TUVALU COASTAL ADAPTATION PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

NANUMAGA AND NANUMEA

Prepared by: *FCG ANZDEC Ltd*

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TUVALU COASTAL ADAPTATION PROJECT
TCAP

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1	3 July 2020	Initial Draft for Review	Kate Walker/Environmental Specialist Patrina Dumaru/Social Specialist
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Acronyms and Abbreviations

ADB	Asian Development Bank
AOI	Area of Impact
BTB	Berm Top Barrier
CCA	Community Conservation Areas
CBD	Convention on Biological Diversity
C-ESMP	Contractors Environmental and Social Management Plan
CFC	Community Fishery Committee
CMS	Convention of Migratory Species
DoE	Department of Environment
DPO	Disabled Persons Organisation
EDSCP	Erosion, Drainage, Sedimentation and Control Plan
EISA	Environmental and Social Impact Assessment
EKT	Ekalesia Kelisiano Tuvalu
EPA	Environmental Protection Act
ESI	Environmental and Social Indicator
ESP	Environmental and Social Policy
GAD	Gender Affairs Department
GBV	Gender Based Violence
GCF	Green Climate Fund
GoT	Government of Tuvalu
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
ICH	Integral Cultural Heritage
IUCN	International Union for Conservation of Nature
LCC	Live coral cover
LDC	Least Developed Country
LMMA	Locally Managed Marine Area
MHARD	Ministry of Home Affairs and Rural Development
MFAT	Ministry of Foreign Trade and Affairs
MICRO	Maritime Investment for Climate Resilient Operations
MSL	Mean Sea Level
NBSAP	National Biodiversity Strategies and Action Plan
NCD	Non-Communicable Diseases
NEMS	National Environmental Management Strategy
NGO	Non-Governmental Organisation
NIWO	Nanumaga Island Women Organisation
OIMIP	Outer Island Maritime Investment Project
PEAR	Preliminary Environmental Assessment Report
PM	Project Manager
PMU	Project Management Unit
PWD	Public Works Department
SECP	Stakeholder Engagement and Consultation Plan
SES	Social and Environmental Standards

SPC	Pacific Community
TC	Tropical Cyclone
TCAP	Tuvalu Coastal Adaptation Project
TCS	Tuvalu Cooperative Society
TEC	Tuvalu Electric Corporation
TPS	Tuvalu Police Service
TWG	Technical Working Group
UNDP	United Nations Development Program
USP	University of South Pacific
UXO	Unexploded Ordinance
WB	World Bank
WMD	Waste Management Department
YCA	Yellow Crazy Ant

1 EXECUTIVE SUMMARY

1.1 Introduction

The Government of Tuvalu has requested assistance from the Green Climate Fund (GCF) to create a Tuvalu Coastal Adaptation Project (TCAP) with the overall objective to reduce the vulnerability of three islands in Tuvalu to the impacts of climate change, namely Nanumaga, Nanumea and Funafuti. The project involves the construction of hard and soft coastal protection infrastructure at these three locations to reduce inundation as well as reduce coastal erosion.

The proposed works at Nanumaga and Nanumea were screened during initial GCF project appraisal and have been classified as 'moderate risk' according to the UNDP Social and Environmental Standards. Moderate risk projects are those that include activities with potential adverse social and environmental risks and impact, that are limited in scale, can be identified with a reasonable degree of certainty, and can be addressed through application of standard best practice, mitigation measures and stakeholder engagement during project implementation.

The overall aim of this report is to provide an Environmental and Social Impact Assessment for all project elements including ancillary sites and activities for the works. It provides a description of the baseline conditions and it details the predicted qualitative and quantitative impacts from the project activities. It also provides the set of mitigations, monitoring, and institutional measures to be taken during the implementation of TCAP.

1.2 Project Summary

On Nanumaga, build berm top barriers (BTB) will be placed on the crest of the main natural storm berm that runs parallel to the foreshore area from the old medical clinic in the north to the end of the village settlement in the south (Figure 5). The footprint of the BTB will meander around obstacles to the greatest extent possible.

The BTB design path has been developed to protect as much of the shoreline infrastructure as possible while maintaining the integrity of the BTB core. As such, the Tuvalu Cooperative Society (TCS) building (structurally damaged during TC Tino) and the proposed site of the new Nanumaga Church will remain outside the protective reach of the BTB given their highly vulnerable location on the seaward side of the existing berm.

Figure 1: Extent of proposed TCAP coastal protection work in Nanumaga

On Nanumea, it is proposed that approximately 1,500m of high value shoreline will be protected under the TCAP design (Figure 9). BTBs are also proposed for use on Nanumea along the crest of the main natural storm berm. For approximately 160m of coastline in front of the church, there are the remnants of existing but crumbling hard coastal protection measures. Following consultation with the Falekaupule, it has been proposed that this area is 're-hardened' to provide protection for the church with a revetment to sit over the existing footprint. A new seawall made from precast concrete interlocking Seabee units is proposed and a minor amount of filling behind the wall will be necessary to reinstate the former shore.

Figure 2: Extent of TCAP coastal protection works on Nanumea

BTBs have been selected as the design solution for the outer islands as they will not interfere with the active shoreline processes which continue to function well on both islands. The BTB will utilise locally available aggregates to both protect and stabilize the landform and to make a more natural appearance which will both allow vegetation to grow and facilitate access across the BTB. The BTB's will sit at approximately 1.5m above ground level and the final width of the completed form will be 10 to 15m.

The purpose of the BTB is to reduce wave over wash and marine flooding of inland areas during storm events. The specific type of BTB technology selected are known as geotextile mega containers, or 'Mega Bags' (Figure 7). The bag will sit in a shallow excavated trench which will be constructed with the intention that the excess water will drain towards the ocean. Once the bags are filled, they are then covered with additional sand, given a final layer of topsoil and planted with stabilizing vegetation from the island. Once established, the BTB will not obstruct foot traffic across the berm or shore and will become visually unobtrusive once vegetation is established.

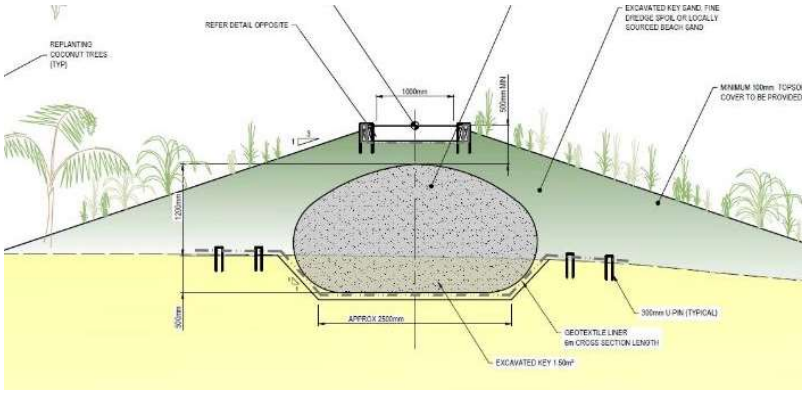

Figure 3: Cross section of geotextile mega bag BTB core

The volumes of sand required for each island have been calculated to be 5,600m^3 for Nanumaga and 15,900m^3 for Nanumea. The sourcing of aggregates on small island nations like Tuvalu is an environmentally sensitive issue. The TCAP engineers and geologists have assessed several alternative options available, these are discussed in Section 4.4. This assessment determined that the existing storm deposits on the islands is the most practical and economical option and also has the lower level of environmental risk compared with the other local extraction options. The assessment has shown that the storm generated sand deposits on both islands are abundant in relation to the needs of this project.

1.3 Environmental and Social Management

The planned works on Nanumaga and Nanumea have the potential to create a variety of impacts through their implementation. These impacts can be either positive (e.g. improved coastal protection for community members) or negative (e.g. loss of trees, landscape changes caused by the BTB's) depending on the activity and receptors involved. The impact of this project on the physical, biological and social environment has been assessed and is described in detail in this report. The key potential project impacts and risks have been identified as:

- Short to medium term depletion of storm sand deposits
- Possible damage to the existing coastal vegetation line
- Solid waste management
- Management of freshwater resources
- Use of heavy machinery on the beach leading increased sedimentation

- Fuel or other hazardous spills
- Loss of mature food bearing or canoe building trees
- Noise and dust disturbance

This ESIA contains the recommended mitigation measures for the Nanumaga and Nanumea investments for pre-construction and construction phases to avoid, reduce or mitigate all identified impacts. The tables (Appendix A) for each phase include details of the mitigation measures required, the cost allocation, responsible entity and the applicable project phase. Monitoring measures are also provided for each project site. A summary of the key protective mitigation measures is provided in the table below.

The Contractor for the TCAP works will be required to produce a Contractors Environmental and Social Management Plan (C-ESMP). The C-ESMP will be the Contractors governing document for the implementation of this ESIA during works. The C-ESMP will be developed, reviewed and approved by the TCAP Project Management Unit and disclosed prior to commencement of civil works.

Impact Area	Key Management Measures
Erosion, Drainage and Sediment Control	• Develop and implement an Erosion, Drainage and Sediment Control Plan for any surface works, sand extraction, embankments and excavation work and storm water pathways. • Sand extraction sites and volumes will be determined by the TCAP coastal experts and engineers and will not exceed volumes discussed in this ESIA without updated analysis. • All relevant approvals to be in place from the island Kaupule for specific volumes of sand to be extracted. • Schedule/stage works to ensure that major vegetation disturbance and earthworks are carried out during period of lower rainfall and windspeeds. • Machinery on the beaches will work within clearly defined and minimal areas. • Strip and stockpile topsoil for use during revegetation. • Ensure that beach is rehabilitated as to not leave an unsafe condition for the public while the beach is naturally recovering.
Noise and Vibration	• Minimise nuisance from noise, especially closer to residential areas and sensitive receptors, through establishment and communication to affected parties of working hours, including night works and avoid increase of noise and number of work equipment at outside of advertised hours. Advertise working hours at the site entrance. • Signage to outline complaints procedure and contact details of recipient of complaints. • Contractor will develop a work schedule or operations with Kaupule to identify hours and days of no work due to religious and cultural activities.
Flora and Fauna	• No permanent gaps will be created in the vegetation line. All trees and plants will be avoided if possible and any which are removed will be replanted or replaced on completion of works. • No trees in the vegetation line outside the direct BTB corridor will be removed or damaged during construction works • Clear boundaries will be set during construction to protect the front of the berm and the vegetation line. Boundaries will be physically marked with temporary construction fencing. • BTB will be covered with stockpiled topsoil and planted with coastal species suited to the environment and already present on the island. The Contractor will work with the Kaupule to create a nursery from species existing on the island in preparation for replanting. • All imported materials, equipment and aggregate will be subject to importation under the quarantine and biosecurity regulations of Tuvalu. • Works will be staged or scheduled to ensure that there is no transferral from project materials or equipment from Nanumea to Nanumaga. Transferral should only occur from Nanumaga to Nanumea to prevent the spread of the kau leafworm to Nanumaga. • Place BTB mega bags in such a way as to minimise disturbance to mature vegetation, particularly canopy trees. Small trees and shrubs shall be removed in preference to large trees.

Community Services and Infrastructure	• Waste management practices will prioritise reduce, reuse, recycle • Preference shall be given to materials that can be used to construct the project that would reduce the direct and indirect waste generated. • Consideration shall be given to the use of recycled aggregates and fly-ash cement mixes for construction of the Seabee wall on Nanumea. • Recyclable waste shall be collected separately and disposed of correctly. • Food wastes will be separated and stored securely to avoid YCA and other wildlife. • All hazardous or contaminated waste will be exported from Tuvalu under the conditions of the Wagnini Treaty and will be coordinated through the WMD • Disposal of waste shall be carried out in accordance with the Government of Tuvalu requirements. For waste which cannot be disposed of in Tuvalu, recycled, reused or composted will be exported and disposed of offshore in a licensed facility. • Disposal of trees shall be undertaken in the accordance with one or more of the following methods: (i) left in place at the request of the owner; (ii) chipped and mulched; or provided to the community for reuse. • Any dangerous goods (including batteries) stored on site shall be stored in accordance with Tuvalu regulations and international best practice • The Contractor will be responsible for repairing any damage to the existing road network caused by construction works. • Contractor will supply all required food for workers to the community to enable community members to be appointed to cook and prepare food for a fee. • Contractor will provide first aid facilities and trained first aiders on Nanumaga and Nanumea for all workers • The timing of the BTB installation and use of the landing may need to be planned such that the area continues to be accessible to the community for facilitating travel and the transportation of cargo in and out of the island.
Hazardous Substance Management	• Prepare spill management plan addressing measures • Store and handle all chemicals, fuels, oils and potentially hazardous materials as specific in relevant standards and guidelines. • Hydrocarbon wastes shall be stored in colour coded and labelled drums placed in secure storage areas on site. • Where possible, fuel and chemical storage and handling shall be undertaken at designated petrol stations on the island, or at the project site on impermeable bunded surfaces (preferable over drip trays). • Onsite storage of fuel and chemicals shall be kept to a minimum. • Emergency clean up kits for oil and chemical spills will be available onsite and in all large vehicles.
Land and Resource Use	• Conduct an inventory of food producing trees that will be cleared for the BTB installation and ensure seedlings are replanted in areas that are accessible to households that rely on cleared trees. • Ensure sand excavation impacts from extraction and transportation of excavators, are minimized or avoid negative impacts on the pulaka pit and food bearing trees.

Social Environment	• Ensure opportunities to incorporate men and women's views and interests into project decisions and implementation are purposefully created and enabled in the stakeholder engagement processes throughout the project life. • Develop and implement and communication plan for the project and in particular the philosophy of the BTB design that is tailored for the Nanumaga and Nanumea communities as well as other stakeholders. • The communities in coordination with their Kaupule will provide the contractor with a list of skilled and unskilled laborers. The Kaupule will also coordinate with the villages to ensure that job opportunities are fairly disseminated. Women are encouraged to participate in the workforce and job opportunities. Persons with disabilities are also encouraged to participate in the workforce and with jobs that are appropriate and significant. • The women of the island will have the opportunity to provide food, beverage and housekeeping services for incoming workers to the islands for 3-4 months. Food services may include lunch and dinner, providing fresh water or coconuts, selling of food items such as local fruits, root crops, vegetables, etc., selling of handicrafts, and laundry services are examples of income generating activities.

2 INTRODUCTION

2.1 Project Background

Tuvalu is the fourth smallest nation in the world. It comprises nine inhabited islands with a population of 10,640 and a total land area of 26km^2. Funafuti atoll, where the nations' capital is located, is home to about half the population. With an average elevation of 1.83m, Tuvalu is one of the most vulnerable countries in the world to the impacts of climate change linked to sea level rise, inundation and extreme weather events. This high level of vulnerability along with the general development challenges are likely to have severe long-term effects on sustainable development of the country.

The Government of Tuvalu (GoT) has requested assistance from the Green Climate Fund (GCF) to create a project which enables them to implement measures that are urgently required to reduce the impact of increasingly intensive wave action on key infrastructure as a result of climate change induced sea-level rise and intensifying storm events. Building coastal resilience is an urgent national priority and the formulation of this 7-year project, the Tuvalu Coastal Adaptation Project (TCAP) has been led at the highest political level by a Technical Working Group (TWG) comprising key government departments and Non-governmental Organisation (NGO) associations representing vulnerable communities.

Implemented by the United Nations Development Programme (UNDP) in partnership with the GoT, TCAPs overall objective is to reduce the vulnerability of three islands in Tuvalu to the impacts of climate change, namely Nanumaga, Nanumea and Funafuti. The project involves the construction of hard and soft coastal protection infrastructure at these three locations to reduce inundation as well as reduce coastal erosion.

The GCF financing, through TCAP, will enable the GoT to address the financial and capacity constraints at all levels – from technical to community awareness – that have so far prevented a sustainable coastal protection solution. It is expected that TCAP will make 35% of high-value vulnerable coastline (2.7km in length) more resilient to the effects of increased wave intensity. TCAP targets areas which have a high concentration of settlements with expected direct benefits to 3,100 people, or 29% of the Tuvalu populations. The project will also strengthen institutional and community capacity for sustaining and replicating project results.

The project has three inter-related outputs that not only aim to achieve impact potential as described in Figure 1 below, but also to enable conditions for scaling up and replicating the project impact beyond the immediate target areas. The outputs lead to longer-terms outcomes which include reduced vulnerability of Tuvalu to future impact of climate change, reduced loss from potential natural disasters, enhanced livelihoods and food and water security. All these outcomes contribute to strengthening climate-resilient sustainable development of the country.

Two Environmental and Social Impact Assessments (ESIA) are now required to support the development of coastal projection on these three islands. The Pacific Community (SPC) has been engaged by the UNDP to conduct the ESIA for these three islands.

2.2 Scope and Objectives

The proposed works at Nanumaga and Nanumea were screened during initial GCF project appraisal and have been classified as 'moderate risk' according to the UNDP Social and Environmental Standards

(SES). Moderate risk projects are those that include activities with potential adverse social and environmental risks and impact, that are limited in scale, can be identified with a reasonable degree of certainty, and can be addressed through application of standard best practice, mitigation measures and stakeholder engagement during project implementation.

To support the implementation of this moderate risk project, this Environmental and Social Impact Assessment has been produced to ensure integration of environmental and social stewardship into the Project as required by Tuvalu's Environmental Protection (Environmental Impact Assessment) Amendment Regulations 2017 and to also fulfill the requirements of the Green Climate Funds project approval process. This ESIA relates to the Nanumaga and Nanumea sites, Funafuti works will be addressed in a separate ESIA.

As the project is an adaptation intervention, positive environmental and social impacts are recognised to reduce vulnerability to climate change and vice versa. This study defines vulnerability as the susceptibility of being harmed when exposed to an external shock or hazard primarily driven by climate change[1]. Therefore, this report assesses the direct and indirect environmental and social impacts of the coastal protection infrastructure in the context of climate vulnerability.

The overall aim of this report is to provide an Environmental and Social Impact Assessment for the hard and soft coastal protected infrastructure proposed for Nanumaga and Nanumea which encompasses all project elements including ancillary sites and activities for the works. As part of that process, this ESIA has undertaken screening of the projects and scoping of the potential impacts, it provides a description of the baseline conditions and it details the predicted qualitative and quantitative impacts from the project activities. It also provides the set of mitigations, monitoring, and institutional measures to be taken during the implementation of TCAP to avoid, offset or reduce adverse environmental and social impacts to within acceptable levels. The ESIA also focuses on safeguard management through project implementation by providing clear instructions, responsibilities and guidelines to Contractor, Engineers and the TCAP Project Team.

The GoT Department of Environment (DoE) have produced a Scoping Form for Nanumaga and Nanumea which has determined the scope of this ESIA under Section 5 of the EIA Screening Template of the Environmental Protection (Environmental Impact Assessment) Amendment Regulations 2017. The form lists the DoE TOR for the TCAP ESIA (Appendix 1) which has been used to guide the contents of the report.

In addition to this, the Green Climate Fund and the UNDP both have environmental and social standards or policies that describes how both entities integrate environmental and social considerations into their decision-making and operations to effectively manage environmental and social risks and impacts and improve outcomes. The ESIA has also been developed in compliance with these standards to ensure that the TCAP works are managed appropriately, especially on matters related to integrating environmental and social considerations into decision-making and operations to effectively manage environmental and social risks and impacts and improve outcomes. The ESIA is guided by human rights, gender equality and environmental sustainability principles as emphasised in the following resources:

- GCF Environment and Social Policy[2]
- UNDP Social and Environmental Standards[3]

[1] Adger, W. N. (2006). Vulnerability. *Global environmental change*, *16*(3), 268-281.
[2] The Green Climate Fund, 2018, *Environment and Social Policy*, GCF
https://www.greenclimate.fund/sites/default/files/document/environment-social-policy.pdf
[3] UNDP, 2014, Social and Environmental Standards.
https://www.undp.org/content/undp/en/home/librarypage/operations1/undp-social-and-environmental-standards.html

2.3 Integration of the ESIA

It is the responsibility of the TCAP Project Management Unit (PMU), to ensure that the requirements of the TCAP ESIA is fully integrated into all project preparation and planning. The ESIA shall form part of any bid documentation for physical works, and it shall be the PMUs responsibility to ensure that the any bid documentation is subject to review against the mitigation measures stipulated in this ESIA to ensure that all appropriate safeguard measures are captured at the bid stage.

It is further the responsibility of the PMU to ensure that the mitigation and monitoring plans within this ESIA are considered in review of any Terms of Reference for Technical Assistance developed for the project. The safeguard requirements for any design or supervision of the project will be fully integrated into the TOR to ensure that all safeguard responsibilities allocated within the ESIA are realized at the tender stage.

In this way, the management measures in this ESIA will be fully integrated within TCAP enabling them to be fully appreciated by all responsible parties and successful implementation will be achieved.

2.4 Disclosure

As part of the requirements of the law in Tuvalu, GCF policy and UNDP SES, the ESIA is to be publicly disclosed and will be the responsibility of the TCAP PMU. The PMU will ensure the ESIA Executive Summary is translated into Tuvaluan prior to disclosure in hard copy and on their website.

3 PROJECT DESCRIPTION

3.1 Site Location and Study Area

This ESIA focuses on the outer island project sites at Nanumaga and Nanumea (Figure 4). The hard and soft coastal protection works will take place along the 'high value' shoreline in front of the villages on both islands.

On both islands, the coastal protection works will take place along the western shoreline, just landward of the coastal vegetation line. The works on Nanumaga and Nanumea will stretch for 800m and 1,500m respectively.

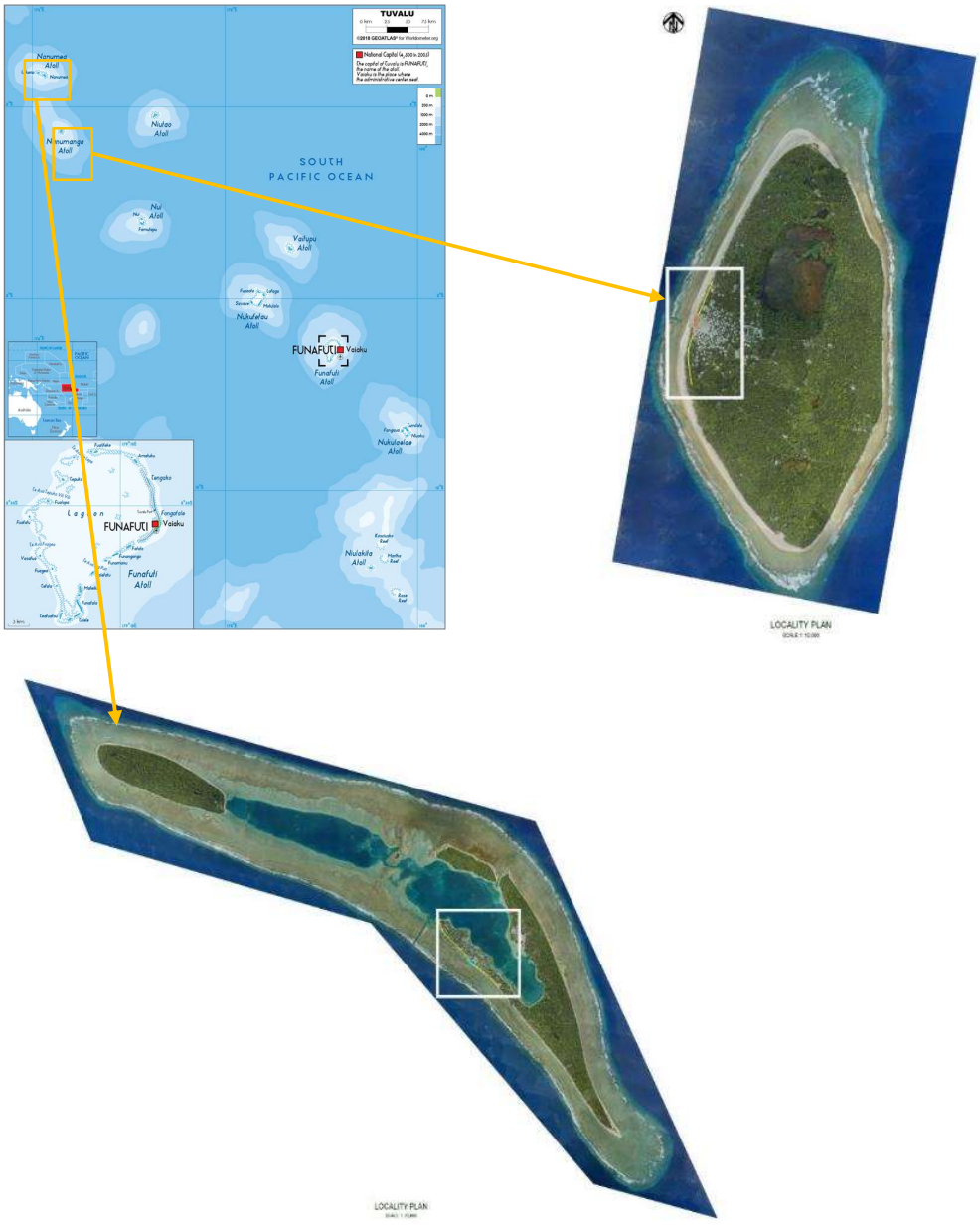

Figure 4: TCAP Project sites bounded by white boxes on Nanumaga (top) and Nanumea (bottom)

3.2 Scope of Works

The scope of works described below are based on the currently available design plans contained in the Draft TCAP Concept Design Report[4].

3.2.1 Nanumaga

On Nanumaga it is proposed that approximately 800m of shoreline will be protected under the TCAP design.

The design intends to build berm top barriers (BTB) on the crest of the main natural storm berm that runs parallel to the existing high-value foreshore area from the old medical clinic in the north to the end of the village settlement in the south (Figure 5). The BTB will follow the crest of the berm top, however, in order to preserve infrastructure, dwellings and important trees, the footprint of the BTB will meander around obstacles to the greatest extent possible. The BTB will be sited to ensure enough distance between the base the of BTB and any residences to avoid impacts on the dwellings and maintained gardens (Figure 6).

