – Forced Labor Convention	1930
ILO – Freedom of Association and Protection of the Right to Organize	1948
ILO - Right to Organize and Collective Bargaining Convention	1949
ILO - Equal Remuneration Convention	1951
ILO - Abolition of Forced Labor Convention	1957
ILO - Discrimination (Employment and Occupation) Convention	1958
Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES)	1967
Convention Concerning the Protection of World Cultural and Natural Heritage	1972
ILO - Minimum Age Convention	1973
Apia Convention – Convention on Conservation of Nature in South Pacific	1976
South Pacific Fisheries Forum Agency Convention	1979
UN Convention on Law of the Sea (UNCLOS)	1982
UN Convention on Biological Diversity (UNCBD)	1982
Rarotonga Treaty – South Pacific Nuclear Free Zone Treaty	1985
Vienna Convention for Protection of the Ozone Layer	1985
SPREP Protocol on Prevention of Pollution of South Pacific Region by Dumping-	1986
Noumea Convention - Protection of Natural Resources and Environment of South Pacific	1986
Montreal Protocol on Substances that Deplete the Ozone Layer	1987
Vienna Convention for Protection of the Ozone Layer	1988
Convention for Prohibition of Fishing with Long Driftnets in South Pacific	1990
SPREP Protocol on Cooperation in Combating Pollution Emergencies in South Pacific	1990
UN Framework Convention on Climate Change (UNFCC)	1992
Niue Treaty – Cooperation in Fisheries Surveillance and Law Enforcement in South Pacific	1992
Waigani Convention – Ban on Importation into Forum Island Countries of Hazardous and Radioactive Waste and Control Transboundary Movements of Hazardous Waste within South Pacific Region	1995
UNCLOS Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish	1995
UN Convention to Combat Desertification	1996
ILO - Worst Forms of Child Labor Convention	1999
Convention on Conservation and Management of Highly Migratory Fish Stocks	2000
Cartagena Protocol (to UNCBD) on Biosafety	2001
ILO Protocol to the Occupational Safety and Health Convention 1981	2002
Stockholm Convention on Persistent Organic Pollutants	2004
Kyoto Protocol to UNFCC	2005
International Tropical Timber Agreement	2006

Treaty, Convention, Agreement	Year came into force
International Treaty on Plant Genetic Resources for Food and Agriculture	2006
Doha Amendment to Kyoto Protocol	2012
Convention on Migratory Species	2013
Nagoya Protocol (to UNCBD) on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization	2014
Kigali Amendment to Montreal Protocol - reduce consumption and production of HFCs	2016
Paris Agreement on Climate Change	2016
ILO Violence and Harassment Convention	2019

Appendix 2: list of the codes of environmental practice[47]

COEP 1 – Site Selection and Project design
COEP 2 – Stakeholder Engagement
COEP 3 – Land Acquisition, Resettlement and Compensation for Lost Assets
COEP 4 – Cultural Heritage
COEP 5 – Construction and Decommissioning
COEP 6 – Community Health and Safety
COEP 7 – Traffic Management
COEP 8 – Biodiversity
COEP 9 – Water Quality
COEP 10 – Working in Coastal Marine Areas
COEP 11 – Solid Waste
COEP 12 – Hazardous Substances
COEP 13 – Noise
COEP 14 – Landscape and Visual Impacts
COEP 15 – Battery Disposal
COEP 16 – Shadow Flicker
COEP 17 – Interaction with Aviation Operations
COEP 18 – Electric and Magnetic Fields
COEP 19 – Network Upgrades/Maintenance
COEP 20 – Monitoring and Management

[47] World Bank. 2016. New Renewable Electricity Generation and Electricity Infrastructure in Tonga: Code of Environmental Practice - Managing Environmental and Social Impacts; and Guidelines for Land Acquisition Approvals, Environmental Permits and Building Permits.