It is proposed that the BTB is constructed from locally available materials with a buried core of sand filled geotextile material (Figure 7) and will be planted to allow the feature to add stability and readily blend with the surrounding landscape. The final height will be subject to detailed engineering design, but it is estimated a BTB of 1.5m above the surrounding land will provide an order of magnitude reduction in wave overtopping volumes. Overall, the Nanumaga BTB will be approximately 800m long and have a final overall completed width of 10 to 15m along its length giving an overall footprint of approximately 8,000 to 12,000m^2.

[4] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

Figure 5: Extent of proposed TCAP coastal protection work in Nanumaga

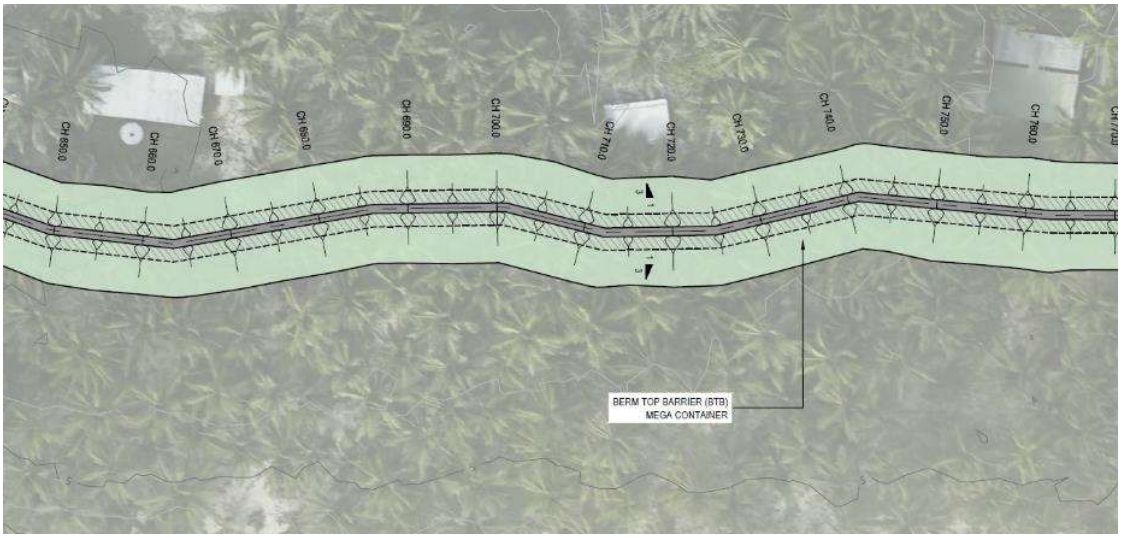

Figure 6: Design path of BTB showing avoidance of properties

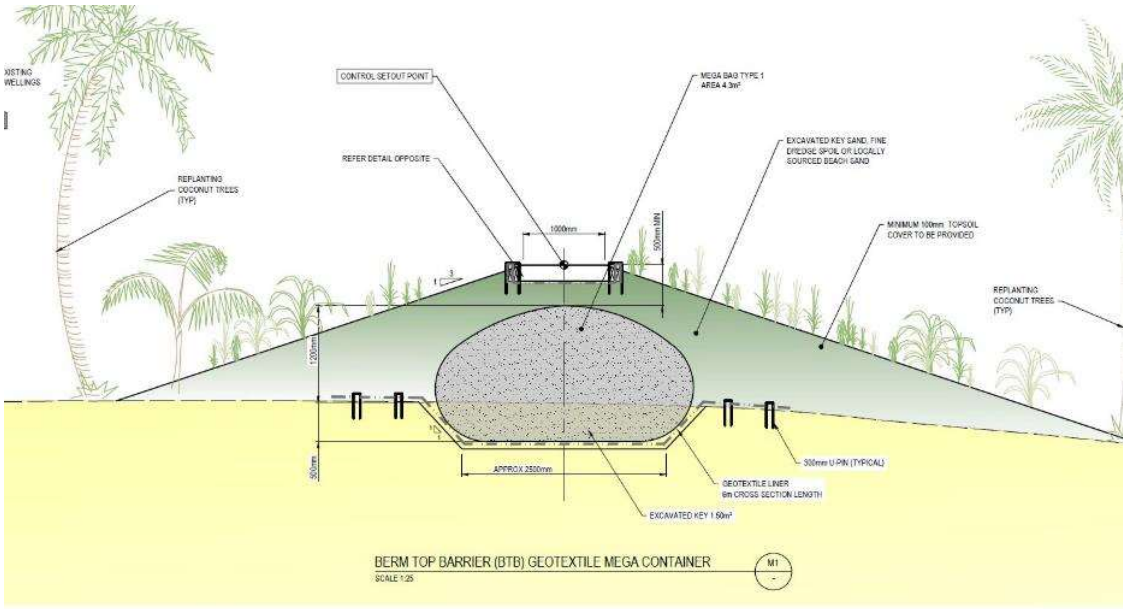

Figure 7: Cross section of geotextile mega bag BTB core

There are buildings within the coastal inundation zone at the village front. There is also a new World Bank (WB) funded harbour design being developed for Nanumaga which may interface with the TCAP works. The BTB design path has been developed to protect as much of the shoreline infrastructure as possible while maintaining the integrity of the BTB core. As such, the Tuvalu TCS building (structurally damaged during TC Tino) and the proposed site of the new Nanumaga Church will remain outside the protective reach of the BTB given their highly vulnerable location on the seaward side of the existing berm. The vulnerability of these sites was highlighted afterTC Pam and TC Tino during which both buildings were inundated. It is not within the scope of TCAP to be able to offer engineering solutions to protect these buildings. Ongoing recommendations from TCAP technical specialists are for these buildings to be relocated further inshore. Figure 8 shows the proposed pathway and extent of the BTB along the developed foreshore.

Figure 8: Extent of TCAP BTB stopping the Nanumaga TCS Supermarket (right) and the church foundations (left)

3.2.2 Nanumea

On Nanumea, it is proposed that approximately 1,500m of high value shoreline will be protected under the TCAP design (Figure 9).

Figure 9: Extent of TCAP coastal protection works on Nanumea

BTBs are also proposed for use on Nanumea along the crest of the main natural storm berm (area labelled 'BERM TOP BARRIER' in Figure 9). As with Nanumaga, it is proposed that locally available material is used for the BTBs which will have a buried geotextile mega container core, with the final buried core planted to enable it to naturally blend in. The Nanumea BTBs are also expected to stand 1.5 m above the surrounding landscape. Overall, the Nanumea BTB will be approximately 1,500m long and have a final overall completed width of 10 to 15m along its length giving an overall footprint of approximately 15,000 to 22,500m^2.

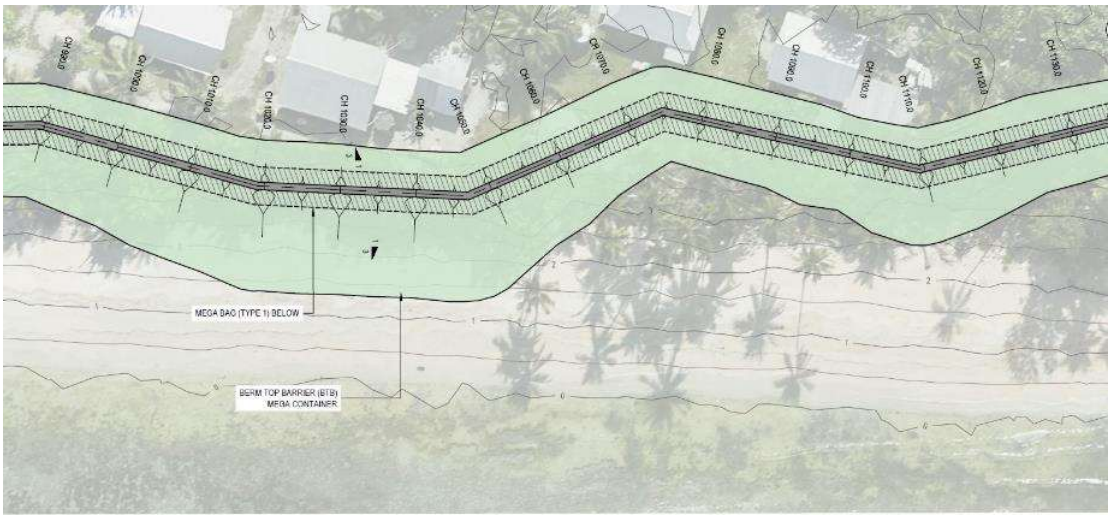

Figure 10: Example of Nanumea BTB design path avoiding buildings

For approximately 160m of coastline in front of the church, there are the remnants of hard existing but crumbling hard coastal protection measures (seawall) (Figure 11). Following consultation with the Fale Kaupule, it has been proposed that this area is 're-hardened' to provide protection for the church with a revetment to sit over the existing footprint. This area of shore has been subject to engineering since at least the 1960s and has adjusted to the hard revetment at this location. TCAP will rebuild a new revetment (Figure 12) to replace the degraded one. As the new revetment is a replacement in the same footprint, it is not expected to have any detrimental impact to the contemporary shoreline processes. Analysis by TCAP suggests that the former revetment had secured shoreline position for several neighbouring properties as well as the church compound and unless it is reinstated a large number of properties will be impacted. Precast concrete interlocking Seabee units (Figure 14) are favoured and a minor amount of filling behind the wall will be necessary to reinstate the former shore.

Figure 11: Existing Nanumea seawall with foundations and wingwall remaining

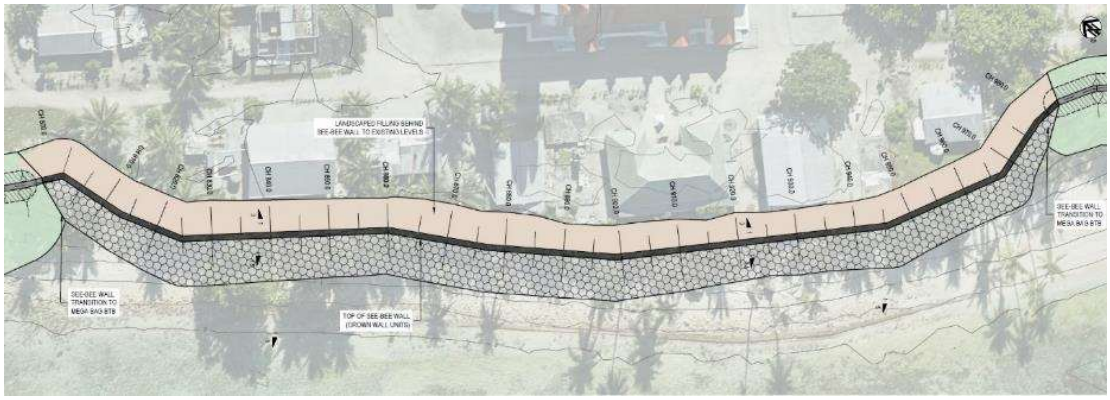

Figure 12: Design plan for Nanumea Seabee coastal revetment in front of church

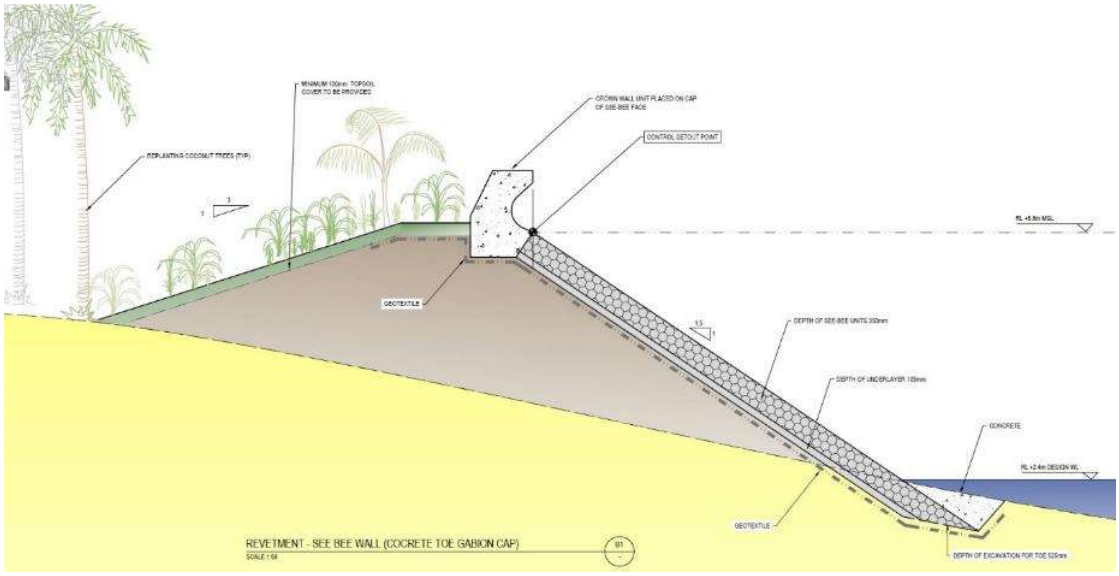

Figure 13: Cross section plan of Nanumea Seabee wall design

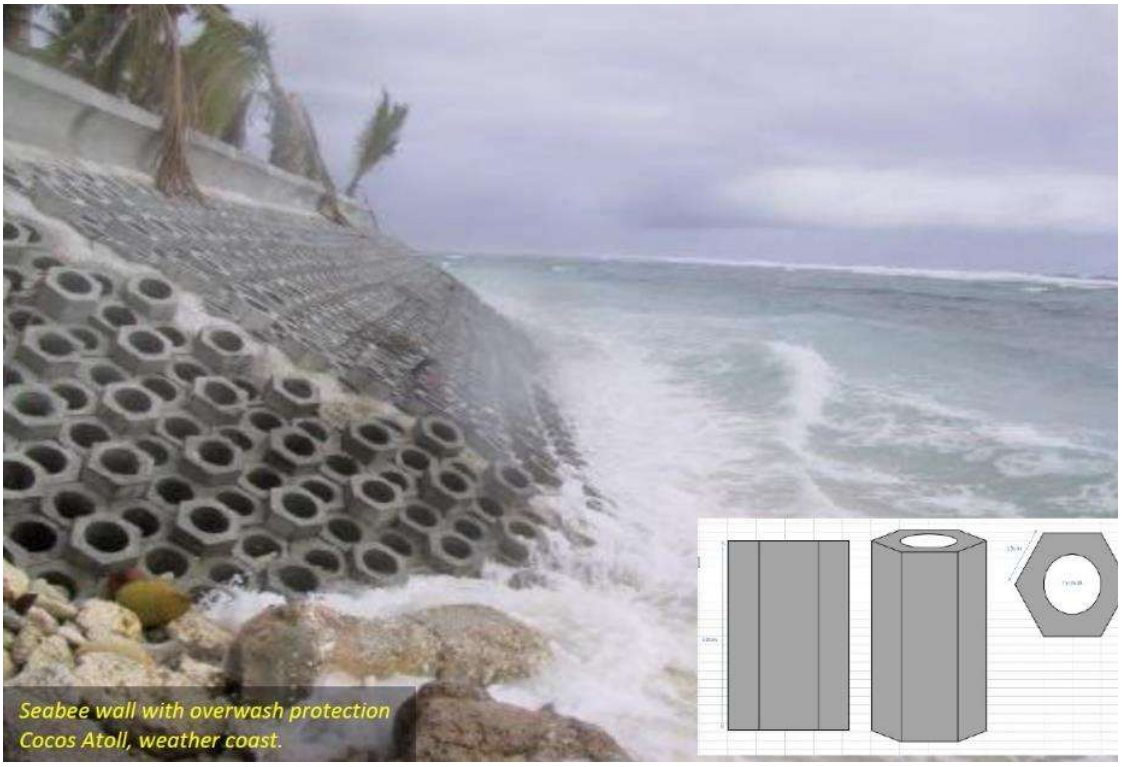

Figure 14: Seabee wall installed in an example location

3.2.3 Berm Top Barriers

BTBs have been selected as the design solution for the outer islands as they will not interfere with the active shoreline processes which continue to function well on both islands. The BTB will utilise locally

available aggregates to both protect and stabilize the landform and to make a more natural appearance which will both allow vegetation to grow and facilitate access across the BTB.

The purpose of the BTB is to reduce wave over wash and marine flooding of inland areas during storm events. The specific type of BTB technology selected are known as geotextile mega containers, or 'Mega Bags' (Figure 7). These bags are approximately 20m long and filled using a drag flow pump which pushes a sand/slurry mixture into the container. The water then drains out of the container in-situ as the sediment consolidates, leaving behind a well compacted sand filling. As can be seen in Figure 7, the bag will sit in a shallow excavated trench which will be constructed with the intention that the excess water will drain towards the ocean. Once the bags are filled, they are then covered with additional sand which will be left to fall at a natural angle of repose, given a final layer of topsoil (set aside during trench excavation) and planted with stabilizing vegetation from the island.

Figure 10 provides an example of the design footprint for the BTB on Nanumea. The flexibility of the bags means that the footprint can travel along the top of the existing berm and meander around buildings and mature trees as needed. The design footprint is such that it avoids all infrastructure such as roads and buildings with sufficient distance to ensure the BTB footprint does not impede on buildings or gardens. There may be instances where it is not possible to avoid some mature trees along the design path, and in these cases the government mandated compensation for the value of those non-land assets (Appendix D) will be paid for by the project to the owner.

Once established, the BTB will not obstruct foot traffic across the berm or shore and will become visually unobtrusive once vegetation is established.

3.3 Construction Methodology

On both Nanumaga and Nanumea construction machinery and equipment will be needed. It is expected that trucks will be required for hauling sand, excavators for extracting the sand and a pump for filling the mega bags. There is existing machinery on both Nanumaga and Nanumea that may be used for the project if they are in good working order, but it is possible that all required items will be shipped into Tuvalu (via Funafuti) and delivered to the islands. In addition to the machinery, the prefabricated concrete Seabees will need to be imported into Tuvalu and shipped to Nanumea for construction. Some heavy lifting equipment will be required for moving the concrete capping beam of the Seabee wall.

It will be the responsibility of the Contractor to develop their methods for shipping the required equipment and materials and to ensure that no adverse environmental or social impacts occur as a result of shipping, loading or unloading, however precedence has been set on both islands for unloading construction type equipment by barge on the exposed reef flat at low tide. Nanumea does have a channel entrance into their lagoon, known as the American Channel, to allow for sheltered berthing of a barge, but there are constraints around the size of the channel which may mean offloading at the reef will become the best option.

3.4 Sources of Aggregate

Critical to the success of the TCAP works is a ready supply of locally available clean beach sand to fill the BTB core mega bags and also to cover the bags to complete the structure. Due to the nature of the bags and the meandering design, sand or very finely crushed aggregate is the only suitable medium to use. The volumes of sand required for each island have been calculated to be 5,600m^3 for Nanumaga and 15,900m^3 for Nanumea.

The sourcing of aggregates on small island nations like Tuvalu is an environmentally sensitive issue. The TCAP engineers and geologists have assessed several alternative options available, these are discussed

in Section 4.4. This assessment determined that using sand already existing on the islands (deposited by inter-annular storms) is the most practical and economical option and also has the lower level of environmental risk compared with the other local extraction options. Section 6.3.2.1 and 9.2.3.1 of this ESIA discusses the existing condition of each sand deposit in more details and assesses the risks to their extraction. This ESIA also sets the management measures that sand that can be extracted under to ensure that no medium- or long-term damage is caused to the natural beach processes. The assessment has shown that the storm generated sand deposits on both islands (Figure 15) are abundant in relation to the needs of this project and repeated storm events increase the chances that these deposits will eventually be lost off the reef and out of the island system altogether.

Figure 15: Storm sand deposits on the northern end of Nanumaga (left) and the southern end of Nanumea (right)

The Draft TCAP Concept Design Report has taken the required volumes of sand on both islands and calculated the physical area that this represents on the two islands (Figure 16). The red circle represents the approximate surface area that would need to be harvested down to the depth of the reef platform which is approximately 2.6m deep on Nanumaga and 2.8m on Nanumea[5]. The calculations have been made based on the LiDAR imagery produced for TCAP.

As is represented in Figure 16, a larger proportion of the storm sand deposit would need to be extracted for the works in Nanumea given that the island has a significantly longer stretch of vulnerable high value coastline than Nanumaga and there a higher number of island residents to protect from storm surge inundation.

[5] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

Figure 16: Estimated harvesting surface area for required TCAP sand volumes on Nanumaga (top) and Nanumea (bottom). Areas are calculated using LiDAR data down the reef flat level (2.6m depth for Nanumaga and 2.8m on Nanumea). Source: TCAP Concept Design Report (draft)

As there are local bylaws that prohibit the unauthorised extraction of any sand on Nanumaga and Nanumea, permission must first be sought from the Kaupule, the six-member executive arm of the community council (Falekaupule). It is important that any decision reached by the Kaupule is well informed and formally documented in writing.

4 ANALYSIS OF ALTERNATIVES

4.1 Introduction

The primary objective of the TCAP project is to provide improved climate resilience in the form of coastal protection to the exposed high value shoreline of Nanumaga and Nanumea in a way that provides unhindered support to the existing beach processes. This section examines the technically and financially feasible alternatives to achieve the objectives on the two islands. These alternatives were considered during the project design development[6] and have led to the validation of the project as it is described in Section 3.

4.2 The 'No Project' Alternative

The 'No Project' alternative for the purposes of this ESIA is the situation where the coastal protections works do not proceed on either island. Under this scenario, there are no adverse environmental impacts caused by the construction of the BTB and other design solutions.

However, the need to protect the high value shoreline of the islands, and therefore the need for the project, is driven by the government and the community's stated need to protect the islands community and infrastructure from the increasing impacts of storm driven wave overtopping and marine flooding. Should the project not proceed, shoreline inundation events will continue to worsen, related safety risks currently experienced by the community will be exacerbated, and likely increase as the effects of climate change become more pronounced. Furthermore, no action would likely mean that people and assets would need to be relocated further inland or even populations relocated to Funafuti, which is not an option for cultural, ethical and practical reasons.

The 'no project' option is not considered to be a feasible or sustainable option in the opinion of this ESIA. The 'no project' option does not meet the community and Government goals.

4.3 Alternative Design Approaches

During early project development, a number of design solutions were assessed[7]. The primary design approach proposed in this document was geo-textile revetments on the outer islands with a design life of 25 years. These revetments would effectively be removing the back of the natural beach and replacing it with sand filled geobags (Figure 17).

Figure 17: Example of back of beach geo-textile revetments

[6] TCAP Initial Island Site Visit, Nanumaga and Nanumea Trip Report, November 2017
[7] Tuvalu Coastal Adaptation Project Detailed Project Proposal Document, UNDP, April 2017

The primary design described in the 2017 Proposal Document was reassessed as a result of additional field investigations on both Nanumaga and Nanumea. Based on the field investigations, it was determined that any hard design options on the beach itself would inhibit the natural process of recovery from storms that occurs on both western shores of the islands. Nanumaga and Nanumea shoreline processes are dynamic and appear in excellent condition. Given the dynamic nature of the beaches, it has been assessed that any attempts to artificially fix the shoreline position with revetments would be inappropriate and could result in more damage and greater community exposure than allowing the natural beach processes to proceed[8].

The TCAP island reassessment[9] determined that, generally, where sound protective natural shoreline systems exist, seawalls can cause more expense and vulnerability than they prevent. It was also noted that replacing a naturally dynamic shoreline with an engineered shore commits that community to an ongoing process of structural maintenance, repair and upkeep.

This assessment has led to the geo-textile revetment design approach being rejected in favour of the less intrusive BTB approach, with this decision supported by this ESIA.

4.4 Alternative BTB Core Options

In addition to the final selected Mega Bag core option for the BTB, the design engineers also assessed two alternative cores: coral rubble core and stacked geotextile bags (Figure 18).

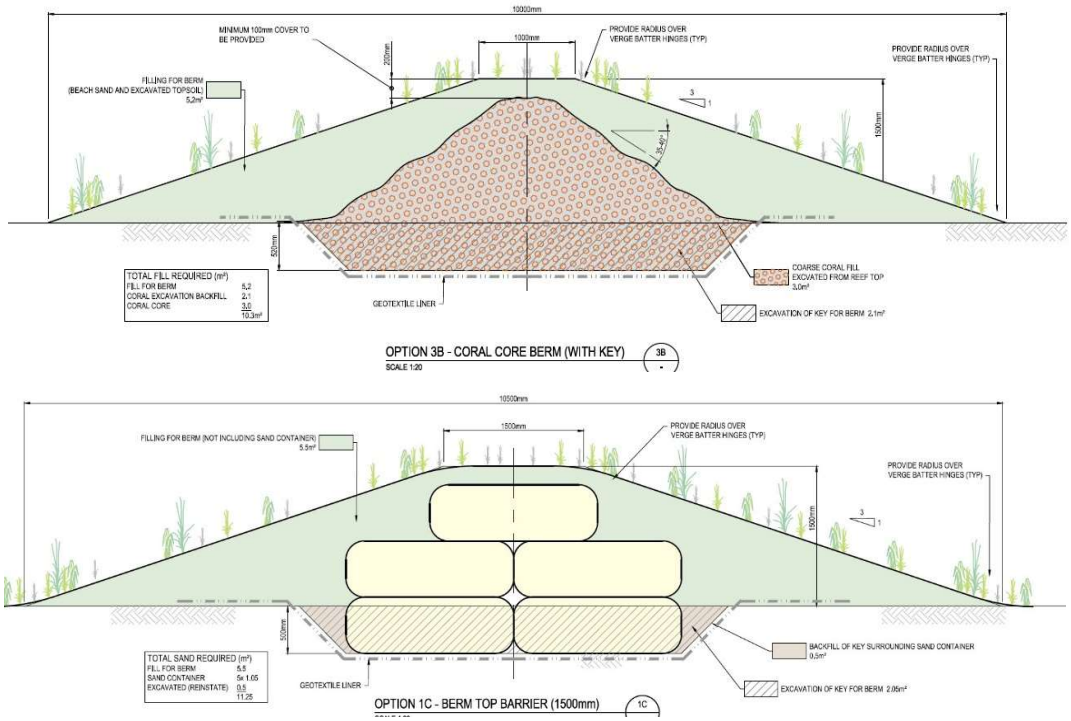

Figure 18: Alternative BTB core options: Coral core (top) and stacked geotextile bags (bottom)

The TCAP Concept Design Report assessed these alternatives as part of the design development and the following comparisons were made.

[8] TCAP Initial Island Site Visit, Nanumaga and Nanumea Trip Report, November 2017
[9] TCAP Initial Island Site Visit, Nanumaga and Nanumea Trip Report, November 2017

Table 1: Assessment of alternative core structure options for Berm Top Barrier

BTB Option	Advantages	Disadvantages
Stacked 2.5m^3 Geotextile Bags	• Individual failure of a bag does not lead to total structure failure • Installation can be also be performed without a pump/dredge • Relatively cheap method of coastal protection • Local Kaupule can be trained in their installation if they have an excavator and a J-Bin to assist in maintenance • Individual units mean the structure is more flexible laterally and alignment can 'snake' its way through footprint.	• It will take 35 bags to reach an equivalent length (and height) for a laid mega container, making cost prohibitive • Not as resilient to large storm waves as GMC, there is a chance of individual bag failure/displacement
Coral Rubble/Sand Core	• Cheapest and easiest method of construction: manual labour, excavator and dump truck • Failure of the berm in individual sections can be replaced with more fill into the future • Can be performed by local labour should it be deemed there is sufficient supply • Design is more flexible laterally (and vertically) and can be constructed to be at differing total overall heights and 'snake' along alignment	• May lead to local small excavations of the BTB as the supply of sediment is now centrally located, this will jeopardise the integrity of the design. • Design levels and slopes will be hard to maintain especially in areas that are thoroughly trafficked etc. • Wash through and blow-outs may occur in sections during large overtopping event. When this occurs there is no protection provided for the duration of the storm or next event (if in close succession) • Uncertain where this core could be reliable and sustainable sourced from
Mega container	• 35 x 2.5m^3 GSC bags to achieve a similar outcome as far as length and height • In the (unlikely) event that the BTB core is exposed to wave attack, the mega containers will acts as a non-erodible structure – last line of defense • The structural support offered will mean that the BTB will maintain its shape even when thoroughly trafficked etc. • Design is still flexible and in the event of undermining the structure will move and bend to the new ground height to be recovered	• Single unit failure can mean total structure failure if integrity is jeopardised/surface is pierced and not repaired. However even reburial of damaged structure will preserve the design life if not exposed to fluctuating water table or waves.

4.5 Alternative Hard Revetment Options: Nanumea

When developing the design for the hard revetment on Nanumea, the engineers followed the TCAP proposal documents call for the most appropriate technology that can be locally used, maintained and potentially replicated. The assessment of alternatives carried out by the engineers (Table 2) demonstrated that this transferability is most likely achieved through a concrete unit system like the Seabees and there are number of atoll locations which are not dissimilar to the Nanumea site where

Seabee units have been used with good result. The table below summarised the assessment process for the alternative hard revetment designs and is adapted from the TCAP Concept Design Report.

Table 2: Assessment of alternative hard revetment designs options for Nanumea

Revetment Options	Advantages	Disadvantages
Rock revetment	• Semi-rigid structure can move and provide flexibility if failure occurs • Appropriate design can reduce overtopping • Suitably sized rock and seawall design will provide last lie of defense to landward infrastructure • Appropriately designed slope and grading will reduce wave reflections, increasing the chance of beach retention at toe.	• Due to location of seawall being in the surf zone during storm events, large wave will break on the structure meaning large rocks will be required to ensure stability • Very expensive to source appropriate rock size • Create very large footprint reducing beach size and possibly interrupting longshore coastal processes • if smaller rock is placed, rocks can become projectiles in large events to the infrastructure located landward • Not adaptive to future sea level rise • The amount of rock required would involve several vessel trips
Concrete armour units	• Semi-rigid structure can move and provide flexibility if failure occurs • Appropriate design can reduce overtopping • Suitably sized rock and seawall design will provide last line of defense to landward infrastructure	• Very expensive to construct, ship, move, place • Specialised equipment required to construct • If locally sourced concrete batched on site, units will have to increase in size to meet stability requirements of higher density materials • Provide an industrialised “built aesthetic” • Hard structure will create wave reflections affecting coastal processes in the lee and reducing chances of retaining a shoreline in front of structure • create very large footprint reducing beach size and possibly interrupting longshore coastal processes • Not adaptive to future sea level rise • The material required would involve several vessel trips and a large vessel able to carry suitably sized crane
Sheet piles	• Due to their modular nature, a large number can be transported via regular sea cargo • Steel has very high strength properties • Reduced footprint due to verticality of design • Most resilient to wave damage	• Reduced design life in the marine environment • High maintenance costs • Dangerous vertical face • Inhibits beach access across structure • Provide an industrialised “built aesthetic” • Require large plant to install • Hard structure will create wave reflections affecting coastal processes in the lee and reducing chances of retaining a shoreline in front of structure • Relatively expensive • Not adaptive to future sea level rise
Seabee	• The pattern of the placed units can be designed to increase surface roughness, reducing wave run-up. In addition to the wave return wall, overtopping should be greatly reduced	• Existing footprint known to interrupt longshore coastal processes • Hard structure will create wave reflections affecting coastal processes in the lee and reducing chances of retaining a shoreline in front of structure

	• The Seabee wall is designed to be placed within the footprint of the failed seawall so there will be no additional impacts to coastal processes • Can be constructed from locally sourced aggregates removing the need to import large rock • Can be constructed relatively easily with minimal plant and local labour as the individual units are comparatively lightweight. • Individual units can be replaced with spares or batched locally by PWD • Do	• Not adaptive to future sea level rise without modification

4.6 Alternative Sources of Aggregate

Aggregates to create the BTB are a key element to the project design. Sourcing aggregate is an environmentally sensitive topic, therefore due diligence is needed in assessing the alternative sources of aggregates and balancing the risks and impacts of these sources.

For most infrastructure projects in Tuvalu, aggregates are imported, usually from Fiji or Australia. Importing aggregates means that there are no pressures at all on the natural resources of Tuvalu and it provides the Contractors with certainty over being able to source the required volume of graded and tested aggregates suitable for the project needs. However, importing project scale quantities of aggregates is a costly exercise both from the purchase of the raw material and the shipping/logistical costs, making importation a prohibitively expensive option within the available budget for TCAP.

The introduction of invasive species or diseases is a further risk associated with imported aggregate. Any imported aggregates would need to be treated and certified in the country of origin prior to shipping and this would add extra cost.

An additional challenge is the difficulty of landing bulk materials on Nanumea and Nanumaga. Neither island has a harbor facility and the difficulty of landing such large volumes of materials via barge onto the reef flats has in itself significant risks for the vessel(s) involved in such maneuvers, related OHS issues as well as environmental risks to living reefs.

In addition to the beach sources described in Section 3.4, another possible source of local aggregate for the works on Nanumaga is from the spoil material that will be created from the harbour dredging works on the WB Maritime Investment in Climate Resilient Operations (MICRO) project. The Nanumaga Kaupule will be the owners of the dredge spoil once the project is complete and the MICRO Contractor will be required to leave the spoil in a crushed usable condition for the needs of the island, as per the Kaupule's instructions. There is a possibility that the Kaupule will allow TCAP to use this material for the Nanumaga BTB and in this case the MICRO Contractor will crush the spoil to the TCAP specifications (also a costly exercise). While this, on the surface, provides a neat solution to the Nanumaga aggregate source, in reality there are several factors which determine that the most reliable design for the best results is to continue to plan to use the storm sand deposit. Most critical of these factors is timing. The MICRO harbour works have not yet been tendered and there is no confirmed timeframe for the works to start. TCAP cannot confirm whether those dredge spoil materials will be available to use when they are needed. Secondly, the geotextile mega bags, which provide a stable and engineered core to the BTB

is more suited to being filled with cleaned, fine, natural sands and it is not determined whether TCAP would be able to control the specifications that the MICRO Contractor used to crush the aggregates. It would be a process outside the control of TCAP and therefore adds an element of uncertainty to this as a potential source of aggregate. No such alternative sources exist for Nanumea.

5 POLICY, LEGISLATIVE AND REGULATORY FRAMEWORK

5.1 Introduction

The policies, legislation, regulations and environmental standards of the Government of Tuvalu, which pertain to this development, along with all applicable GCF and UNDP safeguard policies and standards have been assessed to ensure this project complies with all legal requirements. The subject areas reviewed include environmental quality, health and safety, protection of critical habitats, protection of endangered species, site selection and land use control at the local and national levels.

Ministry of Foreign Affairs and Trade has the responsibility of administering the Environmental Protection Act (2008) and the Environmental Protection (Environmental Impact Assessment) Regulations (2012). Within the MFAT, the Department of Environment has the responsibility, under the legislation, for reviewing, assessing and monitoring of projects.

For all development projects, a Preliminary Environmental Assessment report (PEAR) is required in accordance with Regulation 8 and a full EIA be prepared for activities with significant impacts as identified in the PEAR meaning that an EIA isn't automatically trigger for every proposed project. In the case of TCAP, the DoE have already determined that a full EIA is needed for the proposed works on Nanumaga and Nanumea and have issued their required Tor for the EIA in DoE Scoping Forms for Development Approval (Appendix E). Furthermore, the UNDP SES require that an environmental assessment be carried out for all Moderate Risk projects. This assessment fulfills all GCF, UNDP policies and applicable national laws and will be used as the basis for the Development Approval request submission to the DoE.

5.2 Applicable Tuvalu Policies, Legislations, Regulations and Standards

5.2.1 Environmental Protection Act 2008

The Environmental Protection Act (EPA) is the principal law governing the protection and management of the environment. This Act defines the Tuvaluan Government's role in relation to all environmental management and decision-making processes. In relation to this ESIA, one of the principle roles of the EPA is outlining the requirements and making provisions for an EIA and monitoring of environmental impacts.

Under the EPA, the DoE is responsible for ensuring the proper regulation, monitoring and control of solid wastes to minimise its impact on environmental quality. The DoE is mandated to regulate waste collection and disposal systems and set operational standards by applying guidelines for waste management operations within Tuvalu.

The Act also authorises the Minister to make regulations relating to pollution control, waste management, hazardous wastes and substances and other matters. Section 16 of the Act permits the Kaupule or council on each island to set up an Island Environment Committee whose functions are to identify priority environmental concerns, liaise with the DoE or the Minister and participate in programmes undertaken by the DoE.

5.2.2 Environmental Protection (Environmental Impact Assessment) Regulations 2012

The regulations detail the required content of an EIA and this ESIA has been developed according to these stipulations. In brief, the regulations require a full assessment to contain: (a) a summary of the development proposal and its consequences; (b) a description of the development proposal and objectives; (c) a description of the development proposal including technical description, site

boundaries and justification for the proposal; (d) review of the alternatives; (e) a description of the affected environment; (f) analysis of environmental consequences. In addition to these requirements listed under Regulation 21, a full assessment of baseline conditions and a schedule of compliance monitoring will be included in the EIA.

The Regulations also make provision for the DoE to identify and use a suitably skilled and qualified external review consultant to support the DoE at the cost of the project proponent.

The Regulations state that after review of the full assessment, the DoE may issue instructions for the proponent to undertake consultations and may provide full details for the proposed consultations process.

5.2.3 Waste Operations and Services Act 2009

This Act, in combination with the EPA, gives the DoE responsibility for the waste management in Tuvalu and the collection and disposal of solid waste and other wastes related operations. The DoE is also responsible for implementing the international conventions relating to the management of hazardous wastes. Additionally, the regulatory control of waste dumps and waste disposal sites shall be exercised by the DoE in relation to environmental impact assessment and the imposition of standards, and the designated waste management operators relating to the management of wastes.

The Act states that waste dumps and waste disposal sites shall be managed by each Kaupule or the Solid Waste Agency (SWA) where the need exists for additional technical and operational capacity for the proper disposal of wastes. In the context of TCAP, as no waste will be permitted to be dumped on Nanumaga or Nanumea, the SWA will be an important stakeholder in the waste management plan. The storage and disposal of hazardous wastes shall be undertaken by the SWA.

Section 12 of the Act states that all landfill sites, waste dumps and waste disposal facilities in Tuvalu must be licensed by the SWA.

5.2.4 Conservation Areas Act 2008

The Conservation Areas Act (CAA) makes provisions for the declarations and management of conservation areas. The Minister may declare any part of the territory of Tuvalu as a conservation area upon the request of a Kaupule after due consultation with the Kaupule recommending the establishment of a CA. The objectives of the CA are to protect the coastal, marine and terrestrial environment; to conserve the living and non-living natural resources of the island communities and to provide for their sustainable utilization by present and future generations; to preserve biological diversity of the CA, especially those species which are endemic, threatened, or of special concern and the coastal and marine habitats upon which the survival of these species depend.

Of Tuvalu's eleven (11) marine and terrestrial Conservation Areas, only Funafuti CA is covered by a formal Marine Protected Area declaration that has been legally gazetted under national legislation. The Nanumaga Kaupule has implemented an informal community managed Locally Managed Marine Area (LMMA) using traditional management practices but it has limited enforcement capabilities.

5.2.5 Employment Act 2008

This Act outlines the requirements of the employer as they act towards their staff. In the context of the TCAP project there are several aspects which are noteworthy. Firstly, the employer requires a recruitment license when: (a) the employer employs more than 25 people at one time; or, (b) the workers are to be recruited from more than 25 miles (40km) from the place of work. The issuance of this license is to enable the GoT to consider the impact of removing a number of adult males from their

home area for the duration of employment. The application for this license requires detailed information on the health, safety and welfare of the employees.

Secondly, section 43 of this Act states that no person shall recruit a worker under the apparent age of 18. The Commissioner may grant permission to employ persons from 15 years of age with parental or guardian consent for employment in Tuvalu for light work duties.

The Act also stipulates the maternity arrangements for female employees, including 12 weeks paid maternity leave with at least 25% of her regular salary. The Act also makes provisions for the allowance of twice daily breaks to breastfeed any nursing babies. This Act also protects women from dismissal for absences relating to pregnancy complications, unless this absence exceeds 12 weeks.

Part XI of the Act provides for the care of workers and details the legal requirements governing the following: rations, water, sanitary arrangements, housing, medical care and treatment, hospital maintained by the employer, conveyance of workers by sea and reporting of deaths.

5.2.5.1 Falekaupule (Local Government) Act 1977

This Act governs the establishment and composition of a Falekaupule (traditional assembly) and a Kaupule (island council) as well as their meetings, proceedings and functions. The Act states that the Kaupule on each island shall be the executive arm of the Falekaupule and shall perform all of the functions conferred on the Falekaupule by this or any other Act and generally maintain order and good government and promote development within the area of its authority.

The Act also states that with the express approval of the Falekaupule (and the Minister for Lands outside the Falekaupule area) a Kaupule may, for the purposes of performing its statutory functions or those of the Falekaupule, acquire by purchase, gift or lease any land within or outside the Falekaupule area.

The Act determines that each March, and at 3 monthly intervals throughout the year an assembly of all residents of the Falekaupule area will be held to discuss treasury matters, local development plans and any other matters. Under the Act, there is a local development plan for each Falekaupule that will set out programs and priorities for social and economic development for that area. The local development plan shall be reviewed each year by the Falekaupule Assembly.

Schedule 3 of the Act details the functions of the Falekaupule in specific regard to: (1) Agriculture, Livestock and Fisheries; (2) Building and Town or Village Planning; (3) Education; (4) Forestry and Trees; (5) Land; (6) Relief from Famine or Drought; (7) Markets; (8) Public Health; (9) Public Order, Peace and Safety; (10) Communications and Public Utilities; (11) Trade and Industry; and, (12) Miscellaneous.

In the context of TCAP, some of the specific functions to note are:

- (2a) to regulate and control by bylaws the erection and construction, demolition, re-erection and reconstruction, conversion and re-conversion, alteration, repair, sanitation and ventilation of any public or private building or structure
- (5a) to prevent and control erosion of land by the sea or other cause
- (8a) to safeguard public health and promote public health, including prevention and dealing with any outbreak of the prevalence of any disease in accordance with the Public Health Act
- (8l) to prevent the pollution of any water, and by byelaws to prevent access to any polluted water
- (10a) to make, alter, divert, and maintain roads, streets, parking, paths, culverts; causeways, bridges, drains and water-courses
- (10j) to regulate or prohibit by byelaws the planting, cutting or destruction of trees or vegetation growing along any street, road, path or in any public place

- (12a) to establish, maintain and provide information and publicity services.

5.2.6 Laws of Tuvalu Act Cap. 1.06

To complement the Constitution and Acts of Parliament, this act declares other sources of law that apply in and may be enforced by the courts in Tuvalu. One such source is "customary law" that is defined as "the customs and usages, existing from time to time, of the natives of Tuvalu". These are referred to in some laws as the "aganu" of the Tuvalu. The basic rule is customary law shall have effect as part of the law of Tuvalu, unless it is inconsistent with a written law or its application is likely to cause injustice or is not in the public interest.

Schedule 1 of this Act provides guidance for the determination and recognition of customary law. Clause 4 of this schedule says that in relation to civil matters, customary law may be applied or recognized in selected matters such as:

(a) the ownership by custom of or of rights in, over or in connection with land owned by a native or natives (in this Schedule referred to as "native land") or –

(i) any thing in or on native land; or

(ii) the produce of native land,

including rights of hunting on, or gathering, or taking minerals, from, native land; or

(b) the ownership by custom of rights in, over or in connection with any area of the territorial sea or any lagoon, inland waters or foreshore, or in or on the seabed, including rights of navigation, fishing or gathering;

(c) the ownership by custom of water, or of rights in, over or to water; or

(d) the devolution of native land or of rights in, over or in connection with native land, whether –

(i) on the death or the birth or the adoption of a person; or

(ii) on the happening of a certain event; or etc.

The relevance of this law is that customary rights over coastal waters and resources (such as fishing rights), foreshore and land areas are recognized by the law and should be respected and appropriately acknowledged in order to ensure that the local communities buy-in and support the project.

5.2.7 Public Health and Safety Regulations (Revised 1990)

These regulations set out the required standards in and around villages for maintaining public health. In relation to TCAP, the following regulations are applicable:

- No stagnant water shall be allowed to lie in such lands for more than 24 hours unless treated to the satisfaction of a sanitary inspector by efficient drainage or with petroleum or other suitable oil
- No tins, bottles or receptacles capable of holding water shall be allowed to remain upon any such premises or land
- All tanks, vats and vessels used for retaining water shall be efficiently covered with mosquito proof gauze, or shall be treated with petroleum or other suitable oil to the satisfaction of a sanitary inspector
- No person shall deposit or cause to be deposited any empty tin, bottle or other receptacle in any street road or public place

- Every house or building in daily occupation shall be provided by the owner thereof with latrine accommodation approved by the sanitary inspector and,
- All garbage and rubbish which can be readily destroyed by fire shall be so destroyed; and all other garbage and rubbish shall be placed in tins and covered with fly proof covers, and such tins shall be placed daily in positions convenient for collection.

5.2.8 Foreshore and Land Reclamation Act (1969)

Under this Act the State owns the foreshore and the seabed. This is subject to public rights of navigation, fishing and passing over foreshore as well as any private rights which may exist. "Foreshore" is defined as "the shore of the sea or of channels or creeks that is alternately covered and uncovered by the sea at the highest and lowest tide". In short, this refers to the intertidal zone. Because the bulk of the work proposed to be carried out under this project will take place landward of the foreshore or on private lands, it reinforces the need to respect private, including customary or native land rights.

Section 3(2) of the Act also gives the Kaupule on each island specifically for the purpose of licensing people who wish to remove anything from the foreshore. No person shall remove from the foreshore any part of Tuvalu sand, grave, reef mud, coral or other like substances without first having obtained from the Kaupule in whose area of authority such foreshore lies, a license for that purpose.

5.3 International Treaties and Organisations

5.3.1 International Labour Organisation

The primary objective for the ILO Office for Pacific Island Countries is to assist Government and Employers' and Workers' Organisations of the Pacific Island Countries in their efforts to reduce Decent Work deficits (as part of a global goal) and to pursue development for dignity through the achievements of rights at work, employment, social protection and social dialogue. Tuvalu joined the ILO in 2008 and since that time has ratified one convention, the Maritime Labour Convention (2006)

5.3.2 Convention on Biological Diversity (CBD) (1998)

The CBD is a multilateral treaty with three goals:

1. Conservation of biodiversity
2. Sustainable use of its components, and
3. Fair and equitable sharing of benefits arising from genetic resources.

The convention was opened for signature at the Earth Summit in Rio de Janeiro in 1994 and was ratified by Tuvalu in 2002. As part of its obligations to the CBD, Tuvalu has developed a National Biodiversity Strategies and Action Plan (NBSAP) in which the GoT identifies cross-cutting issues under the CBD. When considered in relation to this project, Cross-Cutting issue 2: Sustainable Development and Environmental Management is the most applicable. Objectives that have been highlighted and which relate to this project include:

- All development activities regardless of its nature and magnitude must be first subject to an EIA; and,
- Consolidate all national efforts and activities under international conventions related to the environment in order to meet Tuvalu's obligations and thus strengthen its position to attract international assistance.

5.3.3 Convention for the Protection of the World Cultural and Natural Heritage

This convention founded the UNESCO World Heritage Site List (the List). To be a site on this List, it must be a place of special cultural or physical significance. The programme catalogues names and conserves sites of outstanding cultural or natural importance to the common heritage of humanity.

Tuvalu became a signatory to this convention in 2004. It does not have any approved sites on the List, but does have two tentative items for consideration for the List, neither of which are in the geographic range impacted by this project.

5.3.4 Waigani Convention

The objective of the Convention is to reduce and eliminate transboundary movements of hazardous and radioactive waste, to minimize the production of hazardous and toxic wastes in the Pacific region and to ensure that disposal of wastes in the Convention area is completed in an environmentally sound manner.

The Waigani Convention is modelled on the Basel Convention and constitutes the regional implementation of the international hazardous waste control regime. Tuvalu became a signatory to the Waigani Convention in 2001 and is therefore obliged to:

- to take all appropriate measures to ban the import and export of hazardous waste to and from the Convention area (Art. 4.1);
- to prohibit dumping of hazardous wastes and radioactive wastes in the Convention Area (4.2);
- to ensure that within the areas of its jurisdiction the generation of hazardous wastes is reduced (art.4.4); and,
- to ensure availability of adequate treatment and disposal facilities for the environmentally sound management of hazardous wastes in the Convention Area (4.5)

5.3.5 Other Applicable Agreements

Tuvalu is signatory to several international agreements which will need to be considered by the Contractor, particularly if they charter a cargo vessel to bring goods into the country. These agreements are:

- Protocol to The International Convention for the Prevention of Pollution from Ships 1978
- International Convention on Standards of Training, Certification and Watchkeeping For Seafarers 1978
- International Plant Protection Convention 1979
- United Nations Convention on The Law of The Sea 1983
- Convention for The Protection of The Ozone Layer 1985
- Convention for The Protection of The Natural Resources and Environment of The South Pacific Region1987
- Protocol for The Prevention of Pollution of The South Pacific Region by Dumping 1986
- United Nations Framework Convention on Climate Change 1992
- Convention on Persistent Organic Pollutants 2001
- International Convention on The Control of Harmful Anti-Fouling Systems on Ships 2001
- International Convention for The Control and Management of Ships' Ballast Water and Sediments 2004
- Paris Agreement under the United Nations Framework Convention on Climate Change 2016

5.4 UNDP Social and Environmental Standards

At the project level, UNDP SES Standards support the implementation of the UNDP's commitments to promote respect for human rights, gender equality, and environmental sustainability. The Standards set out specific requirements relating to different social and environmental issues. During the project development phase, the proposed TCAP works were screened against these Standards and triggered screening criteria were identified. As part of this ESIA process, the screening checklist has been revisited and some additional criteria have been triggered as part of the ESIA's precautionary approach. The following table highlights the original and expanded screening results. All the highlighted have been incorporated into the impact assessment.

Table 3: UNDP SES Standards applicable to the TCAP works. Additional standards added through ESIA screening highlighted in gray.

Standard	Triggered Criteria
Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management	The project could potentially cause adverse impacts to habitats (e.g. modified, natural, and critical habitats) and/or ecosystem and ecosystem services
	Project activities are proposed next to environmentally sensitive beach areas
	The project does pose risk of introducing invasive alien species
Standard 2: Climate Change Mitigation and Adaptation	The outcomes of the project could be sensitive or vulnerable to potential impacts of climate change
Standard 3: Community Health, Safety and Working Conditions	Elements of the project construction, operation, or decommissioning post potential safety risks to local communities.
	The project involves large-scale infrastructure development
	The project poses potential risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological and radiological hazards during Project construction, operation or decommissioning.
Standard 7: Pollution Prevention and Resource Efficient	The project potentially results in the generation of waste (both hazardous and non-hazardous)
	The project includes activities that require significant consumption of raw materials, energy and/or water

5.4.1 GCF Environmental and Social Policy

The GCF Policy on Environmental and Social Policy (ESP) sets out mandatory requirements for identifying and addressing Environmental and Social Risk and Impacts in GCF-financed projects; and for documenting, monitoring, and reporting on associated measures throughout the project cycles. Implementing the Policy is the responsibility of the implementing entity (for TCAP this is UNDP) and they are expected to do this by having in place the necessary policies, procedures, systems and capabilities to implement the policy. The UNDP SES have been assessed to meet the GCF ESP and therefore they are the vehicle used to implement those standards at all levels of project implementation, including by executing partners.

6 NATURAL ENVIRONMENT BASELINE

6.1 Introduction

This section provides information on the physical and biological characteristics of the environment as they are related to the proposed works of TCAP on Nanumaga and Nanumea, which shall be the baseline data set used as benchmarks for future monitoring. The area considered for assessment of baseline conditions covers all physical project sites and are inclusive of an extended potential AOI. This will be large enough in extent to capture all potential direct and indirect impacts from the proposed projects.

All baseline data were obtained through a combination of desktop studies, consultations (stakeholders and communities) and field surveys.