Appendix 3 – Provisional contents list for CEMP

Section title	Coverage	Details
INTRODUCTION	Overview and approach	A brief description describing the purpose of the document. This section may include the company environmental policy. Outline of the EMS developed for the Project
ENVIRONMENTAL POLICY	Corperate/company policy etc	The TPL organization policy / principles on environmental protection designed to minimize the negative effects of its activities on the environment and community.
MANAGEMENT RESPONSIBILITIES		Including: Organization chart showing the interactions between the different members of the site team from the Project Manager (or Similar) through the site supervisors / engineers, surveyors and the labor force. The environmental team must report directly to the Project Manager, not through site supervisors / engineers. Job descriptions setting out the role and responsibility of each post in terms of environmental and social safeguards Emergency contact numbers and procedures – including contacts in the local community
PROJECT DESCRIPTION		To confirm TPL understanding of the extent of their environmental and social safeguard responsibilities
Ancillary and associated works and activities	Project Area	Demarcating construction camps, manufacturing areas, works areas, laydowns, spoil disposal sites, etc and sensitive uses including villages, springs and water courses susceptible to impact from the works.
Materials sources etc	Project Details	Must include suitably detailed location plans for construction camps, Site offices (administration) , Manufacturing areas, Material Storage and Laydown Area. The plans must identify elements such as canteens, ablution blocks, drainage layouts, septic tanks, waste management (disposal bins)
TRAINING		Specific training that will be given to site personnel
H&S	PPE	The correct use of PPE
ERP	Spills	How to deal with spills
WMP	Waste management	Including reuse and recycling and waste separation
HSP	Communicable diseases	To be delivered by approved service provider recruited by TPL
HSP	Worker code of conduct	Particularly for expatriate staff on acceptance / understanding of national cultural differences and governing behavior relative to: fraternization; conduct in villages; behavior around women and children; penalties/sanctions on worker alcohol and/or drug use
RELEVANT LEGISLATION		Extracted from relevant sections of EIA
ENVIRONMENTAL MANAGEMENT PLANS		The specific plans for environmental management that have been identified in the EMP of the EIA
ENVIRONMENTAL MONITORING & REPORTING	Monitoring approach and methodology Site audits and checklists	Elaborated from ESMP: Listing the environmental and social safeguards reports that TPL will be producing during the project. EIA identifies monthly and quarterly reports Identifying environmental monitoring that will be carried out Identifying the site and activity specific forms TPL will use to confirm compliance with environmental requirements
COMMUNICATIONS	Public consultation schedule, notices,	Elaborated from CCP: How TPL will set up and manage a formal set of meetings with the community and any ad hoc meetings

	Disclosure and notices	To comply with the projects consultation and participation plan
Grievance redress mechanism	Process, CLO/GFP, register	Elaborated from GRM: How complaints will be dealt with at site level identifying who is responsible and how a complaint is escalated through the stakeholders (preferably with a flow chart). Complaints hotline Community notice board with contacts

Note that this table is presented for guidance only. It is TPL's responsibility to produce a CEMP based on their approach, program and site activities (working methods) that will achieve the necessary compliance with environmental obligations in the contract. The PMU, supported by the supervision consultant and ADB will review and approved the CEMP prior to any construction activities, including investigations and site clearance, taking place.

Appendix 4: Community Consultations

Summary of Community Consultations

The community consultations were conducted in five villages, Sia'atoutai, Hofoa, Sopu, Halaovave and Tu'atakilangi. The consultation sessions followed the same structure, normally opened by a prayer by the village town officer or appointed village leader. This was then followed by welcoming remarks and purpose of the consultations were explained to the participants to seek their assistance in providing information for the upgrade of the electrification network in their area. The project manager for NNUP from TPL then proceeds with a verbal presentation of the project activities funded by ADB and the benefits that will arise from the project pertaining to energy access and security for the village. The project manager then explains the need for information from the villagers that will help the consultants working on the environmental, social and gender safeguards to mitigate against potential social and environmental impacts that may arise throughout the construction and operational phases of the project.

The Tongan version of questionnaires were distributed to all participants and they were given a brief explanation of what the questions are about. Participants were then given time to complete the questionnaires and encouraged to ask questions about any issues or concerns they want clarified by TPL and the environmental and social safeguards consultants. All questions, discussions and questionnaire responses were recorded by the ADB safeguards consultant team.

Following the satisfactory responses to all issues raised, Tonga Power Ltd advised the next steps and consultations that will be undertaken again prior to construction works expected in the 4th quarter of 2022. Vote of thanks was extended to all participants and the consultation meetings were closed with a prayer. Photographs and participant lists were recorded for verification purposes.

Sia'atoutai community consultation - 17 Nov 2021				
Number of Participants			**Main concerns raised**	**Response to concerns**
Male	**Female**	**Total**		
27	13	40	Compensation from electrical goods damaged due to unplanned power outages and surge in power supply Support from the project for new household connections	TPL has yet to conduct a survey to ascertain damage of electrical appliances due to power outages. TPL is able to offer free connections for new buildings under the project.
			Process for new power connections	The process will be provided to new customers but this needs to be approved by the electricity commission/ board as per process. TPL will then install meter but customers need to hire an electrical TPL to connect the meter to their house.
			TPL to advise power outages in advance in order to prepare their households	TPL will inform customers if there will be any power outages in their area dues to scheduled maintenance works

Hofoa Community Consultation (23 Nov 2021)				
Number of Participants			**Main Concerns raised**	**Response to concerns**
Male	**Female**	**Total**		
7	12	19	Dual connection for 2 properties in one land compound connected through one meter.	New meter connections cost $100 and can be installed as part of the project. Options for separate meters is possible for two-storey houses. Application forms will be provided to the town officer for the community.
			What will happen to properties that have already been fenced? Will new connections and underground cable installation damage the fence?	The excavation works will only be 2 ft deep and will not affect the fence footing. If the concrete needs to be cut through, TPL and TPL will repair it back to its original form. If the property has concrete all around, the overheard cables will be retained and no further excavation works will be carried out
			Does the $100 cover costs for installation? For question 1 will the extra payment of $5 or $20 guarantee a decrease in power outages?	No those responses are not applicable to Tonga and TPL is not able to guarantee this.
			Is there a specific area in your property for the excavation works?	The preferred excavation and installation of underground cables is closest to the meter and power pole. Extra care will be taken to dig around trees or other structures that are of value to them. This also includes water pipes, telephone lines and sewerage tanks etc. You are advised to please communicate this to TPL prior to construction phase. Please note, the excavation works will be undertaken by TPL and it is the responsibility of the land or home owner to communicate to TPL their preferences for looking after their assets and they will then advise TPL
			What is the difference between the role of TPL and electrical TPL? Please distinguish and clarify the role of TPL and the electrical TPL	TPL only installs the wiring and connection from the power pole to the meter. The connection from the meter to the house is the responsibility of electrician companies.
			In my neighborhood, some of the powerlines are extended through our property to neighboring houses because there are no roads. How can you address this?	As part of this project, the Lands and Survey will conduct assessments to demarcate your land boundaries and will determine new roads. At present, MLNR has sub-divided land in the village and roads have also been mapped out but have yet to be constructed. Hence, once this project is underway, all lines will be contained within people's land boundaries.

			Is it alright to install a meter in a property in which the house has not been built?	Yes but the condition is that the house needs to be completed within 6months. Communication through the town officer is essential for the installation to take place
			When will the construction works begin?	The current works for Area 3 will be completed by June 2022 and this area 5 will commence after that, hopefully Q4 2022 or Q1 2023.

Sopu community consultation - 30 Nov 2021				
Number of Participants			**Main concerns raised**	**Response to concerns**
Male	**Female**	**Total**		
10	**5**	**15**	Approximate time for this operation to be conducted.	The project is currently ongoing along the areas of Ma'ufanga, Fasi, etc. Depending on the consultants reports for consultation and approval from ADB, we are hoping to procure equipment by June 2022to commence the work here.
			Current state of electricity within our zones. Been having an electricity pole since 98. What would the project do?	We offer to connect your electricity free, renew the lines/old poles and majority of all household will be re-connected to an electricity pole situated in front of your land's margin along the main/sub roads as per surveyed and approved by MLNR. There will be no more intersecting of lines between homes, since each will be connected to an electricity pole. Unless there is a house behind, or far which there is no road for the poles to be placed.
			Land Areas yet without buildings. Dual meters process	Must ensure that a building will be constructed within 6 months when the projects starts at your zones. must fill in forms if two buildings requests two meters installed in one piece of land
			Sopu is very low lying, and we are worried about the safety of the underground installation of electric cables and wires. How safe is the underground cable?	Every other village has the same concern towards the underground cables and installation processes, but we are definite that this wiring has been approved to be electrically safe, not only that but it has other controlling equipment on each pole which can safeguard the wires underground. -we also put pipes on wires as per requested or when the soil type is more rocky. Would be best if you indicate a wire path when your wires are laid underground so you and others take note in case of other constructional purposes and for your safety.
			Concrete grounds concerns	Concrete grounds will not be destroyed and if part of it is removed, it will be replaced or fixed. -with gates, we will dig underneath, 2 feet -same thing applies to sidewalks, footpaths etc. -last option, is to connect wires above the ground if we are not able to install under-ground wires.