6.2 Location and Setting

Tuvalu is a volcanic archipelago and consists of three reef islands: Nanumaga, Niutao, Niulakita and six true atolls: Funafuti, Nanumea, Nui, Nukufetau, Nukulaelae and Vaitupu. Its small, scattered group of atolls have a total land area of approximately 26km^2 making it the fourth smallest country in the world. Tuvalu lies over an area of the South Pacific Ocean approximately 500km long and 28km wide half way between Australia and Hawai'i (Figure 19) and approximately 1,000km north east of Fiji. It stretches from the latitude of 5°S to 10°S and longitude of 176°W to 180°W encompassing approximately 900,000km^2 of EEZ waters.

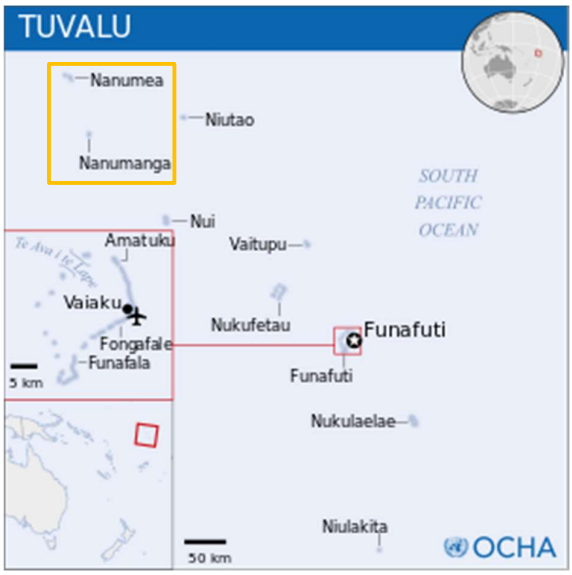

Figure 19: Geographic context of Tuvalu with Nanumaga and Nanumea highlighted

The islands of Tuvalu are very low lying with an average height of 2m above sea level. Like other coral atolls and islands, the soil is derived from limestone that has been formed as a result of coral formation over thousands of years. Tuvalu is geologically very young, with most of its islands having poorly developed sandy or gravel coastline soils.

Nanumea is the northwestern most atoll in Tuvalu. It lies 460km northwest of Funafuti and just south of the Gilbert Islands of Kiribati. It is a classic atoll, a series of low-lying islets sitting on a coral reef shelf surrounding a lagoon (Figure 20). Nanumea is about 12km long by 2.5km wide in overall size, the dry

land area is about 3.9km^2. The two largest islets comprising 90% of the dry land area of the atoll are Nanumea and Lakena.

Nanumaga is located 408km northwest of Funafuti and 72km south of Nanumea. It is a single island of 301ha and is approximately 2.8km long and 1.5km wide surrounded by a fringing reef and with two small central brackish-water lagoons (Figure 20). The larger Vaiatoa Lagoon is located in the north of the island while the smaller Ha'apai Lagoon is in the south. A causeway construction by the Kaupule to the south of Vaiatoa Lagoon provides access to the eastern side of the island.

Figure 20: Nanumea (top) and Nanumaga (bottom) islands

6.3 Physical Environment

6.3.1 Meteorology

The climate of Tuvalu is tropical throughout the year and is divided into two predominant seasons: a wet (November to April) and dry (May – October) season, however rainfall averages more than 200mm each month of the year in Funafuti and more than 160mm in Nanumea (Figure 21). This is due to the location of Tuvalu near the West Pacific Warm Pool where thunderstorm activity occurs year-round.

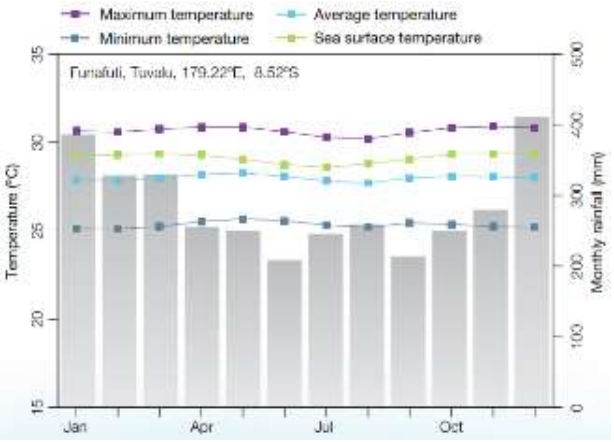

Figure 21: Seasonal rainfall and temperature in Funafuti

Annually, the average rainfall in the period 1942-2005 is 2875mm however rainfall varies from 3500mm/year in the southern islands to 2700mm/year in the northern islands. Dry spells and droughts are relatively uncommon but do occur. Rainfall in the southern Tuvalu atolls is high and reliable throughout the year, but less so in northern atolls. Sixty percent of the rain falls in the November to April period, known as the wet season. There is a significant inverse relationship between rainfall and the El Nino/Southern Oscillation Index leading the rainfall response by several months.[10]

[10] http://informet.net/tuvmet/climate.html

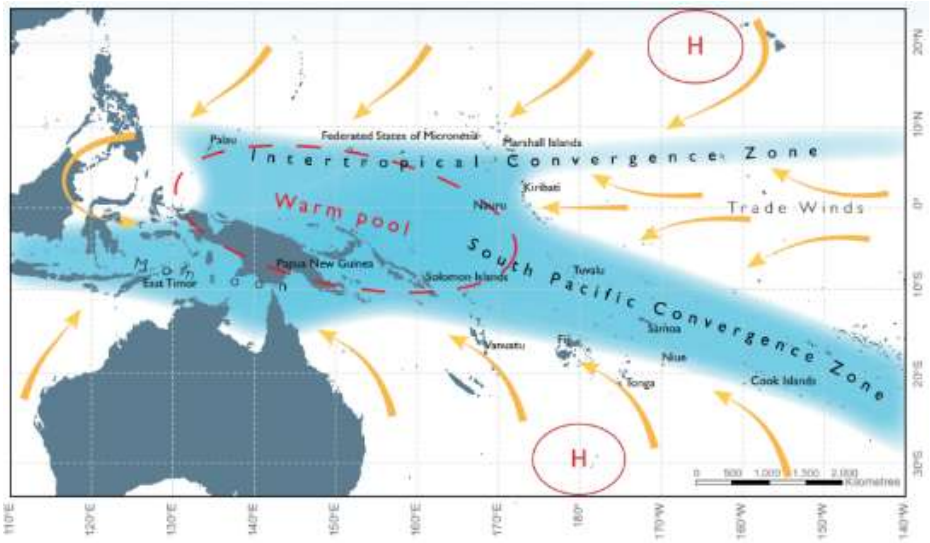

Figure 22: The average positions of the major climate features in November to April.

Tuvalu's wet season is affected by the movement of the South Pacific Convergence Zone. This band of heavy rainfall is caused by air rising over warm waters where winds converge, resulting in thunderstorm activity. The West Pacific Monsoon can also bring heavy rainfall to Tuvalu during the wet season. The Monsoon is driven by large differences in temperature between the land and ocean, and its arrival usually brings a switch from dry to wet conditions.

In Funafuti, there is little variation in temperature throughout the year. The maximum temperature is between 31-32°C and the minimum temperature between 25-26°C all year round. Air temperatures are strongly tied to the ocean temperatures surrounding the islands and atolls of the country, hence the stability.

The prevailing winds in Nanumaga and Nanumea are dominated by the easterly trade winds with only rare wind events from the west (Figure 23)[11,12] meaning that wind-blown sediment on the western coast is likely to only be a minor contributor to the sediment transport processes on the western coastlines where the TCAP works will be installed. On Nanumaga, there is evidence of minor wind-blown sediment on the western coast in the form of well sorted sand accumulating in the vegetation line[13] while on Nanumea there is no evidence of wind-blown sediment on the western TCAP project site therefore it is inferred that wind driven processes are negligible in terms of the qualitative sediment budget for the site[14].

[11] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)
[12] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)
[13] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)
[14] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)

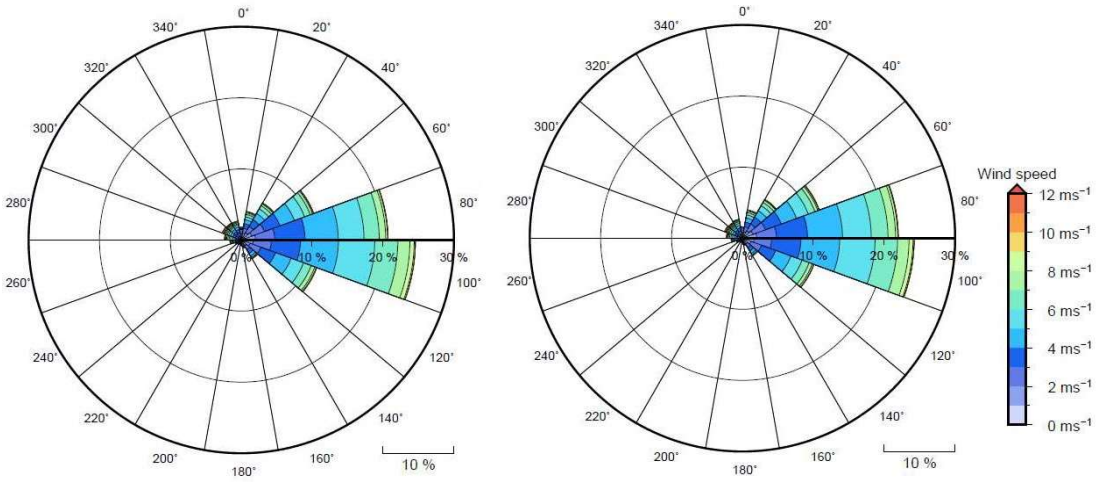

Figure 23: Annual average wind directions for Nanumaga (left) and Nanumea (Right). Source: adapted from TCAP preliminary Geotechnical Investigation Reports (SPC, 2020)

6.3.2 Geology

Preliminary geotechnical investigations were carried out for TCAP on Nanumea and Nanumaga islands in August and September 2019. This section provides an overview of the findings of those investigations. Detailed information on the geology of Nanumaga and Nanumea can be obtained from the SPC Preliminary Geotechnical Investigations Reports (2020)[15] [16].

The investigations conducted along the proposed TCAP coastal protection alignment on Nanumaga consistently encountered unconsolidated calcareous sand and gravel deposits varying from 'very loose' at the surface to 'very dense' at depth. The sand and gravel are comprised of biogenic calcareous sediment derived from the reef platform with minor organic contributions from terrestrial flora. The most abundant component of the sediment is large benthic foraminifera, notably calcarina and *baculogypsina sphaerulata*, with occasional amphistegina and marginopora. Foraminifera dominate the sand fraction of the sediment. Coral fragments dominate the gravel fraction of the sediment with occasional bivalves, gastropods and coralline algae. A Cyclone Pam deposit consisting of relatively clean calcareous sand was encountered at the surface consistently across the Nanumaga alignment. The Cyclone Pam deposit ranged between 0.1m and 0.9m thick and underlying this layer is an organic paleosol consisting of calcareous sediment which has been stained dark grey by decomposing organics. The organic content decreases with depth and the sediment becomes gradually unstained. Deeper organic paleosol's were also encountered. No groundwater was encountered during the investigation and the sediment ranged from dry to moist.

On Nanumea, the investigations consistently encountered unconsolidated calcareous sand and gravel deposits varying from 'very loose' at the surface to 'very dense' at depth. As with Nanumaga, the sand and gravel is comprised of biogenic calcareous sediment derived from the reef platform with minor organic contributions from terrestrial flora. Coral fragments also dominate the gravel fraction of the

[15] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)
[16] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)

sediment with occasional bivalves, gastropods and coralline algae. The upper portion of the soil is stained dark grey due to decomposing organics which have generated traces of organic silt. The organic content decreases with depth and the sediment becomes gradually unstained. A very thin (1cm to 2cm thick) layer interpreted to be the remnants of the Cyclone Pam deposit was encountered at the surface across the site, it is likely that this layer has been disturbed due to human activity associated with the post-cyclone clean-up. Groundwater was encountered along the alignment at 0.6m depth (on the active beach in front of the church at low tide) and between 1.8m and 3.0m depth on the Western Ridge Complex. The groundwater level is influenced by the tide. "Poko" pits were observed within the proposed coastal protection alignment. Poko pits are approximately 1.5m deep holes excavated in the ground to dispose of organic waste, however household rubbish was also observed in some of the poko pits.

6.3.2.1 Storm Sand Deposit Resources

Nanumaga and Nanumea are reef mediated shores: they are protected by living reefs and the sediment supply comes from these reefs. Such shores can be built from storm-oriented deposition or longshore processes or both. The TCAP Preliminary Geotechnical Investigation Reports (SPC, 2020) for Nanumaga and Nanumea has mapped a qualitative sediment budget for the TCAP site on both islands (Figure 24 and Figure 25). The qualitative sand budgets are based on the findings of the preliminary geotechnical investigations combined with the wave climate, the preliminary shoreline change analysis, and baseline ecological information and provide the indicative sources of sediment at the project sites.

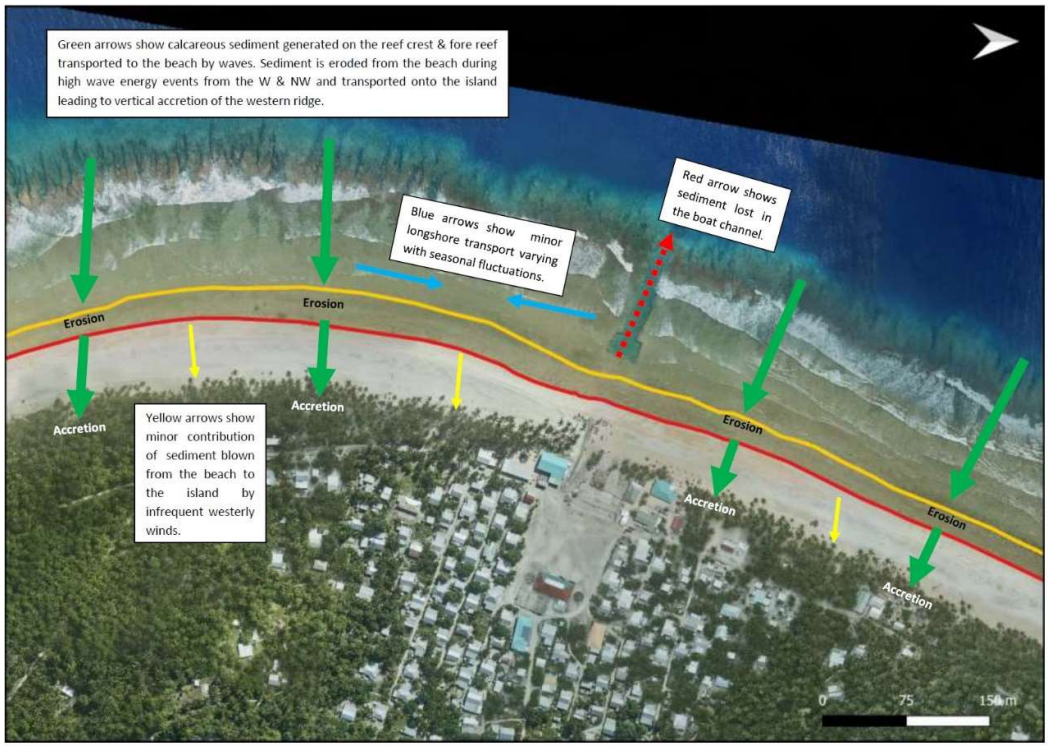

Figure 24: Nanumaga qualitative sediment budget; orange line shows 2006 toe of the beach, and red lines shows 2019 toe of the beach (imagery date: 26th May 2019). Source: TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. (SPC, 2020)

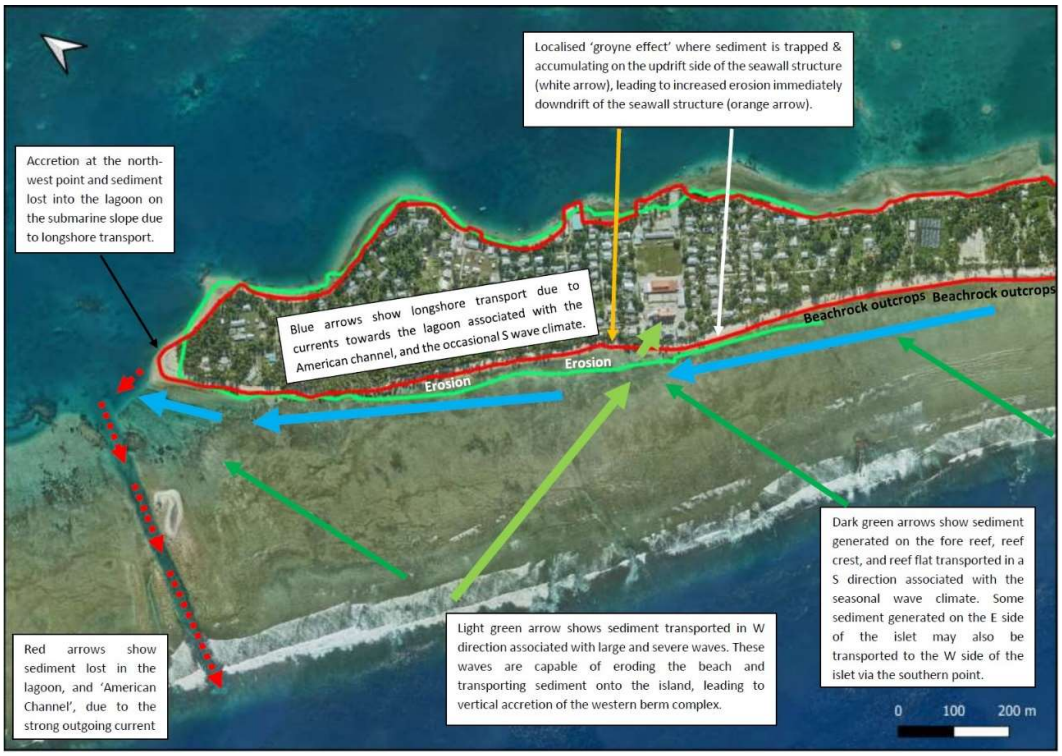

Figure 25: Nanumea qualitative sediment budget: green line shows 1943 toe of the beach, and red line shows 2019 toe of the beach (imagery date: 26th May 2019). Source: TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. (SPC, 2020)

The storm sand deposits on Nanumaga and Nanumea have also been assessed in the TCAP Concept Design Report (draft)[17]. The report notes that coastal sediment systems are very complex and there is a unique interplay of biological and physical parameters to consider, which are individual to each island, even from shore to shore on the same island. There is spatial, temporal and biological variability at every step.

The report describes that non-expert assumption of shores like this is that they are under stress and eroding, however, this is not supported by the best science available. A 2018 study[18] of 700 atoll islands supported earlier findings[19] which (along with many other studies) show that atoll islands are not (at this time) showing a broadscale trend of erosion or land loss. Instead, overall atoll islands globally are getting incrementally bigger in land area. The studies have shown that only islands smaller than 5 hectares have shown consistent patterns of loss and larger islands like Nanumaga and Nanumea have generally demonstrated a historical trend of increasing in size over time. It is important to note that these have been backwards looking studies and careful monitoring is being established through TCAP to follow trends in the future.

Nanumaga: This is an island which is essentially in a "climax state"20 in terms of its growth. There is no accommodation space on the reef flat to enable growth and the inland lagoon is closed off, preventing

[17] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)
[18] Duvat, VKE. A global assessment of atoll island planform changes over the past decades, Wires Clim Change. 2018; e557. https://doi.org/10.1002/wcc.557
[19] Webb, A.P., Kench, P.S., The dynamic response of reef islands to sea-level rise: Evidence from multi-decadal analysis of island change in the Central Pacific, Global and Planetary Change (2010), doi:10.1016/j.gloplacha.2010.05.003
[20] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

natural infilling. If the reef system remains in balance and the prevailing climactic conditions remain stable in the decadal timeframe, the only factors causing significant changes to the shoreline are major storm events such as TC Pam or TC Tino (Figure 26), which are natural part of the systems functioning. After these storm events on Nanumaga, the coastal sediment system will set about recovery and will re-fill to absolute capacity with sediment. Once capacity is reached, it will start to leak sediment to the open ocean at roughly the equivalent rate to its production from the reef and deposition on the shore21. It is hypothesized in the Concept Design Report that this leaking of sediment predominately occurs to the north and the unusual reef features at the north-eastern reef edge is likely a sign of this.

Figure 26: Nanumaga storm sand deposit in September 2019 (top) and again in 2020 after TC Tino (bottom). Source (top) SPC Initial Geotechnical Analysis Report and (bottom) GoT Department of Lands

[21] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

Nanumea: The baseline condition at Nanumea is similar to Nanumaga and many of the processes, such as storm driven changes to the deposit (Figure 27), are similar, however, Nanumea island is growing in area and to some extent parts, such as the northern island of Lakena, are migrating lagoon-wards (but not substantially changing in area). The lagoon is also infilling and this appears to be the dominant geomorphological process on the island.[22] The infilling of the lagoon indicates that sediment productivity on the Nanumea reef and reef flat is in excess of the level of sediment that can be held on the coastline.

Figure 27: Nanumea storm sand deposit in September 2019 (top) and again in 2020 after TC Tino (bottom). Source (top) SPC Initial Geotechnical Analysis Report and (bottom) GoT Department of Lands

[22] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

6.3.3 Coastal Hydrology

Non-cyclonic Wave Climate: Hindcast modelled wave data offshore of Nanumaga and Nanumea (deep ocean waves) was obtained and assessed under TCAP as part of the Concept Design Report[23]. The report states that the offshore non-cyclonic wave climate is predominately driven by the south-east trade winds and long period south-westerly swells from the Southern Ocean for both islands. Figure 28 presents the annual wave roses for Nanumaga and Nanumea.

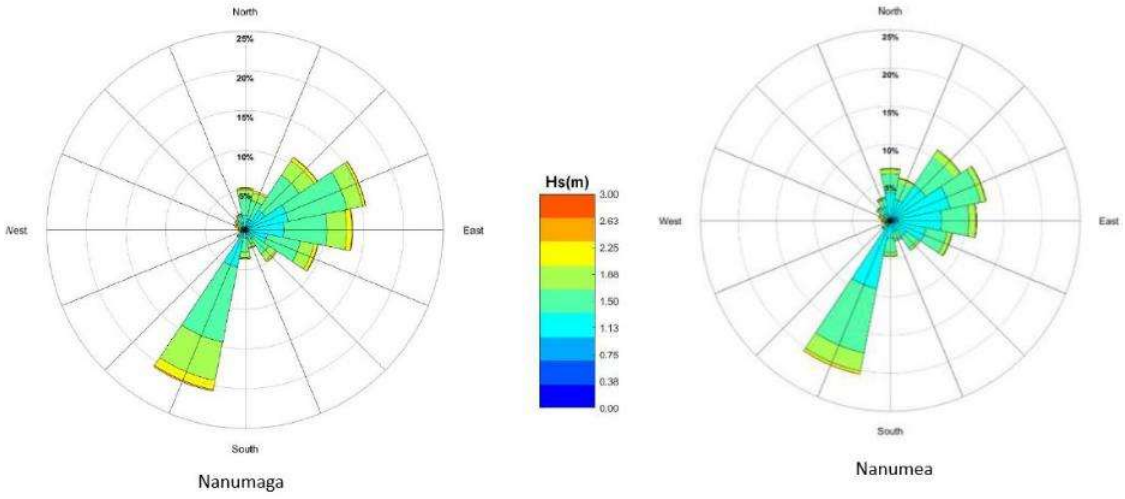

Figure 28: Offshore wave rose for Nanumaga and Nanumea. Adapted from: DRAFT TCAP Concept Design Report (2020)

The wave roses present the occurrence of wave height as a function of the wave direction. Wave height classes are set by the colour and thickness of the line and the length of the bar indicates how often certain classes occurs and their direction (presented in the nautical convention i.e. coming from). Winds from the north-east to south east blow for 50% of the time with waves between 1.5 to 2m high the majority of that time. For about 20% of the year, waves will be received from a SW direction, again with an average of 1.5 to 2m in height. Waves from the north-west through to the west are infrequent occurring only approximately 5% of the time, but these are the waves with the most significant wave height reaching over 4m as they are associated with cyclonic activity.

Extreme Swell Conditions: Wave climate analysis undertaken for TCAP[24],[25] shows that the principle wave direction for large and sever waves is from the north-west direction on Nanumaga and Nanumea (Figure 29**Error! Reference source not found.**). Subsequently it is likely that these waves are the principle process driving the formation of the western berm on Nanumaga[26], while on Nanumea this means that the western coast of the main islet is sheltered from the most frequent large and severe waves from

[23] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)
[24] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)
[25] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)
[26] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)

the north direction due to the boomerang shape of the Nanumea atoll[27]. However, on Nanumea, the western coast of the islet is exposed to large and severe waves from the west and south-west direction (such as was experienced during TC Pam), which account for approximately 35% of the frequency. On both islands, it is likely that these waves are the predominant process which has driven vertical accretion of the western berm complex and have transported fresh sediment from the fore reef and reef crest onto the reef platform, eroding existing sediment from the beach, and deposited sediment on the western berm complex.

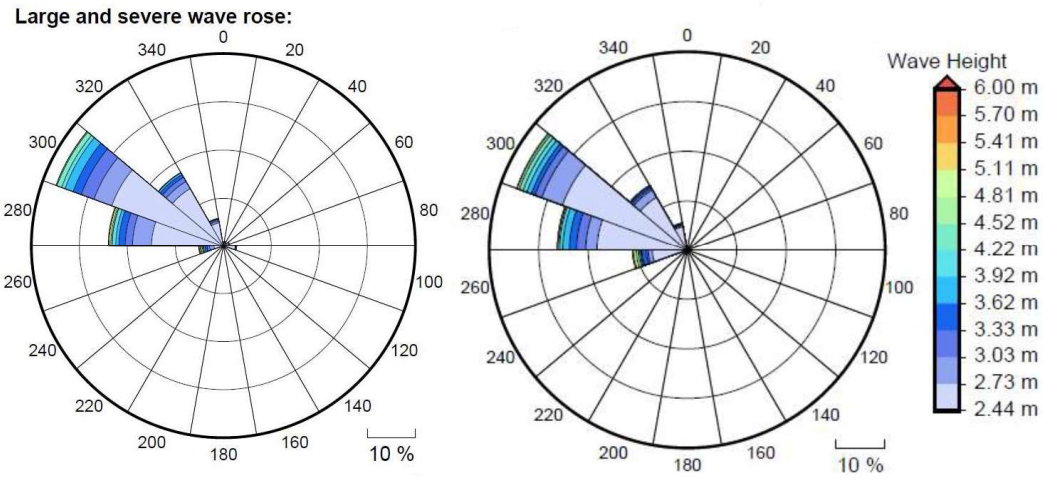

Figure 29: Large and severe wave heights (mean) around Nanumaga (left) and Nanumea (right). Source: adapted from TCAP Preliminary Geotechnical Investigation Reports (SPC, 2020)

6.3.4 Topography

Topographic relief maps have been created from TCAP LiDAR imagery for both islands (Figure 30). The imagery shows that the beach berm on both islands is on the western shoreline, which correlates to the direction of storm generated waves. Sediments are pushed onto the berm, and indeed further into the islands during storm events. Over time these berms have grown in size as more sand is deposited.[28]

[27] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)

[28] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

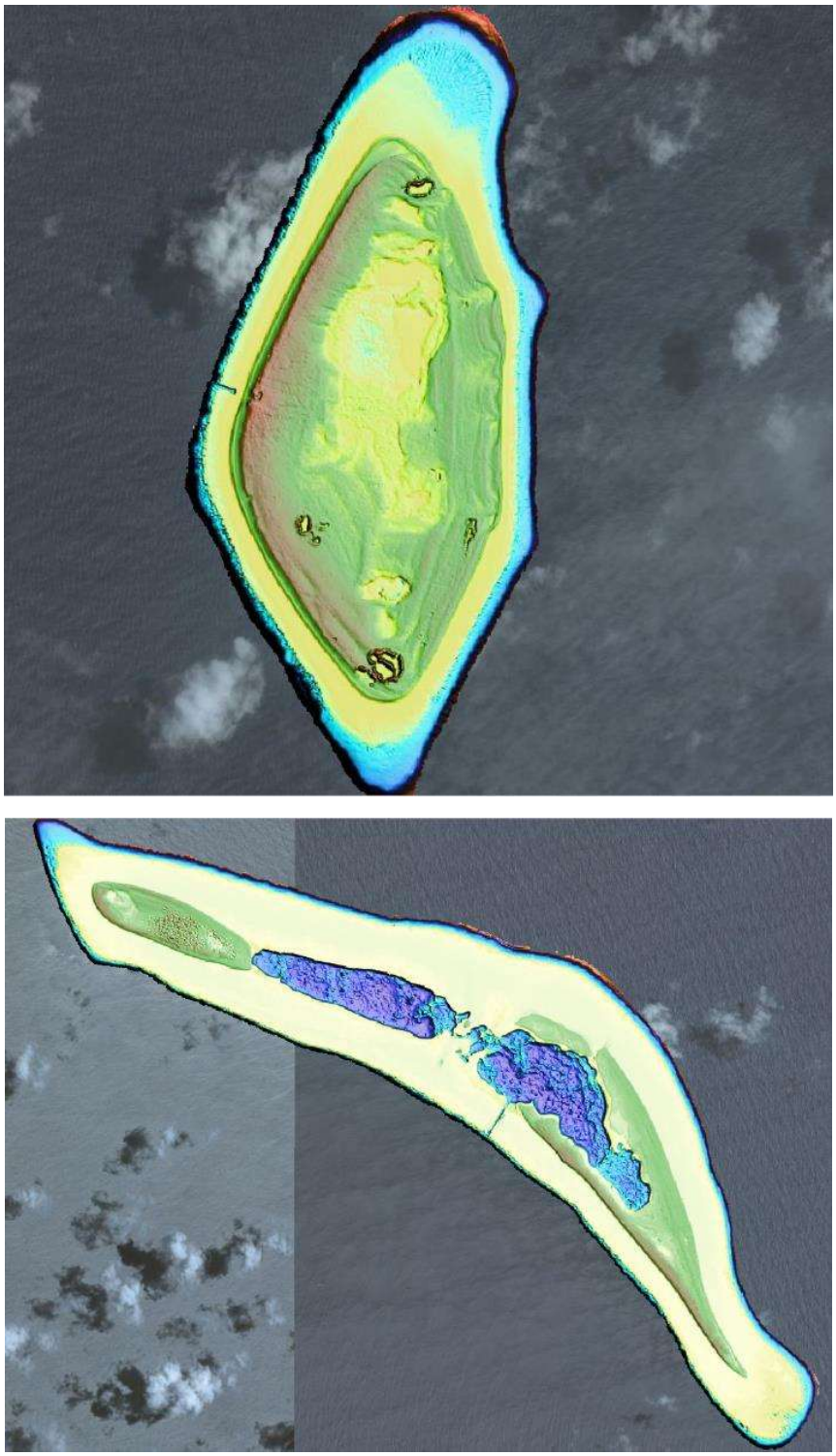

Figure 30: LiDAR Imagery showing the islands topography. Red areas indicate the elevated sections, the purple and blues indicate subtidal areas.

The LiDAR imagery shows that the storm berm is higher on Nanumaga, indicating that this shoreline is more heavily impacted by cyclone waves than Nanumea, most likely due to the differences in their

orientation and therefore exposure to the worst of the waves. Also, the reef flat width (over 300m) on Nanumea is far wider than on Nanumaga (100-150m) and thus wave energy dissipation over the reef flat as they travel to shore is more effective on Nanumea.

The topography of Nanumaga village indicates that it rises from the reef flat to the berm crest approximately 7m above MSL and from there descends towards the interior of the island. Considering that Tuvalu's highest point above MSL is generally recorded as approximately 4m, the height of the Nanumaga berm at 7m is significant and demonstrates the role that previous storms have had in forming this particular island.

6.3.5 Natural Hazard Vulnerability and Risks

Cyclones and Storm Surge Potential: Looking specifically at Nanumaga and Nanumea, historical cyclone tracks have been extracted from the International Best Track Archive for Climate Stewardship (IBTrACS) database from 1950 to 2019 in order to understand the exposure of the islands to the passage of tropical cyclones. Figure 31 shows that there have been 4 cyclones passing within a 300km radius of the islands since 1950. This equates to one cyclone every 17.5 years passing in their direct vicinity, it is expected however that the islands would still experience the effects of large waves from cyclones generated in the South Pacific passing outside the 300km search radius due to the remoteness and exposure of the Tuvaluan islands to wind and waves in all directions.[29]

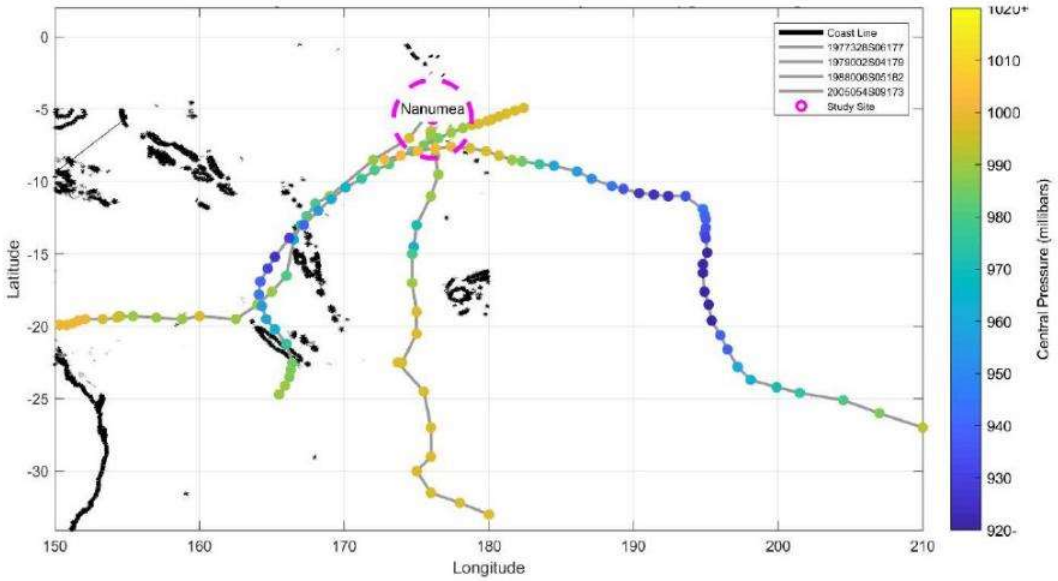

Figure 31: Cyclone tracks showing active storms found within 300km radius of Nanumea encompassing Nanumaga for the period 1950-2019. Source: TCAP Draft Concept Design Report (2020)

The GFDRM classes the risk in Tuvalu to flooding from storm surges as high. This means that potentially damaging waves are expected to flood the coast at least once in the next 10 years.

[29] Tuvalu Coastal Adaptation Project Draft Concept Design Report (2020)

While direct passes from cyclones are rare on the islands, extreme storm surge from a few severe cyclones have caused devastating damage to them in recent years. These cyclones are not reflected in Figure 31, but include:

i. In March 2015, Category 5 TC Pam resulted in 3-5m high waves causing significant damage to agriculture and infrastructure on most islands. The impact of TC Pam was compounded in Tuvalu by previous flooding from King Tides that peaked at 3.4m on 19th February and caused considerable road damage across Tuvalu. Nanumaga suffered damage to houses, crops and infrastructure as a result of the storm surges with areas of the village up to the top of the berm subject to damage; and
ii. Category 4 TC Ula affected Tuvalu in early 2016 with 3-4m high waves affecting all the islands. [30]
iii. In January 2020, Category 3 TC Nino heavily impacted Nanumaga and Nanumea with damaging storm surge resulting in significant inland inundation, coastal erosion and building damage in Nanumaga.

Wave overtopping and marine flooding due to storm waves and water level set up over the reef is a noted vulnerability at the project sites in Nanumaga and Nanumea, hence the need for the project. Cyclones Pam and Tino resulted in significant levels of reworking of sediments along these sandy shorelines on both islands and on both islands nearshore assets and houses (Figure 32) were damaged and undermined. Visual estimates from land were that waves 3-5m high impacted the islands, overtopped the natural coastal berms and caused inundation. When these waves reached the coral reef edge the waves breaking over the reef edge generated a large flux of water onto the reef. This resulted in setup over the reef flat that pushes water levels up and in turn permitting larger waves to pass over the reef and attack the soft shore of the island. The reworking of the foreshore sand during Cyclones Pam and Tino was dramatic with sand being both lifted and swept over the berm and further inland (in some cases layers up to 0.5m deep were deposited) and sand was also pushed to the terminal points of the island (southern spit in Nanumea and both the north and southern points on Nanumaga but predominantly to the north). Large lobes of transported sand formed on the north eastern (Nanumaga) and south-eastern (Nanumea) ends of the islands and in both cases, at the time of the storms, these lobes extended to the reef edge so that material was lost from the system.[31]

[30] ADB Tuvalu Outer Island Maritime Infrastructure Project Initial Environmental Examination, Cardno 2016
[31] Tuvalu Coastal Protection Scope Definition Report, AECOM 2015

Figure 32: Erosion on the western foreshore of Nanumaga following TC Pam

Figure 33: House undermined and eroded on Nanumea

Earthquakes: Tuvalu is situated in a relatively quiet seismic area, but is surrounded by the Pacific 'ring of fire' which aligns with the boundaries of the tectonic plates. According to the Global Facility for Disaster Risk Management (GFDRM), Tuvalu is classified as "very low risk" based on the information that is currently available. This means that there is a less than 2% chance of potentially-damaging

earthquake in the project area in the next 50 years. Based on this information, the impact of an earthquake need not be considered in the different phases of the project, particularly during design and construction.[32]

Tsunamis: Tsunamis are long period waves generated by disturbance in the water column and may be caused by: tectonic movement, underwater landslides, volcanic eruptions or meteor impacts. An assessment in 2009 indicated that Tuvalu has the third lowest tsunami hazard of the Pacific countries assessed, with a maximum tsunami amplitude of 1.6m for a 2000 year return period (comparatively the highest is 5.2m for PNG and the lowest is 1m for Nauru).[33]

Looking at the islands of Tuvalu, the assessment found that most of the energy originating from Tuvalu's major source of risk (the New Hebrides trench) is likely to be directed towards the southern islands of the archipelago due to the orientation of the trench. Subsequently the maximum tsunami amplitude (2000 year return period) is lower for the norther islands when compared to the national maximum of 1.6m in Nukulaelae (the most southern island). The maximum amplitudes for Nanumaga and Nanumea is 1.1m[34,35]

6.3.6 Climate Change

The Pacific-Australia Climate Change Science and Adaptation Planning Project (PACCSAP) is using Conformal Climate Atmospheric Models (CCAM), at 60km downscaled dynamic modelling, to predict the possible impacts of climate change over the next 90 years (**Table 4**). Dynamic downscaling is a methodology for providing more detailed climate projection information for a specific region, in this case in Tuvalu.

The models predict that, in Tuvalu over the 21st century, surface air temperature and sea surface temperatures are projected to increase. There is a very high confidence in this prediction among the models. The majority of the models simulate a <1°C increase in annual and seasonal mean temperature by 2030, however by 2090, under a high emission scenario, temperature increases greater than 2.5°C are simulated by almost all models.

The wet and dry season annual average rainfalls are projected to increase by less than 5% by 2030, however by 2090 most of the models agree that a >5% increase can be expected by 2090. While the baseline hasn't been provided in the report, for extreme rain events, the intensity and frequency of days of extreme rainfall are projected to increase with a high confidence in these projections. The majority of models simulate an increase of at least 20mm in the amount of rain received on the 1-in-20 year wet day by 2055 under a low emission scenario, with an increase of at least 35mm by 2090 under the high emission scenario. The majority of models also predict that the 1-in-20 year extreme rainfall event will occur, on average, four to five times per 20 year period by 2055 under the low emission scenario and six to seven times per 20 year period by 2090 under the high emission scenario.

The incidence of drought is expected to decrease over the 21st century. It is predicted that mild drought will occur approximately eight to nine times every 20 years by 2030 under all emission scenarios, decreasing to six to seven times per 20 years by 2090. The frequency of moderate to severe drought is

[32] Global Facility for Disaster Risk Management: http://thinkhazard.org/en/report/252-tuvalu/EQ
[33] Thomas, C and Burbidge, D (2009). A Probabilistic Tsunami Hazard Assessment of the Southwest Pacific Nations. Geoscience Australia Professional Opinion. No. 2009/02
[34] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumea Island, Tuvalu. Pacific Community (SPC)
[35] Lee, G., Roqica, D., Sovea, T. and Momoivalu, V. 2020. TCAP Preliminary Geotechnical Investigation Report: Nanumaga Island, Tuvalu. Pacific Community (SPC)

projected to remain approximately stable from 2030 through the 21st century at once to twice and once every 20 years respectively.

Tropical cyclone predictions indicate a decrease in the frequency of cyclone events in the southeast basin of the Pacific. Having said this, there is very little consistency between the six models used for the spatial patterns of the predicated change in wind hazard. There were some common trends shown in each model with most models indicating a reduction in cyclonic wind hazard north of 20°S and some regions of increased wind hazard south of 20°S. Although it is still difficult to detect clear trends in Tuvalu specifically recent observational assessments alight with international climate simulations and indicates that the number and relative intensity of tropical storms are increasing in the tropical Pacific.[3637]

Mean sea level (Figure 34) is projected to continue to rise over the course of the 21st century with a very high confidence. The models predict a rise of between approximately 5-15cm by 2030, with increases of 20-60cm indicated by 2090 under high and medium emission scenarios.

Table 4: Projected change in the annual and seasons mean climate for Tuvalu, under low (blue), medium (green) and high (purple) emission scenarios [38]

Variable	Season	2030	2055	2090	Confidence
Surface air temperature (°C)	Annual	+0.7 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.3	+1.1 ± 0.4 +1.5 ± 0.5 +1.4 ± 0.4	+1.5 ± 0.6 +2.3 ± 0.8 +2.7 ± 0.6	High
Maximum temperature (°C)	1-in-20-year event	N/A	+1.0 ± 0.6 +1.5 ± 0.6 +1.5 ± 0.5	+1.4 ± 0.7 +2.1 ± 1.1 +2.7 ± 1.3	Low
Minimum temperature (°C)	1-in-20-year event	N/A	+1.2 ± 1.8 +1.5 ± 2.0 +1.5 ± 1.8	+1.6 ± 1.8 +2.2 ± 2.0 +2.4 ± 1.9	Low
Total rainfall (%)*	Annual	+3 ± 8 +3 ± 8 +4 ± 8	+7 ± 11 +7 ± 10 +7 ± 12	+7 ± 12 +12 ± 14 +11 ± 18	Moderate
Wet season rainfall (%)*	November-April	+3 ± 10 +3 ± 9 +4 ± 8	+7 ± 9 +6 ± 11 +6 ± 10	+7 ± 11 +11 ± 14 +11 ± 16	Moderate
Dry season rainfall (%)*	May-October	+3 ± 10 +4 ± 11 +5 ± 13	+7 ± 16 +7 ± 16 +8 ± 19	+8 ± 18 +12 ± 23 +12 ± 26	Moderate
Sea-surface temperature (°C)	Annual	+0.6 ± 0.4 +0.7 ± 0.3 +0.7 ± 0.4	+1.0 ± 0.3 +1.3 ± 0.4 +1.3 ± 0.5	+1.3 ± 0.5 +2.1 ± 0.6 +2.5 ± 0.6	High
Aragonite saturation state (Ωar)	Annual maximum	+3.6 ± 0.1 +3.5 ± 0.2 +3.5 ± 0.2	+3.3 ± 0.1 +3.2 ± 0.2 +3.2 ± 0.1	+3.2 ± 0.2 +2.8 ± 0.2 +2.6 ± 0.2	Moderate
Mean sea level (cm)	Annual	+9 (4–14) +9 (5–14) +9 (4–14)	+17 (9–25) +19 (10–29) +19 (9–28)	+31 (16–45) +37 (19–56) +39 (19–58)	Moderate

[36] Global increase in major tropical cyclone exceedance probability over the past four decades. 2020 PNAS. James P. Kossina,1, Kenneth R. Knappb, Timothy L. Olanderc, and Christopher S. Veldenc

[37] Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment 2019 Science Vol309 P. J. Webster,1 G. J. Holland,2 J. A. Curry,1 H.-R. Chang1

[38] Tuvalu Country Report, Pacific Climate Change Science Program, 2013

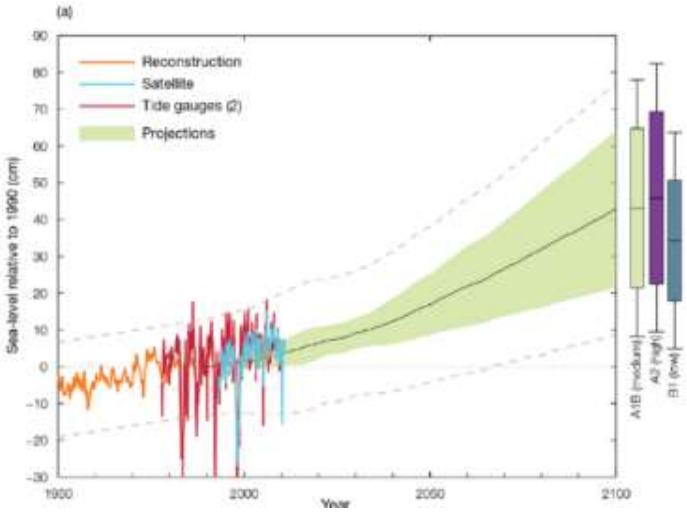

Figure 34: Observed and project relative sea-level change near Tuvalu[21]

6.4 Biological Environment

6.4.1 Terrestrial Environment

Flora: Of the approximately 200 plants species (list not available) recorded in Tuvalu, it is estimated about 50 are indigenous[39]. Most of the exotic species are ornamental, food plants or weeds. On Nanumaga, there are 51 plant species recorded[40], although not surveyed, approximately the same is expected on Nanumea due to their similar geography, elevation and history.

The indigenous terrestrial flora of Tuvalu is highly disturbed, and the flora is now numerically dominated by introduced species. This has been the result of human development on the islands for hundreds of years. On Nanumea, further disturbance has occurred from extensive excavation and habitat destruction where a "borrow pit" was created to access material to build airstrips during WW2.[41]

There are no plant species endemic to Tuvalu, with almost all of the indigenous plants being widespread, easily dispersed pan-tropical or pan-Pacific coastal species that have the ability to cope successfully in atoll environments. The most widespread vegetation type in Tuvalu is coconut-dominated agroforest or woodland.[42] The term agroforest is used to describe those agricultural lands dominated by deliberately planted or protected useful trees, in this case almost exclusively the coconut palm (Nui, *Cocos nucifera*), although useful indigenous trees, such as Pua (*Guettarda speciosa*), Foa (*Neisosperma oppositifolium*) and Nonu (*Morinda citrifolia*) are often protected and allowed to remain. Pandanus, breadfruit and other useful trees are planted, sometimes as small tree groves, in more favourable sites, usually near villages, residences or around excavated taro pits.

Excavated taro pits (pulaka pits) are unique, specialised and highly modified communal garden areas found in the center parts of larger atoll islets, normally near the main settlements. The pits have been excavated to the level of the freshwater lens through limestone bedrock to depth of 1.5 to 2m. The improved humus rich soils in these pits are swampy and blackened with organic material and have been

[39] Tuvalu National Environmental Management Strategy, Department of Environment, SPREP, 1997
[40] Nanumaga Island Profile, Ministry of Home Affairs, 2012
[41] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016
[42] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016

formed over many years by adding mulch or compost. The main crop planted on the islands is the Giant Swamp Taro (pulaka, *Cyrtosperma chamissonis*). Nanumaga has two main pulaka pits (Figure 35), while Nanumea has a series of smaller pits on the islet of Lakena, away from the main settlement and the TCAP project site (Figure 36).

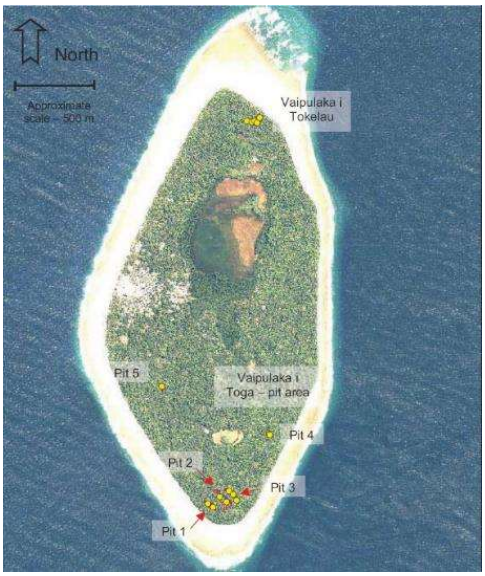

Figure 35: Community pulaka pits at the northern and southern end of Nanumaga. Source: Tuvalu Technical Report. Assessment of Salinity of Groundwater in Pulaka Pits in Tuvalu, SPC 2007

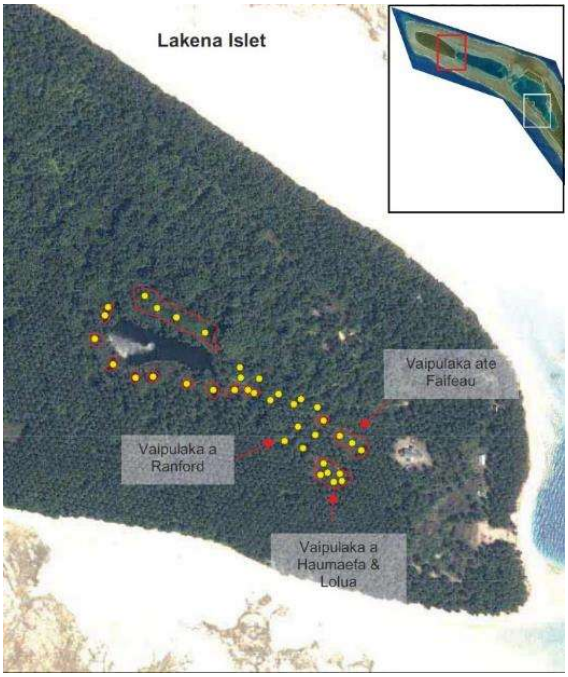

Figure 36: Community pulaka pits on Lakena Islet in Nanumea. Adapted from: Tuvalu Technical Report. Assessment of Salinity of Groundwater in Pulaka Pits in Tuvalu, SPC 2007

Indigenous broad leaf species, including *Calophyllum inophyllum*, make up single trees or small stands around the coastal margin. These trees are also useful for providing protection against erosion along the foreshore and assist in reducing the inland penetration of salt spray.

The interior of Nanumaga has two tidally influenced salt water lagoons surrounded by mangrove trees comprised of the two recorded mangrove species in Tuvalu, the common Togo (*Rhizophora stylosa*) and the red-flowered mangrove Sagale (*Lumnitzera littorea*), which is only reported on Nanumaga, Niutoa, Nui and Vaitupu.[43] The mangrove forest of the northern Vaiatoa lagoon is by far the largest, covering an area approximately 20 hectares and reaching to the village settlements. Mangrove ecosystems are protected under Tuvaluan law. A causeway of crushed stone crosses the southern mangrove area of Vaiaota linking the village areas of Tonga and Matematefaga.

Both project sites front the main island village areas. Vegetation here is sparse with the villages having the only significant area of cleared land on the island. The vegetation line between the village and the beach is formed mostly of coconut trees which provides erosion control and salt spray barrier functions, but the vegetation lines are thinning in these areas with each significant storm event.

Fauna: There are no indigenous land mammals, amphibians or freshwater fishes in Tuvalu. There are a number of terrestrial reptiles, all lizards, one of which is Tuvalu's only recorded endemic vertebrate, the Tuvalu Forest Gecko (*Lepidodactylus tepukapili*), which is found on Tepuka Islet, Funafuti.[44] Of particular importance are 28 species of indigenous birds, approximately 20 of which are sea birds, and a few are migratory species[45].