			Cutting of trees concerns	Overall, it will totally depend on the each household's survey, whatever is possible and not risky, that will be done. What is best for you, us and the environment will be done. Of course we would not want to destroy your gardens and trees that you've been planting all your lives. Communication matters, and that's why we are here tonight. NOTE that we will seek your permission prior to undertaking works on your property. However, it is important that you contact us directly as TPL will act on the direction from us.
			Dual meters process	-forms needs to be filled by both households -those that already have electricity, just inform us, you do not need to fill a form -Only new customers' needs to go through the usual processes. i.e hiring contractors, paying bonds to Electricity commissions, from there, we can install meters for electricity connections to your house. -Note that bond $100 are to be paid, to cover bills should you leave the country.
			Low lying house, wires are near the ground when connected to the house.	Current network are experiencing shortages in wires and proper equipment, however, if you experience such problem please call us on 944.
			New residential Land Areas yet without buildings.	First fill up forms and contact us to see what plan/electricity package you want for your house if its short term usage of electricity, you have to contact contractors namely Palu at Sunia aka veka Road, Siale, and Aisea Fisilau, either one of them and then from them to the electricity commission for approval and bond paying and then will connect it for you.
			Filling of forms at Electricity commission requires maps and landlords approval. It slows our needs for electricity since the landlord is not here, and the MLNR processes takes ages. (years)	These are usual requirements, and were made because of several cases before like, one can stay and has their own electricity at a land area, and has left without paying bills. Aagain, communication is important, or just have your maps ready by the time the project starts here. You have time to complete all that so you can take part in this offer.
			What do you do with the old electricity poles.	We gathered the old electricity poles and we are selling them for an

				amount below $50 or $100. You can buy one, and sign a contract of 5 years of owning it.
			5 years electricity poles contract	Before connecting your own line, you must sign a 5 year contract, you will own these assets you bought for 5 years, but then after that, even though you connected the line yourself, the maintenance expected due to natural disasters will be covered by the project.
			Intersecting of lines within houses	Under this project, all lines will be connected within the main/sub roads only, there will be no intersecting, unless there is a home that does not have a pathway/road, then there also be a contract sign by the main electricity host agreeing to allocating space for the neighbour to have a meter located at their compound.
			Concrete grounds in property	All properties damaged during this project will be fixed. These includes gates, ground cement, water pipes etc. If the underground installation process is not feasible for your property, we will connect the line with the overhead wires.

Halaovave community consultation - 01 Dec 2021				
Number of Participants			**Main concerns raised**	**Response to concerns**
Male	**Female**	**Total**		
3	**10**	**13**	The probable cause of fire through electricity.	Most of the previous destructive house fire here in Tonga were being suspected by the Tonga Police Fire Department to have been electrically caused. That is why we call on people to leave all electrical work especially installation of electricity to their houses to the experts. There are many licensed contractors namely Siale Hola here in Hala'ovave, Pau and 'Aisea Fisilau, they and other electrical contractors are qualified to install electricity. They are trustworthy of installing electricity safe for your household. In addition to that, most electrical fires are caused by faulty electrical outlets and old, outdated appliances.
			Plans for the underground installation of electricity if grounds are plastered with cement.	the whole process will depend on the pole's position however, homes with gates and concrete grounds will be surveyed carefully to avoid damaging any structure. If possible to be installed underground, we would do, and if not, it will be lead directly above from the pole. This applies to the sidewalk, if damaged by our workers, we will fix the damages
			What unit of our electricity meters that the Government usually pays for?	The Government usually pays for the first 100 unit of our electricity bill, but only due to emergencies and unexpected circumstances such as tropical cyclones, tsunamis, the Covid-19 pandemic etc.