Notable terrestrial invertebrates are land and shore crabs including Paikea (*Cardisoma rotundum*), Tupa (*Cardisoma carniflex*), kamakama (*Grapsus albolineatus*), a range of hermit crabs, uga (*Coenobita spp*) and the coconut crab, uu (*Birgus latro*). Seven of the crab species are reported to be eaten in Tuvalu with most of the smaller crabs being used as fish bait and bait for bird traps (NBSAP 5). Also important are a range of land snails, misa (*Melampis spp*) used to make shell leis (ula) and handicrafts.

As environmental assessments have not been possible within the project footprint to inform this ESIA, it should be assumed that the faunal species may occur within the project areas but are expected to be low in abundance along the project footprint as it is altered habitat. With the bird species, as their use of the coastal vegetation is for roosting or nesting, it can be assumed that they would generally prefer uninhabited areas of the islands so the risk of impacts to nesting are relatively low.

6.4.2 Marine Environment

The living reef systems and reef flats around Nanumaga and Nanumea produce the island's sand, so it is important to understand the health of those reefs to inform the impact assessment. Surveys of the two islands have been undertaken at different times by different projects[39, 42]. The methodologies differed between the studies therefore results are not directly comparable. To account for this, each island is discussed separately below.

6.4.2.1 Nanumaga

Under the ADB Outer Island Marine Investment Project (OIMIP) project preparation work, an environmental baseline report of the Nanumaga marine environment was commissioned 2016[46]

[43] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016
[44] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016
[45] Watling, D. 1998. Funafuti Marine Conservation Area, Tuvalu. Report of the bird survey. Environmental Consultants Fiji, Suva
[46] Tuvalu Outer Island Maritime Infrastructure Project Baseline Ecological Investigation, Cardno 2016

(baseline survey). The survey looked at a 50m wide corridor around the existing boat channel within the TCAP project site and a reference site on the southwest shoreline. The boat channel site in the survey is within the TCAP project area and can therefore been considered directly relevant to TCAP. This subsection is informed by OIMIP report.

Reef Zones: The survey area was divided over three defining characteristics of the reef environment: the reef flat, reef crest and reef slope. Tuvalu's shallow marine environment, such as that found at Nanumaga and Nanumea, consist predominantly of fringing reefs with reef flats and intertidal rocky/sandy shores.

Methodology: The baseline survey sampling was undertaken by snorkel from a small tender and also from the shore on foot at low tide. The percentage cover of coral, macroalgae, coral rock, coral rubble and soft sediment was estimated visually at the sites to provide a broad assessment of marine ecology and with which to compare any potential future changes. Figure 37 shows the sampling points at all surveyed locations (including the location of a third survey site (southwest location), which has been disregarded and is not discussed in this section). The data collected during this sampling form the baseline condition.

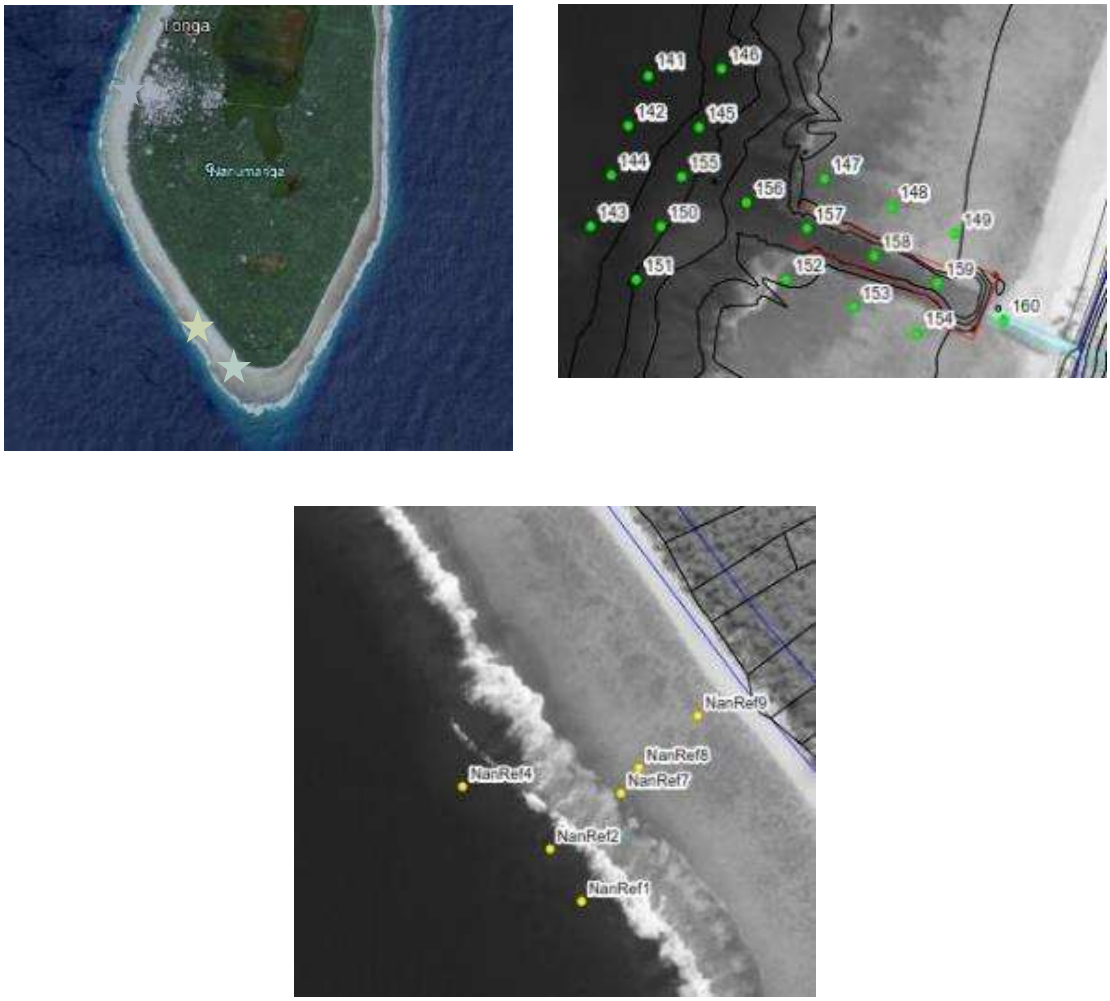

Figure 37: Marine environment survey sites (top left), sample sites at boat channel (top right) and sample sites at reference site (bottom)

Photos and videos of each site, including the corals, macroalgae and other biota (fish and mobile invertebrates) present, were taken for subsequent identification. A towed underwater video camera with a live video feed was also deployed from the vessel to investigate habitats in deeper parts of the reef slope at the seaward margin of the surveys sites and buffer. Percentage cover data were interpolated using 3D analysis in ArcGIS to generate a model representing the spatial distribution and percentage cover of coral and macroalgae at each survey site.

Results: Overall there was a notably lower percentage of live coral cover at the existing boat ramp than there at the reference site. Mean percentage live coral cover (LCC) was assessed in terms of reef flat, reef crest and reef slope. Table 5 shows that LCC for the reef flat at the boat channel site is 0%, at the reef crest is 1% and on the reef slope is 12.5%. At the reference site, LCC on the reef flat is also 0% with 10% LCC on the reef crest and 8.5% on the reef slope.

The highest level of LCC at the boat channel (12.5% on the reef slope) is considered to be a low level compared to national (LCC 20-30% across Funafuti, Nanumea and Nukulaelae) and regional (30-70% LCC across reefs in Kiribati).[47] Globally, the standard criteria for coral reef health define a LCC level of less than 24.5% as being low indicating that the reef at both sites are in poor health.[48]

Table 5: Nanumaga marine baseline survey percentage cover substrate types. Adapted from Cardo 2017 Marine Ecological Survey

		Mean Percentage Cover (%)			
Location	Reef Zone	LCC	Macroalgae	Coral Rock	Rest (coral rubble/soft sed/recently dead)
Boat Channel	Flat	0.0	0.0	95.0	5.0
	Channel	0.0	0.0	95.0	5.0
	Crest	1.0	0.0	94.0	5.0
	Slope	12.5	0.0	86.3	1.3
Reference Site	Flat	0.0	20.0	77.5	2.5
	Crest	10.0	10.0	80.0	0.0
	Slope	8.5	5.0	86.5	0.0

The distribution of coral cover at the Nanumaga boat channel site showed an increasing percent of LCC with increasing distance from the shore. This distribution was similar but less defined at the reference site. Only three corals of families (Merulindae, Pocilloporidae and Poritidae) were recorded at the boat channel, while at the reference site, over seven families were recorded.

No macroalgae was recorded at the boat channel site but was present at the reference site in all reef zones with mean percentage cover being greatest on the reef flat, then decreasing with increasing distance from shore. Macroalgae species recorded included red filamentous and brown encrusting algae (*Caulerpa racemose, Halimeda sp., Dictyota covernosa* and *Padina sp.)*

[47] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012
[48] A Standard Criteria for Assessing the Health of Coral Reefs: Implication for Management and Conservation, IUCN 2014

By far the most dominate substrate type at the boat channel site and the reference site was coral rock providing over 85% at all reef zones at the boat channel. Other substrate types (such as sand) accounted for 5% or less of the substrate type across the project site.

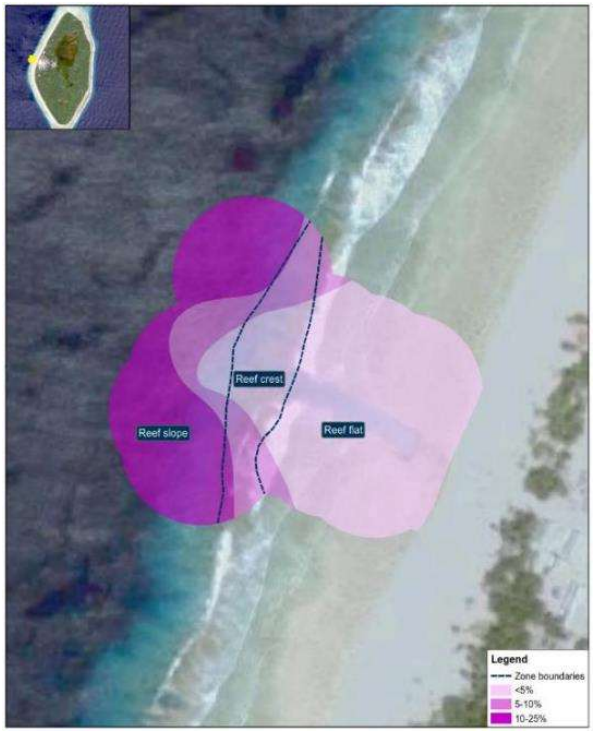

Figure 38: Percentage Live Coral Cover at existing boat ramp, Nanumaga.

Figure 39: Percentage macroalgae cover reference site, Nanumaga

Fish Assemblages and Macro Invertebrates: Tuvalu has recorded 607 species[49] of fish in its waters, with the commonly calculated Coral Fish Diversity Index (CFDI) bringing the estimated number of fish for Tuvalu to 711 species. A comparison between Tuvalu's CFDI and comparable Indo-Pacific locations shows that Tuvalu's fish diversity is close to the upper third of the regional estimates.[50]

During the OIMIP marine survey, a total of 68 species of fish from 15 families were recorded during the surveys of Nanumaga across all locations surveyed. Of the 68 species, 11 can be considered to be commercial (or subsistence) species from the snapper, grouper, trevally, and parrotfish families. Families of fish represented by the greatest number of species included surgeonfishes (Acanthuridae), butterfly fish (Chaetodontidae), wrasses (Labridae), damselfishes (Pomacentridae), parrotfishes (Scaridae) and groupers (Serranidae). The most commonly observed fish species at Nanumaga included in the velvet surgeonfish (*Acanthurus nigricans*), blue lined surgeonfish (*Acanthurus lineatus*), pinktail triggerfish (*Melichthys vidua*), steephead parrotfish (*Cholorurus microrhinos*) and blackvain parrotfish (*Scarus rubroviolaceaus*). The holothuroid echoderm sea cucumber (*Holothuria atra*) and gastropod whelks were abundant in the reef flat. Several starfish (families Echinasteridae and Oreasterisdae) we observed on the reef crest and slope.

[49] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012
[50] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012

6.4.2.2 Nanumea

A survey of the Nanumea reef, was carried out in 2012 in the lagoon and Community Conservation Area (see Section 6.4.3)[51]. The survey did not have any sampling sites along the reef parallel to the TCAP project site, but the results can still be considered to be reflective.

Of the three islands (Funafuti, Nanumea and Nukulaelae) surveyed for the Tuvalu Marine Life Scientific Report (2012), Nanumea had the overall highest fish density, while fish biomass was higher in Funafuti. The study matched the density estimate to the relatively low biomass values suggests that on Nanumea there are large numbers of small fish, which was consistent with the large number of juveniles found in the lagoon and the high abundance of small wave-tolerant species found on the highly exposed outer slopes. Despite the lower fishing pressure on Nanumea compared to the more densely populated atolls, larger fish were scarce, most likely due to the relatively small size of the atoll and low diversity of available habitat[52].

In terms of LCC Nanumea has between 20-30%, but the study sites did vary significantly in some aspects of the benthic communities: the lagoon in particular had distinctive benthic assemblages. The results of the 2012 survey seem to indicate that Nanumea may have a higher percentage of live coral cover than Nanumaga. The survey did confirm that Nanumea has the highest and richest coral community of the three islands covered.

Macroalgal cover in Nanumea was higher closer to inhabited areas which is consistent with the other atolls surveyed, suggesting higher levels of nutrients in the water due to urban waste. No systems exist in Tuvalu for treating wastewater, which enters the ocean and lagoon directly or through seepage of the freshwater lens.

The Nanumea CCA did not stand out as having a particularly high fish diversity, density or biomass. This is probably due to the sampling methodology not being designed to compare inside and outside CCA areas and also because, at the time of the survey the Nanumea CCA was relatively new and there is often a long time lag between cessation of fishing and a measurable ecological change[53].

The Tuvalu Marine Life Scientific Report created a synthesis map of Nanumea to present a visual summary of their findings (Figure 40).

[51] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012
[52] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012
[53] Russ GR & Alcala, AC (2004) Marine reserves: Long-term protection is required for full recovery of predatory fish populations. Oecologia 138:622-627

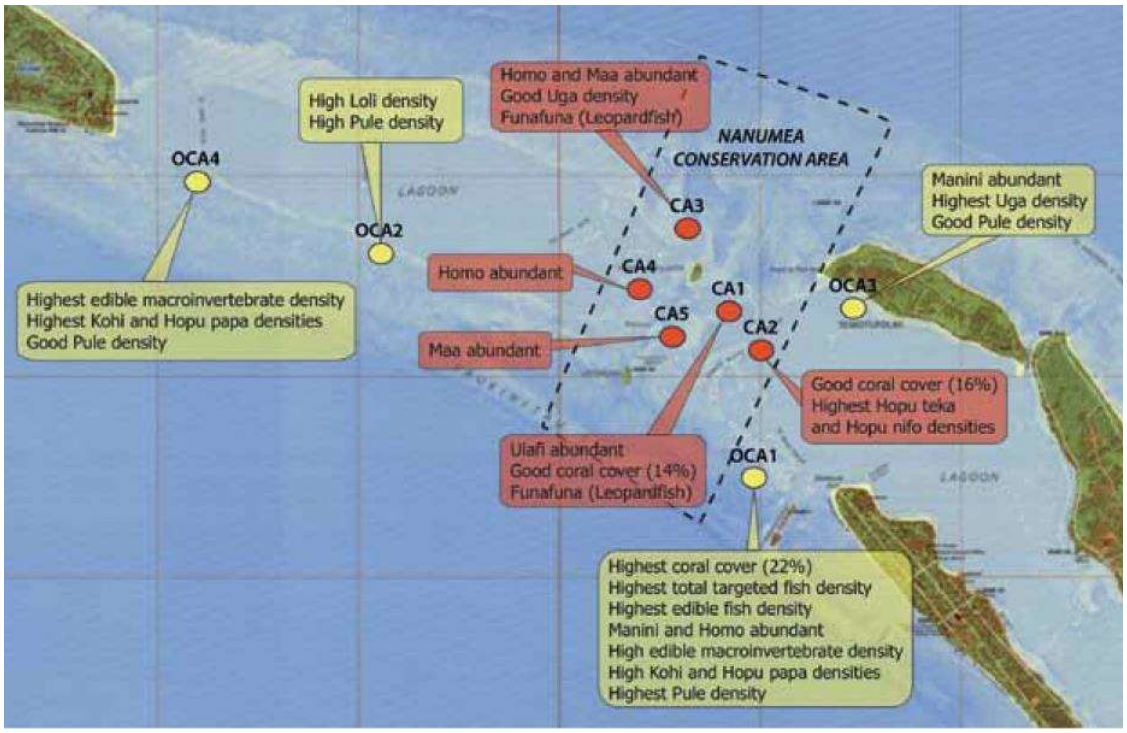

Figure 40: Synthesis map showing the points of interest at all stations investigated in Nanumea atoll. Source: Tuvalu Marine Life Scientific Report (2012)

6.4.3 Local Marine Managed Areas

Nanumaga has an actively managed Locally Managed Marine Area (LMMA). The LMMA encompasses the entire island both on the eastern and the western site. Additionally, it states that no fishing is allowed on the reef on the western side of the island, except handlining. Spear fishing is also totally banned on the island. If anyone is caught breeching these community determined rules, they will have to feed the whole community with any food that they or their family can provide[54]. One of the key fishing grounds identified for the community of Nanumaga is a sea mount located approximately 4km northwest of the village, just off the northern tip of the island and outside of the TCAP impacts. This sea mount has been declared a 'no anchor zone' to protect this important fishing ground.

[54] Environmental and Social Impact Assessment, World Bank Maritime Investments in Climate Resilient Operations, Tuvalu, 2018

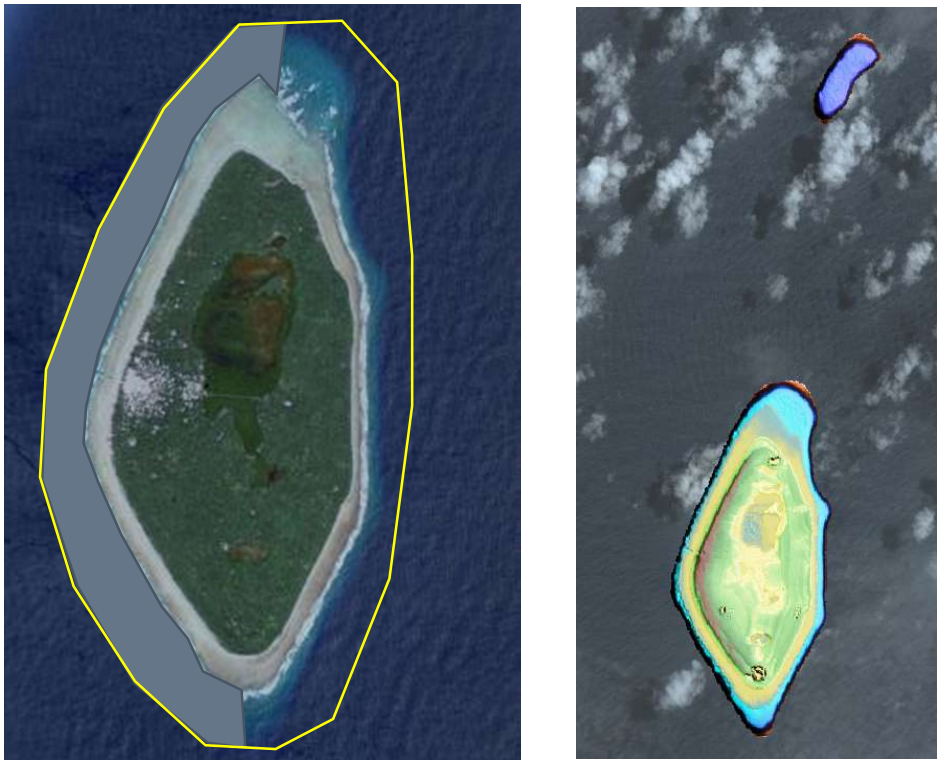

Figure 41: Left - Nanumaga LMMA approximate boundary (yellow) and no fishing zone approximate area (grey). Right – 2019 Lidar showing proximity of off-shore northern emergent reef in relation to Nanumaga.

Nanumea also has an LMMA which includes the whole lagoon and the Community Conservation Area (CCA) (Figure 42). The use of nets and spearing has been prohibited in all parts of the lagoon area since the early 1990s, while the CCA was established in 2006 as a no-take zone covering about 20% of the total reef area for Nanumea. A formal bylaw was made by the Kaupule in 2014 to enforce the area and fines of AUD$100 per person are issued to those poaching inside the CCA.

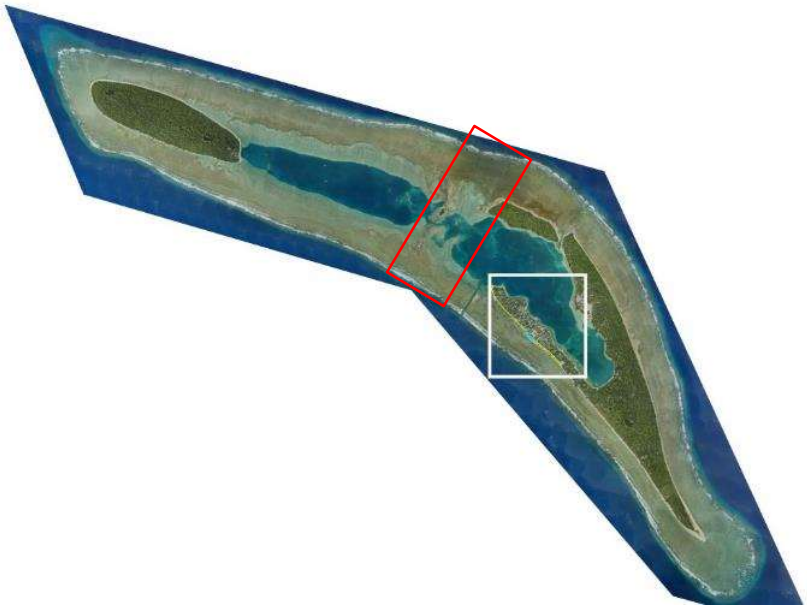

Figure 42: Nanumea Community Conservation Area in shown in red (approximate boundaries) in relation to TCAP project site shown in white bounded box. Source: Adapted from TCAP LiDAR Imagery

6.4.4 Vulnerable and Endangered Species

The current IUCN Red List database provides summary information regarding the number of threatened and protected species by country (Table 6). This indicates that for Tuvalu there are a total number of 1023 of animal species listed, including those that are endangered, vulnerable and near threatened. A large proportion of those species are lower risk/least concern and/or data deficient. These include several species of sharks and rays, sea snakes, whales, marine turtles and corals from at least 12 families. Green turtles (*Chelonia mydas*) are the most common threatened species seen in waters, however neither they, nor any other Red List turtle species, nest on the beaches within the TCAP areas.

Table 6: IUCN Red List categories: EX - Extinct, EW - Extinct in the Wild, CR - Critically Endangered, VU - Vulnerable, LR/cd - Lower Risk/conservation dependent, DD - Data Deficient, LC - Least Concern

Category	EX	EW	CR	EN	VU	NT	LR/cd	DD	LC	Total
#Species	0	0	0	8	87	118	3	56	751	1023

The Tuvalu Marine Life Report[55] has verified the IUCN Red List status for all commercially important fish species or fish species of global conservation concern recorded in Tuvalu. For coral species, reef surveys undertaken for the WB MCIRO project show that, only three families of coral were identified: Merulindae (one *Favites Sp*.), Pocilloporidae (two *Pocilloporal Spp*.) and Poritidae (one *Poirities Sp*.). In the IUCN Red List species-specific information for the south-west pacific marine region, all *Favites Spp*., *Pocilloporal* Spp., and *Poirities* Spp. are listed as vulnerable. In the project survey Site No. 146 recorded 3 of these 4 vulnerable species and Site No. 145 recorded the remaining one. Most corals in the south-west pacific are listed as vulnerable or higher on the IUCN Red List.

[55] Tuvalu Marine Life Scientific Report, Alofa Tuvalu & Department of Fisheries, 2012

6.4.5 Invasive and Alien Species

As the proposed project may be importing machinery and equipment into Tuvalu and transporting it to outer islands, it is important to have an understanding of the current threats and impacts from invasive species both on the native biodiversity and the economy.

The NBSAP highlights the following[56] which are of relevance to the proposed project:

Agricultural Pests: On Nanumaga, the coconut scale insect (*Aspidiotus destructor*) has severely infested the coconut palms, breadfruit, papaya, bananas, pandanus and slightly affects the principle rootcrop crops (giant swamp taro and taro) and other cultural trees such as frangipani and *Premna serratofolia*. Chemical control, through spraying of soap, kerosene and malathion and the cutting and burning of infested plant materials have been unsuccessful.

Other notable agricultural pests include pink mealybug, black mirid garden fleahoppers, aphids and the delphacid planthopper, all of which cause leaf deformation and yellowing due directly to the pests or pest acting as vectors of plant viruses.

Of recent concern is the threat posed by fruit flies of the genus Bactrocera that have cost millions of dollars in the pacific region in lost fruit export income and control costs. The neighbouring islands of Fiji, Wallis and Futuna, Niue, Tonga, Rotuma, Samoa, Cook Islands, Nauru, American Samoa, French Polynesia and the Queensland region of Australia are all home to economically damaging Bactrocera Spp.

Invasive plants: Wedelia or trailing daisy (*Sphagneticola tribolata*), a plant native to the Caribbean that has spread throughout villages, along roadsides, into open lots and has colonized outer beach vegetation where it outcompetes important medicinal plants and other native species of cultural importance. It is considered one of the world's 100 worst invasive species. Once established it is almost impossible to eradicate and is slowly replacing many of Tuvalu's most important low-growing herbaceous species along beaches and roadsides and inhibits the growth of seedlings of threatened trees and plants.