Tu'atakilangi community consultation - 02 Dec 2021				
Number of Participants			**Main concerns raised**	**Response to concerns**
Male	**Female**	**Total**		
6	9	15	Should the village wait for this project to connect their electricity if they are currently not connected to the power grid?	You can connect to electricity any time you need. You don't have to wait for the project and the connection process does not take too long.
			Concerns around safety of underground cables	The cables are completely safe and have been designed to be water resistant and have a safety feature that automatically switches off if there is a breach in safety conditions
			What is the depth of installation of the underground cables?	2 ft deep and once installed, an orange warning tape is laid over it to notify landowners incase they undertake further development works on their land.
			What about properties with 2 different meters?	Two poles may be installed to connect to those meters.
			What is the process for installing 3-phase meters?	There is a form to fill in to get those 3-phase meters.
			What if my neighbour does not want to cut down trees in their property that may be a threat to the electricity lines?	The law is 1 meter clearance from the home boundary. You can submit a complaint to us so we can assess the issue accordingly.
			I have sandalwood trees on my property growing close to power lines. I want them trimmed but not destroyed.	We can arrange that with TPL to only trim but not cut the tree down. However, you must communicate this with us so we can inform TPL.
			Some of the street lights in our area have been removed by TPL. This poses safety issues for our women and children. When can these be replaced?	The street lights were removed as they had old parts that could not be replaced. Most street lights are being replaced by LED lights. In addition, the distribution of street lights is determined by the Ministry of Finance. The process is that they approve which areas to install the street lights and they contact us to install them.
			When will our electricity tariff be reduced?	Hopefully, soon with the many projects being implemented.

Sia'atoutai Community Consultation

Hofoa Community Consultation

Sopu Consultations

Halaovave Consultations

Tu'atakilangi Community Consultations

List of Participants

TONGA POWER LIMITED

Nuku'alofa Network
Upgrade Project
Villages Pre-awareness Meeting
Siatoutai
Tuesday 16th November 2021

Attendance Record

	Name	~~Village~~ CONTACT	Male/ Female	Signature
1	Kaione Lousioli	7784542	M	
2	Mele Lava Finau	7714570	F.	Mele. Finau.
3	SINIVA PUATISI	7202960	F	Puafisi.
4	Selu Ngauamo.	7202064	F	
5	Tule Lokotui	7736314	F	Tlokotui
6	Akoiita Paongo.	77-51652.	F.	
7	Pepe Huihui	77-30620	F	
8	Meleana Teifi.	7722886	F	Teifi.
9	Lisiate Nuku	7752648	M	
10	Fgnueli Mahe	8414082	M	Mahe.
11	Lolualofi Finlayalu	7789644	M	Finlayalu
12	Apolosi. Fohofoua	843-8876	M	
13	Lopeti Taunga	7711109	M	Taunga
14	Setaleki Mafi	7709658	Male	Mafi.
15	Litani Tupou	7735922	M	
16	Pilimilose Liavaa	7746611	M	
17	Ehasi Tauga	871-4656	M	
18	Lopini Tupou	881-1596	M	
19	Tivonale M. Fenua	8464776	M	
20	M. SOAKIMI.	7708751	M	
21	Siosaia. Kofe. Makoni	7709890	M	
22	Viliami K. Malia.		M	Malia.
23	Sione Main	8421824	M	
24	UESILI TOKOMATATA	7725600	M	Tokomatata
25	Popilio Aholelei	6626517	M	
26	Sione Kafe	7753001	M	
27	SALESI T. PAONGO	8780263	M	
28	Finau Nekesi	77-11505	M	

	Name	~~Village~~ CONTACT.	Male/ Female	Signature
28	Kemueli John	7200270	M	
29	Simione 'Ofamoli	7726887	M	
30	Kolopi Tui Fifita	7743211	M	
31	Sitaleki Fangalahi	7778402	M	
32	Uwiri Lee		M	
33	Kelepi Tuinauvai	7721139	M	
34	Daviona Tuinukuafe		M	
35	NUKU TUINUKUAFE	7730394	M	
36	Telusila Fifita	7758482	FM.	
37	LESIELI H. NIU.	7717001	F.	
38	Mele Ncm	77-03328	FM	
39	MELEANE AHOFI	77 03855	F	
40	Melenaati Sifa Fakakava	8785680	M	
41	Ebenezer Mau	8123824		
42				