Yellow Crazy Ant: Alien ants are considered one of the greatest threats to biodiversity and the yellow crazy ant (*Anoplolepis gracilipes*) (YCA), which was probably introduced with infested timber or sea cargo, was reported present in the early 2000s and is now causing serious problems in Tuvalu. The YCA, which forms dense multi-queen super colonies and releases an acid that burns on contact, preys on a wide range of plants, invertebrate and vertebrate animals including birds, crabs, and insects. YCA have wiped out crabs in infested areas and affected birds, geckos, plants and organism on many islands, such as Christmas Island in the Indian Ocean. On Funafuti the YCA, has destroyed crops, attacked animals such as chickens, land crabs, hermit crabs and coconut crabs and threatens seabird populations. The YCA has also spread to Nanumea and to Nanumaga where it has formed several super colonies across the island (pers obs, June 2018) and is reported by the Kaupule as being responsible for loss of lizards, crabs, chickens and other birds. The SPC are in the early stages of a baiting program on Nanumaga and a toolkit (www.piat.org.nz) has been developed to help Pacific Island nations to control the problem.

Kou Leafworm: in 2011 the kou leafworm (*Ethmia nigroapicella*) has had a devastating impact on Nanumea where it has destroyed the Kanava trees (*Cordia subcordata*), commonly known as the beach

[56] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016

cordia. The leafworm consumes the leaves of the trees leaving behind bare branches (Figure 43). Kanava trees are considered to be very important as they provide coastal protection, wind shelter, shade and are habitats for sea birds and other smaller organisms. The flowers of the Kanava are also locally prized. The devastation of the Kanava trees on Nanumea by the kau leafworm was considered a national, cultural and environmental disaster.

Figure 43: The invasive kou leafworm (*Ethmia nigroapicella*) (left) and a destroyed stand of Kanava trees on Nanumea (right) in 2011. Source: http://www.pestnet.org/

Invasive seaweeds: The rapid spread of a non-native brown seaweed (*Sargassum polycystum*) in Fogafale lagoon, beginning in 2011, is a major concern with its dense coverage reducing sunlight and outcompeting corals and making fishing difficult. It is suspected that the seaweed was brought via international shipping (through ballast waters, hulls or anchors), possibly from Wallis and Futuna where it is present. It seems to have become established following the prolonged drought of 2011 and has responded to localised nutrient enrichment in Funafuti lagoon.

Destructive Feral Animals: On Nanumea free roaming pigs have contributed to the loss of some plants, such as the laukatafa (bird's-nest fern), one of Tuvalu's only green vegetables, which is now found mainly on islands with no pigs.[57]

[57] Tuvalu 5th National Biodiversity Strategy and Action Plan, Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour, 2016

7 SOCIAL & BUILT ENVIRONMENT BASELINE

This section describes the baseline situation of Nanumaga's social and built environment. The section is largely informed by the 2012 Nanumaga and Nanumea Island Profiles[58] which were funded by NZ Aid and the UNDP as a tool to be utilised for leaders when it comes to planning and decision making and as a reference material for education and research.

7.1 Land Use

7.1.1 Nanumaga

The Nanumaga landscape is largely covered by the village settlements of Tonga and Tokelau, the two main pulaka pit areas, the mangrove forest surrounding the internal lagoons and the areas of general vegetation which includes coconuts, pandanus trees and other vegetation types as shown in Figure 44. As demonstrated by the grey footprint along the western shore in Figure 45, the proposed BTB will sit at the crest of the existing berm along the tree line and within the vicinity key infrastructure and sensitive social receptors including houses, communal structures including the old church footprint (where the community intends to rebuild), cargo storage house, the islands main Maneaba and the boat channel that is the main point of entry for inter-island vessels.

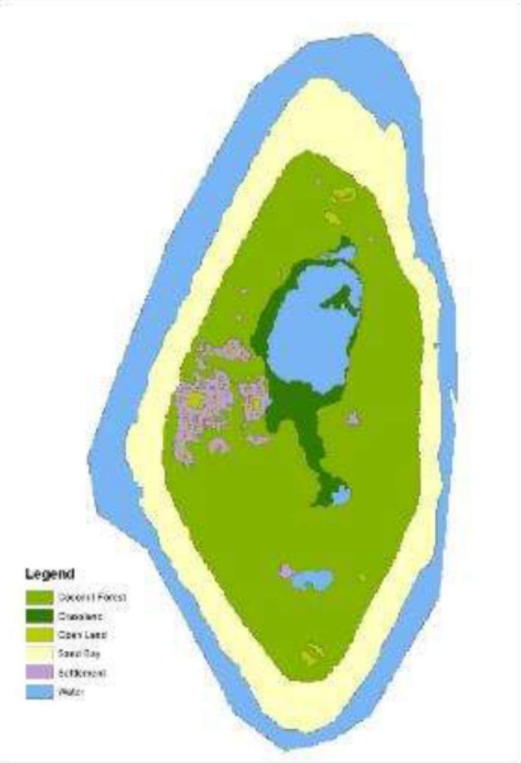

Figure 44: Land Use map of Nanumaga

Figure 45: Project area and nearby sensitive receptors

[58] Government of Tuvalu, 2010, Nanumaga Island Profile, Prepared by the Department of Rural Development, Ministry of Home Affairs

7.1.2 Nanumea

The land use and vegetation profile of Nanumea is no different to other islands of Tuvalu. The land is used mainly for pulaka cultivation, home gardening and livestock care. Most of the island is coconut woodlands (62%), coexisting with vegetation like pandanus, tamanu, half flower, kanava (Cordia spp) and other common tropical plants. There are mangrove forests, a small patch to the south and another on the islet of Lakena northwest of the village settlements. Figure 46 shows the functional infrastructure and social receptors clustered to the mid-section of the settlement.

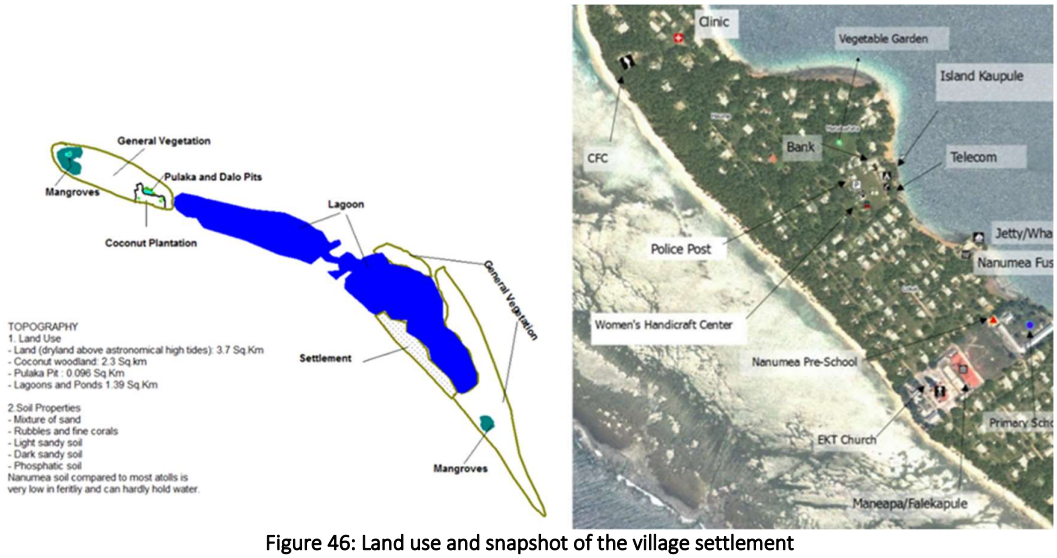

Figure 46: Land use and snapshot of the village settlement

7.2 Demographics

7.2.1 Nanumaga

The 2017 mini census in Tuvalu showed that Nanumaga has a population of 444 across the two villages. The island's population increased by 39% between 1979 and 1991 but had subsequently dropped by 55% when records were collected in 2002. In 2012, there appears a decrease by 125 people with a negative annual growth rate of -2.39%. These figures are indicative of ongoing outward migration from Nanumaga, mainly to Funafuti by people seeking better employment, social and healthcare opportunities. The 2017 census also showed that the Nanumaga population on Funafuti was nearly double that of the actual island community, at 722 people.

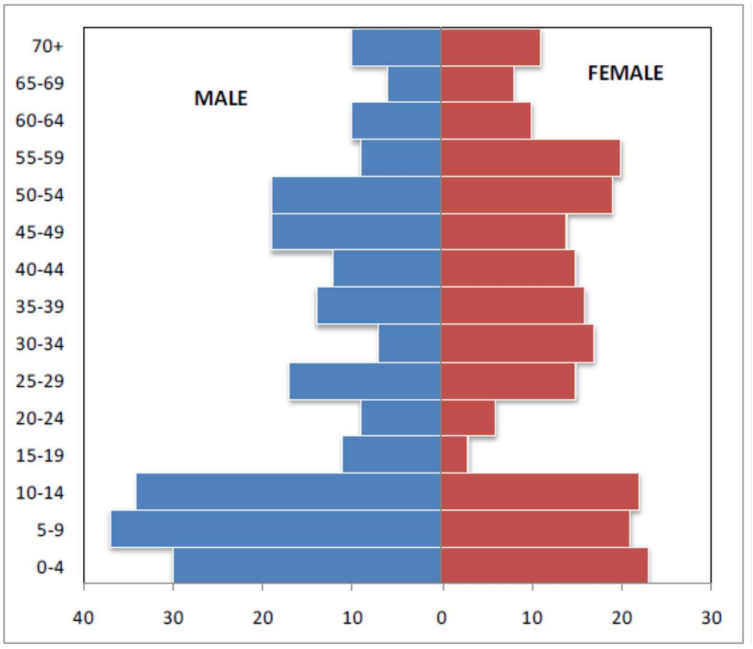

Figure 47: Nanumaga 2012 Population Structure

The 2012 population structure (Figure 47) shows that there are more men than women living on Nanumaga. The current population structure has a broad base from the 0-14 year's cohort indicating a growing population. At the 15-24 cohort, the population structure narrows, which could be down to students attending secondary school and tertiary education in Vaitupu and Funafuti. The 25-49 year cohort broadens with a higher percentage of females and then narrows again after the 60 year cohort.

The Nanumaga island population has increased by about 300 people since about March of this year when the Government of Tuvalu blocked all international flights due to the Covid-19 global pandemic. Nanumagans living in Funafuti were offered a free boat ticket to return to their island of origin to avoid economic or financial hardship

7.2.2 Nanumea

In 2017 Nanumea's population was 475 spread across its seven villages. Records since 1979 shows that Nanumea's population decreased by 2.4% in 1991 to 19.4% in 2002 and a further 20.6% in 2012. The constant decline in population is a result of migration in search of education, health and work opportunities in Funafuti and other islands of Tuvalu as well as outside of Tuvalu. Records show that there were 894 Nanumea people residing on Funafuti in 2012 which increased to 1,069 in 2017. The sex ratio of 51% as in the 2012 survey shows that there are slightly more males than females.

Population structure indicated the presence of very young and old generations with broad base (0-14years cohort), narrow mid-section (15-44 years' cohort) and a broad top section (45-59 years cohort). At age of 15-19 students attended secondary education on Vaitupu or Funafuti, and people leave at the age of 20-44 for further education and in search of employment. As they near the retirement age, the 49-59 years cohort start making their journey back to Nanumea. The structure becomes much narrower from the 60+ cohort which indicate low life expectancy due to mortality. It also indicates more women live longer than then their male counterparts pass the age of 65.

Population density has been dropping over the years since the first census in 1979 and continue to drop from 213 in 1991 to 136 persons per year in 2012 due to migration out of Nanumea. There's minor inward migration, 53 people in 2012, due to returning residents coming for holidays and workers posted

to work for the government or business on the island. The majority of the population settled in Hauma, Lolua and Haumaefa with 20% in the other three villages Vao, Matagi and Mataluafata according to the 2012 survey.

A majority of the population above the age of 15 years are married (59%) with equal number of male (91) and female (90). There are significantly more single males (39) than females (21). Single women are more likely to be widowed (82%) compared to men (18%). Those who are never married totals to 8 while those who are separated or divorced is 16.

The elderly population[59] continued to decrease over the years from 133 elderlies in 1991 to 127 in 2002 and further decline 127 in 2012. Based on the sex ratio of the elderly population there are more females than males consistently throughout 1991, 2002 and 2012 on the island. To support the elderly population from the age 70+ the government implemented an Elderly Support Scheme in 2009 administer by the Department of Community Affairs.

Total number of people with disabilities is very low with a range 16-36 according to the 2012 survey. The profile of disabilities on Nanumea within that range recorded physical (43%), hearing impairment (22%), speech and hearing (14%), mental health (14%) and vision impairment (7%).

The Nanumea island population has increased by about 255 people since about March of this year when the Government of Tuvalu blocked all international flights due to the Covid-19 global pandemic. Nanumeans living in Funafuti were offered a free boat ticket to return to their island of origin to avoid economic or financial hardship. Hence, the Nanumea population now stands at 750 with limited evidence to indicate a return to Funafuti for most of them in the near future.

7.3 Education

Tuvalu is a small island state with very limited resources and relies heavily on its people as its key asset. Therefore, education investments is key strategy for the country's development. The GoT allocated the largest portion (22%) of its annual budget in 2012 to the education sector which totaled around AU$6.1million.

Preschool education, for 3-5 year old's, is not compulsory. There is one preschool on Nanumaga and two on Nanumea. The preschool on Nanumaga has an average annual enrollment of 46 children. The Island Kaupule run the schools, although subsidized by the government. Pre-school enrollment is generally more represented by females. The preschools on Nanumea have an average annual enrollment of 46 (2012 survey), however this figure fluctuates due to inward and outward migration. In 2012 the Nanumea teachers were volunteers and often not qualified, however recently the Education Department have invested in preschool education with qualified teachers on payroll.

Primary school education is free and compulsory for all children. The national teacher:pupil ratio for Tuvalu is 1:25 with the Nanumaga ration being below this at 1:17, Nanumea has an even better ratio 1:14. On Nanumaga 100% of children of primary school are enrolled and attending school, with most students going to Motufoua Secondary School (MSS) on Vaitupu Island for their secondary education. The MSS is a public boarding school operated by the government with a 2012 roll of up to 495 students (295 females, 200 males), whereby 46 (29 female, 17 male) of came from Nanumaga. Nanumea recorded a lower attendance rate (79%) in the 2012 survey recorded, with enrollments dropping from 142 in 2009 to 115 students in 2010.

Secondary education level is more limited compared to the primary education, with only two educational institutions. Motufoua Secondary School operated by the Government is located on

[59] Elderly population is defined as those aged 60 years and above.

Vaitupu island and entry is limited to those who pass the national exam at year eight. The other secondary school is owned and managed by the Ekalesia Kelisiano[60] Tuvalu (EKT) subsidized by government. In 2011, there were 81 Nanumea students in Motufoua Secondary School out of the total 495 pupils. This is equivalent to 18% of total student population.

7.4 Health

The Princess Margaret Hospital in Funafuti is the country's only hospital, which is the primary provider of medical services for all islands of Tuvalu. The hospital is located about 1.3km north from the center of Funafuti. The hospital has 50 beds and offers basic routine medical, surgical, obstetric and gynecological services.

There are no private formal medical services on Funafuti. NGOs such as the Tuvalu Red Cross Society, Fusi Alofa (for the care and rehabilitation of disabled children), the Tuvalu Family Health Association and the Tuvalu Diabetics Association all have offices in Funafuti.

Prior to TC Pam in 2015, there was a medical clinic on Nanumaga with 4 inpatient beds and two delivery beds spread over 4 wards (male, female, children and general). Up to 4 medical personnel providing health services for people at the clinic. TC Pam damage to the clinic has been irrecoverable and it has now fallen into an abandoned state. There are now only 2 nurses on the island who work out of a small clinic behind ocean-facing main mwaneaba. Nanumea has three inpatients' beds and one delivery bed in one ward. Two nurses are supported by two other health workers on Nanumea. There are no doctors on Nanumea and Nanumaga islands, so any critical care case must be referred to Funafuti. Non-communicable diseases (NCDs) are one of the leading causes of mortality, including diabetes, hypertension, arthritis/gout, obesity and heart disease) and injuries or accidents. NCD reported cases from Nanumaga is very high at 20.8% which is the highest in the country. The most common NCD reported on the island is body aches and pain (38.4%) and lifestyle disease (33.3%). Nanumea has a much lower proportion of NCD reported cases at 11.1% with the most common being body aches and pain (43.9%) and lifestyle disease (7.1%). Communicable diseases are also high on Nanumaga at 21.7% of all recorded medical cases with the majority being for septic skin sores, respiratory tract infections and diarrhea. In Nanumea, communicable diseases account for 11.4% where the highest incidence of skin diseases is septic sores (210 cases in 2010) and where diarrhea and influenza were the most reported at 116 and 101 cases respectively.

The most important health security issues identified by men, women and youth in Nanumaga and Nanumea via the 2018 IVA survey, in order of priority, are as follows:

Table 7: Nanumaga community identified health priority issues by men, women and youth

Men	Women	Youth
Meeting coast of transportation to Funafuti hospital	Mosquito presence and vector-borne diseases	Meeting cost of transportation to Funafuti hospital
Meeting cost of installing adequate toilets, maintenance and upgrade	Meeting cost of transportation to Funafuti hospital	Meeting cost of installing adequate toilets, maintenance and upgrade
Low health resilience to droughts	Meeting cost of installing adequate toilets, maintenance and upgrade	Community members affected by diabetes
Lack of traditional healing knowledge transmission	Community members affected by diabetes	Low health resilience to droughts

[60] The main Christian denomination in Tuvalu

Inadequate toilet and kitchen waste disposal	Limited to no capacity to respond effectively to domestic violence	Lack of traditional healing knowledge transmission

Table 8: Nanumea community identified health priority issues by men, women and youth

Men	Women	Youth
Mosquito presence and vector-borne diseases	Mosquito presence and vector-borne diseases	Mosquito presence and vector-borne diseases
Meeting cost of transportation to Funafuti hospital	Meeting cost of transportation to Funafuti hospital	Community members affected by diabetes
Meeting cost of installing adequate toilets, maintenance and upgrade	Meeting cost of installing adequate toilets, maintenance and upgrade	Limited to no capacity to respond effectively to domestic violence
Low health resilience to droughts	Community members affected by diabetes	Low health resilience to droughts
Inadequate toilet conditions	Limited to no capacity to respond effectively to domestic violence	Lack of traditional healing knowledge transmission

7.5 Gender Equality and Empowerment of Women

Tuvalu has been progressive in its efforts to improve gender equality by ratifying the Convention on Elimination of all forms of Discrimination against Women in 1999. Immediately after ratification the Government developed its first National Women Policy in 1999, reviewed in 2005, 2011. In 2014 and in response to the trend at that time, the policy was updated with a twist to the title to read Tuvalu National Gender Policy. A Strategic Action Plan with five key areas was also developed to support the implementation of policy and climate change and environmental issues, gender was one of them. Integration of gender into budgets and annual plans is mandatory across all ministries. (Oxfam in the Pacific, 2020).

In terms of population proportions women have been underrepresented in parliament since independence in 1978. In the 2017 Mini Census Preliminary report 48.6% of the total population are women and so far, there has only been three female parliamentarians at different periods with very low number of electoral candidacies.

Tuvalu, although primarily a patriarchal and patrilineal society, has evidence of matrilineal practices. A traditional society is under the leadership of the *ulu aliki* (chief) supported by *matai,* which are the heads of family units (Oxfam in the Pacific, 2020). Traditionally, women are responsible for domestic duties and child rearing, while men tend to work outside of the home such as fishing, subsistence farming. Traditionally it is not common for women to hold positions of *ulu aliki* or *matai,* however with recent development in gender empowerment women have taken up leadership roles as *matai*, Kaupule member and presidents or Pule Kaupule(s) (OIP,2020).

7.5.1 Gender Based Violence

Like many Patriarchal societies domestic violence is common to everyday life in Tuvalu. Forty percent of women experienced physical and/or sexual violence in their lifetime (Pacific Women 2017). Eight percent of women experienced physical violence during their pregnancy. The majority of cases of violence towards women reported are caused by current spouse or intimate partner (90%) and others due to sibling hostility (8%). Almost one to five women (21%) have experienced sexual violence with 13% of women attested that their first sexual encounter was involuntary. The lack of community capacity to respond effectively to domestic violence cases was identified as the top five health concerns by women in Nanumaga and Nanumea (Table 7 and Table 8)

Women in Nanumea are the backbone of the community who, together with the youth, implement decisions made at the Falekaupule and Kaupule. There is a women organization known as the "Fafine Nanumea Katoa" that includes all girls and women from the age of 18 years and above. The organization is administered by a president, treasurer and secretary on two year terms. There is also the Nanumaga Island Women's Organisation that consists of a President, Treasurer, Secretary, and representatives from the five clans of the island as well as a representative from the Kaupule.

7.6 Economy and Employment

Tuvalu's economy is highly dependent on foreign earnings and official aid. Foreign earnings include interest received from the Tuvalu Trust Fund (TTF) and the Falekaupule Trust Fund (FTF), fish license, .tv, remittances from migrant labour and Tuvaluans residing abroad. Official aid is from Australia, China, EU, Japan, New Zealand, World Bank, UN agencies, Pacific regional development agencies, and others. Gross National Income (GNI) is considered to be a more useful measure to economic activity in Tuvalu compared with gross domestic product due to this high dependence on foreign earnings. GNI per capita averaged A$4,970 annually in 2015, making Tuvalu ready for Least Developed Country (LDC) graduation, although the Government resists such graduation due to the country's environmental and economic fragility. There are few career-oriented opportunities outside the government with slow growth in the private sector.

7.6.1 Nanumaga

Within a monetary-based economy people rely on employment, rent, land lease, pension, remittances, self-employment or ad-hoc businesses. Only about 66 people (22%) of the population aged 15 or above are employed, which is below the national average of 75 people per village. A total of 231 people of working age are not employed. Significantly, there are more females (53%) employed than males (47%). The main types of occupation on Nanumaga are classified as 'Professional and Technical' (22 people in 2012), 'Management and Administrative' (8 people), 'Clerical Support Workers' (20 workers), 'Production Workers' (14 people), and 'Agriculture and Fisheries' (2 people). The percentage of female workers under the professional and technical and clerical support categories is higher than males. Since 2002 there has been a decrease in the number of people employed as production workers, but an increase of workers in the professional and technical, management and administration and clericals support workers categories.

The main source of employment on Nanumaga is the Island Kaupule which employs 26 people (39% of the employed population), followed by the central government at 17 people (26%), public corporations such as Tuvalu Electricity Company (TEC) and Tuvalu Telecommunications Corporation (TTC) with 8 people (12%), the private sector with 5 people (8%), NGOs with 4 people (6%) and the lowest is seafaring and the self-employed (canteen owners) with 3 people each.

Pensions are paid to 17 people on Nanumaga under Tuvalu's Elderly Support Scheme which supports those in the population aged 70 and over with a monthly payment of AU$50 on the condition that they are resident in Tuvalu and are earning less than AU$4,000 per annum. The annual amount paid by the scheme in Nanumaga is AU$15,000.

Household remittance amounts include all members of households who are sending and receiving money. On Nanumaga, 58 households receive remittances monthly and out of these 42 households receive less than AU$150 per month and 16 receive more than that. Remittances into Nanumaga during 2010 from Funafuti total an estimated AU$10,352 which is the second highest amount in the country.

7.6.2 Nanumea

On Nanumea people participate predominantly in subsistence activities such as farming and fishing as their primary economic activity[61] as well as some monetary based activities such employment both self and by government. They also receive rent, land leases and pension. Only about 26% of the Nanumea population is engaged in paid employment. A third (33%) of the employed population work for the Kaupule, 25% work for the government, 19 percent are seafarers, 11% are self employed, 7 work for public corporations while the remaining 6% works for private businesses and NGOs. Nine of the 10 self-employed persons are women and their income is sourced mainly from canteens, baking, and local tobacco, oil and ice-block production. The main source of other income is from pensions and land leases. Pensions are paid to 26 people on Nanumea under the Elderly Support Scheme which supports those in the population aged 70 and over with a monthly payment of AU$50, as in Nanumaga. Up to 18 people receive payments for land leases of which 17 earn AU$50 and 1 earns AU$51-100 monthly.

7.7 Subsistence

7.7.1 Nanumaga

Subsistence activities refer to unpaid work which contributes to the household such as feeding the livestock, farming, fishing, cutting toddy, and handicraft making.

A total of 199 people (86%) over 15 years are not employed but are involved in subsistence activities while 32 people (14%) are not involved in any means of subsistence activity or employment (of these people 11 have a disability, 7 are elderly and 14 were visitors in 2012). There are more males involved in subsistence activities than females.

The most common subsistence activity is feeding of livestock with a total of 174 people (75%) involved in it, the next most common activities are cutting toddy (80 people), farming (71 people), fishing (69 people) and handicrafts (69 people).

Livestock is one of the major subsistence activities on the island as it is the main source of meat, especially with pigs and poultry. On Nanumaga, chickens make up 64% of livestock on the island followed by pigs (20%) and ducks (16%). Pigs are kept away from the villages in bush piggeries while chickens and ducks roam freely around the gardens.

Agriculture on Nanumaga provides for basic needs, however there are very limited vegetations that grow on the island. Coconuts are the most common food crop on Nanumaga where coconut palms cover most of the island. There are some varieties of vegetables, fruits and root crops which are common in agricultural activities but also provide subsistence to the local communities, among these is pulaka (swamp taro) which is grown in large man-made pits or in smaller raised beds. Nanumaga has very poor soil structure and therefore the pulaka requires a lot of effort to ensure its growth.

Nanumaga has a Community Fisheries Center (CFC) who's main purpose is to assist registered fishermen in marketing their fish by selling it on their behalf. In 2012 there were 24 registered fishermen under the CFC. Between 2005 and 2009 the total revenue generated by the Nanumaga CFC was AU$13,680. The CFC operates under the Island Kaupule with assistance from the Fisheries Department.