TONGA POWER LIMITED

Nuku'alofa Network

Upgrade Project

Villages Pre-awareness Meeting

Hofoa

Tuesday 23rd November 2021

Attendance Record

	Name	Contact	Male/ Female	Signature
1	Dorothy Foliaki	7748628	Female	
2	Mele Toyofaga	8722003	Female	
3	Anitita Niu	8404389	Female	
4	Sine Mary	8721744	Female	
5	Sin. Tei	8746423	Female	
6	Mele 'Akaila	8787683	Female	
7	Hepi Kanongataa	8402902	Female	
8	Mele Naia Niu	842935	Female	
9	Vaimoana Kau	7724038	Female	
10	JACINTA KOTO	7743031	FEMALE	
11	Kalo Tupou	21-144	M/F	
12	Nglongalu Tonga	8452251	Female	
13	Taniela Halasima	7708209	M	
14	Kitaleong Tuita	7774137	Male	
15	Grace Fonua	2521-256	Female	
16	Ilami Tei	7747001	M	
17	Sevita Mafi	8420410	M	
18	Amelia Uele		Female	
19	Aleki Kanongataa		Male	
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21				
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TONGA POWER LIMITED

Nuku'alofa Network
Upgrade Project
Villages Pre-awareness Meeting
Sopu
Tuesday 30th November 2021

Attendance Record

	Name	Contact	Male/ Female	Signature
1				
2	Petina, Heta	—	F	
3	Anna Seini Ika	7769 866	F	
4	Malonia Otukolo	887-9550	F	
5	Losipeli Funaki	7790115	M	
6	Mateaki Hoko	845-9483	M	
7	Isileli Matangi	871-5067	M	
8	Sekope Halatokalafiki	77-41430	M	
9	Akesa Lomuli	77-37267	F	
10	Sione Misa	871 9909	M	
11	Liliani Makasini	77-30555	F	
12	Samiu Motuliki	7715819	M	
13	Semisela Pohiva	7712346	M	
14	Folaniola Peta	7777280	M	
15	Lopeti Lomu	7761156	M	
16	Aliyuleti Isiloko	845 2204	M	
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19				
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TONGA POWER LIMITED

Nuku'alofa Network

Upgrade Project

Villages Pre-awareness Meeting

Halavave

Tuesday 1st December 2021

Attendance Record

	Name	Contact	Male/ Female	Signature
1	Dorothy Foliaki	7748628	Female	
2	Eniketi Pulu	8633874	Female	
3	Macini Longo	7756666	Female	
4	Meleseni Nonu	7783308	n	
5	Lesieli Pulu	7700477	Female	
6	Mele Pulu	25-335	Female	
7	'Aivi Fakahua	7708573	Female	
8	Melenaite Tuipotolola	7758103	Female	
9	Imisi Helg	24-0025	F.	
10	Siale A. Hufavi	77 15766	Male	
11	Amelia	~~7400~~ 7767711	Female	
12	Losipeli Fuiaki	7790115	M	
13	Liuaki Maile.	7720553	M	
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TONGA POWER LIMITED

Nuku'alofa Network

Upgrade Project

Villages Pre-awareness Meeting

Tuatakilangi

Tuesday 2nd December 2021

Attendance Record

	Name	Contact	Male/ Female	Signature
1	Mele Tuitupou	24994.	F.	
2	OFA FANUATICO	7724326	F	
3	Heneli Pulaiku	7742572	M	
4	Lopeti Funaki	7790715	M	
5	Linaki Maile	7720155	M	
6	TOFA. SOAKIMI	7708251	M	
7	FOKI KATA MATANA	7784923	F	
8	Talita Lō	8785767	F	
9	Fēfa'aki Puleanga	8414244	F	
10	Dolofi Foliaki	7748628	F	
11	Keletia Lavaki	7711915	F	
12	Evalesi Hala	8788860	F	
13	SAMUELA LATU	8428146	M	
14	Eseni Ngalupafa	7717855	M	
15	Caroline Main	77-28271	F	
16				
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20				