[61] https://globaledge.msu.edu/countries/tuvalu accessed at 1538 on 29th June 2020

7.7.2 Nanumea

On Nanumea there are 223 people involved in subsistence farming and from the data it can be inferred that apart from the 11 disable and 7 elderly people all those participants in the monetary economy also practice subsistence living. It can also be inferred that most are involved in more than one type of subsistence activity. As it is common in all the Islands, Nanumea men are expected to do one or all of the following feeding livestock such as pigs ducks and chicken (236 or 91%). One hundred and forty or 54% are involved in handicraft; 138 people or 53% undertake fishing and 110 people or 43% *Sali kaleve* or cut toddy and 81 people 31% are involved in farming. One hundred and forty or 54% are involved in handicraft; 138 people or 53% undertake fishing and 110 people or 43% *Sali kaleve or* cut toddy and 81 people or 31% are involved in farming.

7.8 Outer Island Structure and Governance

The local decision-making structure and governance for each island is defined in the chart below. The "Falekaupule" is the supreme decision maker. It is defined as the 'traditional assembly that composed according to the local customs of each island'. The local government structures consist of 3 main bodies: the main head which is the Falekaupule, the Kaupule which is the executive arm of the Falekaupule, and the Falekaupule Assembly which is the consultative forum where issues are tabled for discussion and includes anyone from the community 18 years or above.

The Falekaupule normally holds its meetings monthly in which they are briefed on minutes of the Island Kaupule meetings and also on issues that concern the community.

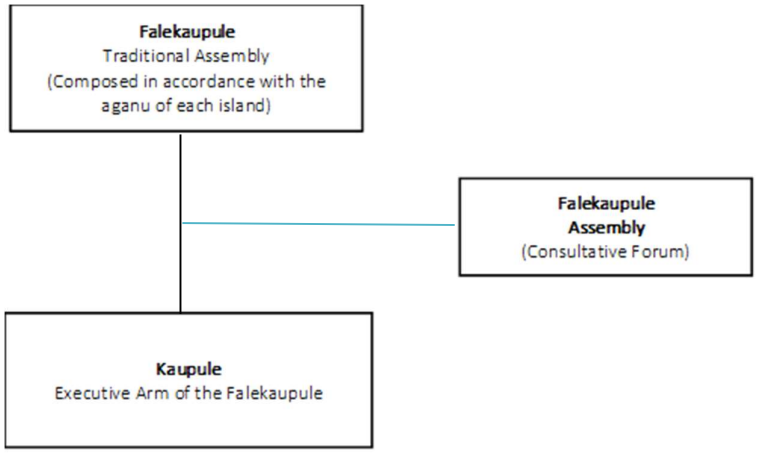

Figure 48: Local decision-making structure on Nanumaga

The Kaupule is a unique institution as it mediates between the traditional assembly and the government. Under the Falekaupule Act, the general functions of a Falekaupule includes local government functions related to agriculture, livestock and fisheries; building and town or village planning; education; forestry and trees; land; relief of famine or drought; markets; public health; public order; peace and safety; communications and public utilities and trade and industry.

The Falekaupule Act falls under the administration of the Ministry of Home Affairs, Rural and Urban development and the activities of the Falekaupule are funded, in part, by the Falekaupule Trust Fund which is a development trust fund set up between the Government and the Falekaupule of Tuvalu. The

purpose of the fund is to provide additional financial resources to support the development of the outer island communities.

7.9 Land Tenure and Rights

Land tenure and rights and within modern and customary laws will need to be considered and carefully navigated for the success and sustainability of this this project in the longer term. This project's footprint will be on the foreshore (for sand extraction) and land immediately beyond the foreshore (for BTB installation). The GoT does not own land, other than that as defined as 'foreshore' although it leases land from the native owners, usually via the Kaupule.

Section 2 of the Tuvalu Land Reclamation Act defines the foreshore as "the shore of the sea or of channels or creeks that is alternately covered and uncovered by the sea at the highest and lowest tides". Land beyond the foreshore is either held as *kaitasi*, land that is used and controlled for and on behalf of the extended family or *vaevae*, which is a division of lands amongst the *kaitasi*, generally smaller sub-units of the extended family.

The land on which a village sits is regarded as communal land. Section 15 (a) of the Tuvalu Lands code states that the land on which villages now stands (for all islands with the exception of Funafuti) "shall be used for the village in the same way as though it were communal land. If and when the village is moved elsewhere the lands shall revert to their owners". This distinction is important as the decision to install the BTB within the communal boundary of each village may be determined via consultations with the Kaupule and the community. If the BTB extends beyond the village communal land that approval should be sought from the relevant landowning unit.

Government and other corporate companies like the Tuvalu Electric Corporation have acquired lands through lease tenancy agreements with the respective landowning units. Recently a Native Lands Trust Board has been established to overlook the leasing of native lands as in the case of Funafuti where majority of the lands on Fongafale are under lease.

On Nanumea 62% of households own the land and the house on which it built, 36% only own the house and not the land while the rest 2.6% rent from government. In Nanumaga 73% of household dwellings are built on the owners land while 25% only own the house but not the land. Government workers on the island make up the 1% that are renting and living on the islands on a temporary basis.

The Kaupule of Nanumaga has designated access to the land where the BTB is to be established and with the support of the community members that were part of the consultations process. In such case, the tenure of land within the footprint of this project remains unchanged although and overlaying arrangement (e.g. lease) may be required to govern access and use of BTB area by the respective landowners and non-landowners. A similar situation and arrangement may also be applied in Nanumea once the Kaupule's support of the proposed BTB installation has been secured.

It may be well noting that the use of communal land for the BTB, under Section 15 (a) of the Tuvalu Lands Code, is only valid for as long as the village is located at its current site. Should the village relocate further inland, then the proposed land the establishment of the BTB returns to the individual landowning units.

7.10 Community Services

7.10.1 Solid Waste Management

The Tuvalu Department of Environment advocates good waste management practices. The preferred hierarchy and principles for achieving this is: (i) waste avoidance (avoiding using unnecessary material

on the projects); (ii) waste re-use (re-use material and reduce disposing); (iii) waste recycling (recycling materials such as cans, bottles, etc.); and, (iv) waste disposal (all other waste to be dumped at approved landfills).

Community consultations via the 2018 IVA highlighted that toilet and kitchen waste disposal were the top three health related problems that were separately identified by men, women and youth on Nanumaga. The Nanumaga Kaupule does not arrange for the collection of household therefore a fenced waste landfill with an incinerator is largely underutilised. On Nanumea the Kaupule arranges for the collection of household waste in Nanumea and deposits the waste in a fenced waste landfill.

Poko pits are the main means of waste disposal by households by burying, burning, disposing through own back yard, at sea or using compost. While the poko pits are used for composting organic waste, more non-biodegradable waste such as used diapers, plastics (bags and containers), glass and cans are also evident.

7.10.2 Water

In 2012, most households in Nanumaga (46 in total) owned water tanks with a storage capacity of 3,000 gallons (11,350L), 4 had a cistern and 10 had both a water tank and a cistern, while 4 houses did not have any water storage at all. Nanumaga had three large community water storage cisterns: at the church, the old medical center and the Falekaupule. The total amount of storage capacity for all the community storage facilities is about 450,000 gallons (1.7ML), which is currently insufficient for community needs. Furthermore, the church and medical center cisterns were damaged by TC Pam in 2015.

Nanumea as the most northern island in the group is more susceptible to long periods of drought compared to others. As a national priority, the Government of Tuvalu invested significantly in water security projects[62] which aim to improve and increase water storage facilities.

Nanumea, according to the 2012 survey has a total of 117 households across Haumaefa (37), Lolua (36), Hauma (21), Matagi (12), Vao (6) and Mataluafata (5). About 40% of the households are built from modern materials and 17.9% are thatched or made from local materials. The materials of the building particularly the roof influence the capacity of a household to collect water effectively.

From the survey, all households in Nanumea have storage capacity of more than 3000+ gallons (11,350L). Of the 117 households two have a water tank and a cistern, the remaining 114 households have water tanks while one household has neither.

7.10.3 Energy Sources

The government owned TEC is the only provider of electricity. Both islands run on almost entirely on solar power imported oil powered generators used as backup. Nanumaga has a 205kW solar array that provides electricity 24 hours a day to all connected buildings. About 91% (104 households out of 114) of households in Nanumaga and 95% (112 households out of 117) of households in Nanumea reported electricity as their main source of light while the remaining use kerosene of oil lantern or are without energy. The capacity of the batteries coupled with the current level of demand on Nanumaga means that usage levels are at 20% of supply and the island can go up to 4 days without sun before the back-up generator is used.

[62] International Water Resource Management, NAPA I

7.10.4 Transportation

The roads on Nanumaga and Nanumea are narrow and unsealed. A moderate number of scooters, three-wheel motorcycle trucks and small trucks use the roads. Pedestrians also use the roads as the main walking paths. There are several small tractors which use the roads along with a few small pieces of construction machinery.

The development of infrastructure on both islands in terms of roads and marines facilities has improved travel and trade access within and between islands as well as internationally. Motorcycles are the most common form of land transportation also with the use of cars, trucks, bicycles and handcarts. Outboard motors and canoes are used for sea transportation inter-islets while the use of two shipping vessels Manufolau and Nivaga II is for travelling long distance between each island in Tuvalu and especially connecting the outer islands to the Funafuti capital. Tuvalu has only one airport, located on Funafuti, and this serves three flights a week to Suva (Fiji's capital) via Fiji Airways.

On Nanumaga there were 58 households that have motorbikes in 2002 and this increased to 92 households in 2012, even though there was a decline in number of households by 65. The number of households with handcarts remained the same. Motorbike use in Nanumea increased from 65 households in 2002 to 131 households in 2012 with the use of bicycles decreasing from 103 households to 51 for the same period. Handcarts in Nanumea increased slightly from 45 in 2002 to 47 in 2012 and no households have a car or truck.

Canoes are the main means of transportation for both islands (over 50%). In Nanumaga, canoe use increased by 26 households (28 to 52) while outboard motor used decreased by 14 houses (37 to 23) between 2002 and 2012. In Nanumea, canoe use decreased from 62 to 43 households between 2002 and 2012.

Nanumaga currently has an unprotected 10m wide boat channel from which cargo is manually carried to and from the inter-island ferry workboats. The channel is located along the shoreline that the BTB is expected to sit. The boat landing, in particular, is located on the shores of the administrational centre of the island, where the old main church footprint and island mwaneaba are located. This boat landing will continue to be used. On Nanumea, similar "ship to shore" arrangements exist but in this case the smaller tender boats run through the "American Channel" and offload passengers and cargo at a small wharf within the protected lagoon. It is thus an easier, safer landing in Nanumea.

The maritime sector is crucial to connecting Tuvalu's outer islands with the country's main port in Funafuti. The small size of the outer islands and the infertile soil make inhabitants heavily reliant on shipping operations. Most foodstuffs (excluding local foods, such as fish, breadfruit, root crops, coconuts and some fruits), building materials, and manufactured products, as well as critical emergency relief after natural disasters, are imported from Fiji and distributed among the islands with inter-island vessels. The inter-island vessels visit each island with an average frequency of once every two to three weeks, depending on the length of the route. There is no viable alternative to these vessels as there are no domestic aviation services in the country.

7.10.5 Communication

The communication industry in Tuvalu has remained a government-owned monopoly via the Tuvalu Telecommunication Corporation (TTC). Connectivity to the outer islands including Nanumaga and Nanumea has changed significantly since the TTC upgraded the country's internet infrastructure to fourth generation broadband cellular network technology (4G) in late 2018. Since the upgrade, mobile phones have become a key medium of communication and information for most Nanumaga and Nanumea residents. This upgrade means that outer islands better connected to Funafuti and abroad. TTC services include internet, fax, and telephones, and emergency satellite phones.

In 2012, communications and information for most households was mainly sourced from radios, videos, television, telephones, and mobiles. In Nanumaga, radio was the most commonly used source of information in 2012 totaling to 66 (58%) households and followed by videos with 49 (43%) household. In Nanumea, 36 (48%) of household source most of their information from radios, followed by 33 (44%) by videos for the same period.

7.11 Cultural Heritage Resources

Culture underpins peoples' ability to live and thrive in Tuvalu's atoll environment. Tuvalu's culture is generally characterized largely by communal values whereby extended family and kinship networks channels the flow of knowledge and resources within and between islands as well extending to relatives abroad. Shaped largely by history of atoll life and journeys, Tuvalu's communal culture has been a source of community resilience in times of pressure stemming disasters, climate change and other pressures.

Decision making structure and governance in the outer islands is uniform across the islands of Tuvalu and as outlined in Figure 48. The structure was enacted in 1997 through the Falekaupule Act. The Act constitute the "Falekaupule" a traditional assembly as the ultimate decision maker. All island affairs are discussed and debated at the Falekaupule Assembly, a consultative forum which includes everyone above the age of 18. The assembly is operated under the leadership of the "Aliki or Pule Fenua" and the "matai(s)" of the island.

Tuvalu is rich with tangible cultural and natural heritage (e.g. monuments, artistic creations) and intangible (practices, stories, dances, expressions, knowledge and skills) cultural heritage. The 2003 Convention for the Safeguarding of the Intangible Cultural Heritage (ICH) specifies the interdependencies between the types of cultural heritage and the importance of the later to cultural diversity and driving sustainable development[63]. Some of the more significant examples of ICH are the fatele (traditional song and dance performance), alofa (presentation of performing arts and gifts such as mats and handicrafts to conclude visitors' welcome events) and traditional craftsmanship such as mat weaving, fan making, and shell necklace making[64]. Other key elements of ICH include pulaka (giant swamp taro) agriculture, traditional community fishing practices, canoe building and Te Ano games (cross between volleyball and murderball) played on communal malae (ground), all of which supports wellbeing and livelihoods[64] [65] [66].

Traditional canoes and fishing are still evident in Tuvalu, especially in the outer islands such as Nanumea and Nanumaga. As the cost of fuel in the outer islands of Tuvalu are generally high locally-produced canoes for fishing continues to be an economical choice for local fishers. Locals also generally believe that some fish such as the large yellowfin (takua), is more likely be caught by a sail-powered trolling canoe than by an outboard-powered boat.

These outrigger canoes are made from local trees. The fetau tree (Calophyllum inophyllum) is mostly used for the main hull (vaka) and outrigger beams (kiato), whereas the lighter-weight puka (*Hernandia nymphaeifolia*) is used for the outrigger (ama)[66]. Canoes made from puka can last more than 10 year if well cared for by painting and keeping it out of the sun when not in use. Canoes made from the fetau

[63] https://resources.riches-project.eu/glossary/tangible-and-intangible-cultural-heritage/#:~:text='Tangible%20Cultural%20Heritage'%20refers%20to,transmitted%20intergenerationally%20in%20a%20society.

[64] Government of Tuvalu, 2018, Tuvalu National Culture Policy Strategic Plan 2018-2024, Published by the Government of Tuvalu (http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Apia/pdf/265528e_compressed.pdf)

[65] https://blog.tepapa.govt.nz/2013/10/01/a-cross-between-volleyball-and-murderball-te-ano-national-game-of-tuvalu/

[66] file:///D:/Users/dumaru_p.LAUCALA/Downloads/TRAD8_20_Passfield.pdf

lasts much longer. The declining number of fetau trees for canoe building may determine the continued transmission of this cultural heritage.

Figure 49: Canoes a protected by painting and kept away from the sun when not in use (Photo by Alan Resture/TCAP)

7.11.1 Nanumaga

Most, if not all, of the above cultural knowledge and practices continues to shape the way Nanumaga, as a social unit operates, some of which is reflected in the way the villages and communal structures are laid out (Figure 50). The marae, where the Te Ano, is played sits at the front of the front of the main mwaneaba and behind the church footprint, in between the two villages of Tonga and Tokelau. This central area faces the boat channel and is where the main fatele and alofa gatherings are conducted that engages the two villages. The fetau tree is still present on Nanumaga and provides the material needed for canoe making.

Figure 50: Nanumaga Heritage Map

Additionally, towards the northern end of Nanumaga is a large cave at more than 40m depth down the reef wall discovered in 1986. Dark patches on the roof and wall of the cave and blackened coral fragments on its floor suggest the use of fire by human occupants. It is thought that the last time anyone could have occupied the cave was during a period of low sea level more than 8,000 years ago, which is sharply at odds with the view that the Pacific was settled just 6,000 years ago. These caves are known as the Fire Caves of Nanumaga and their discovery was due to interest in a local legend that a large 'house under the sea' existed. The caves are still part of local legend and tradition and often discussion around sea level change in Tuvalu are set against the backdrop of this legend.

7.11.2 Nanumea

The main ICH of Tuvalu continues to be practiced way of life in Nanumea, as it does for the rest of the country. Like Nanumaga, the islands' more tangible cultural heritage elements such as the mwaneaba, malae, pulaka pits and canoe-building trees continues to support the ICH that is part of daily life in Nanumea such as the fatele, Tea no and alofa gatherings that reinforce meaning and cohesion on the island.

Figure 51: Nanumea Heritage Map

The people of Nanumea are renowned in Tuvalu as canoe master craftsmen. A 1996 survey conducted on Nanumea (population around 1000) found some 80 such canoes still in use and these were made from Fetau tree. Today there are about 50 canoes made on the island (Figure 52) with up to five households holding and practicing traditional canoe building on the island. More of the youth are being trained to build canoes. However, the supply of fetau trees on the island are declining and there are currently no initiatives to replant more. The community uses the canoes mainly for fishing as well as for travelling to the pulaka pits in Lakena island.

Figure 52: A newly built canoe in Nanumea island (Photo by Alan Resture/TCAP)

During World War II Nanumea was one of the three US naval bases in Tuvalu. During their occupation they built basic facilities like clinics houses and an airfield which is located on Matagi, the eastern village settlement. After the war the US left behind tankers and other artillery equipment on land and also dumped some of its equipment in the lagoon. While the relics are an interesting aspect of history it has left fear amongst the island that their marine resources are being contaminated by these artifacts threatening their wellbeing and surrounding ecosystems.

8 STAKEHOLDER ENGAGEMENT AND CONSULTATION

This section describes the stakeholder consultations implemented and planned, by the GoT, through the TCAP PMU, associated with the proposed TCAP infrastructure on each of the islands. A Stakeholder Engagement Consultation Program (SECP) has been developed (refer Section 8.2) and initiated and this document will guide the ongoing engagement of stakeholders.

The ESIA team initiated regular ongoing consultations with the TCAP design engineer and project management team as well as the SPC project team to ensure that the assessment was based on the latest available data and is well informed by the experts. Building on the community consultations already undertaken by the TCAP and SPC teams, the ESIA also communicated with the Funafuti based project team to engage with the outer island representative communities that are based on Funafuti. The Funafuti team will facilitate, where possible, email communication with the Kaupule's via the Island Secretary of Nanumaga and Nanumea as needed.

Consultations with the community have shown broad levels of support for the proposed works. While field visits were not possible due to COVID-19 travel restrictions, attempts were made to engage with key informants who are part of Tuvaluan culture and heritage and had worked on a professional basis in climate and disaster reduction and management in Nanumea and Nanumaga.

8.1 Stakeholder Groups

Stakeholder groups applicable to TCAP are described below.

8.1.1 National Government Authorities

National authorities are defined as those agencies of the GoT who have the power to regulate or influence the Project in terms of granting permits or other approvals for the Project, and monitoring and enforcing compliance with GoT law throughout the project implementation cycle. Productive ongoing dialogue with these national authorities will be had throughout project implementation.

Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster: The Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster is responsible for the formulation and implementation of policies and programs for resilient and sustainable development. The ministry overseas permitting and approval processes related to infrastructure and public works, environment, labour, and disasters.

Ministry of Environment, Foreign Affairs, Labour, and Trade (MEFLT): The MEFLT is responsible for the formulation and implementation of environmental policies with the aim of ensuring ecologically sustainable development in Tuvalu. The MEFLT will also oversee the environmental permitting assessment and approval process on behalf of the MCT for TCAP.

Ministry of Finance and Economic Development (MFED): The Ministry of Finance and Economic Development is responsible for supporting the Government in pursuing a sound economic policy, enhance growth and productivity and ensure efficiency in the public sector. Through eight program areas, the Ministry provides fiscal discipline and balanced budget; is responsible for clear budget expenditure priorities that offer high rates of return, structural change, innovation and economic reform, increase private sector share of GDP, minimize external debt and lower subsidies to public enterprise. The MFED is the executing agency for TCAP. The Minister of MFED is the Chair of the Board of TCAP.

Ministry of Natural Resources (MNR): The Ministry of Natural Resources is responsible for ensuring that sustainability is safeguarded in the utilization of Tuvalu's natural resources through informed Government policies and public practices. Through three program areas, the Ministry has to maximize

social and economic returns through the sustainable management and harvesting of all agricultural resources in Tuvalu; also, to maximize social and economic returns through the sustainable management and harvesting of marine resources; and to facilitate maximum land usage in Tuvalu by maintaining a systematic register of all available land resources. Any land issues associated with TCAP will be managed through the Department of Lands and Survey which sits under the MNR.

Ministry of Home Affairs and Rural Development: The Ministry of Home Affairs and Rural Development is responsible for all economic and social policies as development, for the betterment of all Tuvaluans on each island. Through five program areas, the Ministry provides and ensures a distributive growth of Tuvalu's economy by providing policy direction and coordinating implementations; enhanced economic and social development in the outer islands through their Kaupule empowerment and community participants; promotes the social well-being for individuals; to facilitate, preserve and protection of valuable cultural heritage in Tuvalu through systematic recording and documentations; minimizing the negative effects of solid waste on Tuvalu's environment through prudent policy, legislation and sustainable systems. The Kaupule located on Nanumaga is a vital partner on the design, development, and implementation of the MICRO Project. The Kaupule on both Nanumea and Nanumaga are a vital partner on the design, development, and implementation of the TCAP.

The Kaupule Island Administration: The governing bodies of each island, as described in Section 7.8, have a significant role on the TCAP project. The Kaupule on both Nanumaga and Nanumea will be vital partners on the design, development, and implementation of TCAP. The Kaupule will be particularly critical for mediating local issues and consultations with the wider community. Their involvement will be particularly critical to securing land access for establishing and managing the BTB as well as in acquiring approval to extract sand from other parts of the island for the BTB construction.

Tuvalu Family Health Association (TFHA): As a primary contact with supporting services from the ***Gender Affairs Department (GAD)*** and the Tuvalu National Council of Women (TNCW) may provide advise and support towards address any issue associated with gender-based violence that may arise from the planning, implementation and evaluation of this project.

8.1.2 Project Affected Communities and Individuals

This group includes all people who may be directly or indirectly affected by the TCAP coastal protection infrastructure project, especially those households located adjacent to the proposed BTB installation. It includes communities located on Nanumaga and Nanumea.

Women's Groups: The Tuvalu National Council of Women (TNCW) is an NGO that was set up in the late 1970's to direct and manage women's affairs and their issues. The council consists of elected women and the formal link between Government and women's communities. TNCW has provided support in the area of women's political participation, women's handicrafts, legal literacy and recently ran programs on ending violence against women. All women above the age of 18 years become part of their respective island's women's organization which office bearers consisting of the president, treasurer and secretary who serves a 2-year term before there is an election for the next office bearers. The women are presented at the Kaupule via the women's community officer, whose role is to ensure development activities and funding is channeled to support women's needs and interests.

Churches, Schools, and Health Clinics: The majority of church members on Nanumaga are members of the Christian Church of Tuvalu, with smaller numbers practicing the Seventh Day Adventist, Jehovah's Witnesses, and Baha'i faiths. Like many Pacific Island societies, churches are a central part of communal and cultural life, with most community members attending Sunday services as well as weekday prayer and fellowship group activities. It will be important for the TCAP to initiate engagement with the main faith-based institutions of each island and these will provide opportunities to effectively communicate

and disseminate information about the TCAP activities in a way that is sensitive to community beliefs and worldviews.

There are two educational institutions on the island of Nanumaga. Lotohoni Primary school has an enrolment of approximately 135 students from the villages on Nanumaga. Nanumaga Pre-school has an enrolment of approximately 45 students. Nanumea has a pre-school and primary school with a roll of 45 and 115 in 2011 respectively.

There is only one hospital in Tuvalu, the Princess Margaret Hospital in Funafuti. The health centers on Nanumaga and Nanumea are vital links and resources to the local communities due to the remoteness of the island from the main hospital on Funafuti.

8.1.3 Civil Society and NGOs

This group includes smaller groups in society who may have an interest in the TCAP and its social and environmental aspects. On Funafuti, there exists and umbrella organisation of NGO's called the Tuvalu Association of NGOs (TANGO).

TANGO was established in 1986 and has a membership of approximately 48 members. TANGO's core role is to provide a policy voice within government and provide information and communication to its members and the local community. Other activities include capacity building, project and program coordination, and fundraising and resource mobilization.

As mentioned above, the Tuvalu National Council of Women (TNCW) is a Non-Governmental Organisation (NGO) set up to manage women's affairs and their issues. TNCW continues to provide support in the area of women's political participation, women's handicrafts, legal literacy and trainings on gender-based violence and child abuse and exploitation.

Disability Persons Organisations (DPOs) will be consulted throughout the TCAP lifecycle. Fusi Alofa is the only DPO currently located in Tuvalu. The estimated number of persons with disabilities with significant difficulties functioning in Tuvalu is 444.

8.2 The Stakeholder Engagement and Consultation Program

The SECP maps out the stakeholders to be consulted over the duration of the project and the mechanisms/mediums to be employed to engage with them. This ESIA build upon previous consultations by the TCAP and SPC teams, therefore the SECP incorporates activities already undertaken as well as planned future consultations. The SECP will be updated and refined throughout the lifecycle of the Project. During this process, the focus and scope of the SECP will change to reflect the varying stages of project implementation and to encompass any changes to project design.

8.2.1 Engagement Mediums

Table 9 below lists the recommended engagement mediums that are appropriate for SECP activities proposed as part of the implementation plan components in Table 10.

Table 9: Recommended Engagement Mediums for TCAP Project Stakeholders

Medium	Description
Stakeholder Meetings	
Focus Group Meetings	The aim of a focus group is to pull together stakeholders with the same interest into a single meeting to discuss issues. Meetings usually have a very specific objective which is aligned with the expectations and interest of the stakeholders' present.
Community based consultations	These consultations are focused to identify and discuss stakeholder concerns or to provide feedback using detailed information. These consultations should, wherever feasible, be held within the community environment.
Written / visual communications	
Project Information Bulletin	This needs to be a short and concise document provided in jargon-free information describing the project actions, the potential social and environmental impacts, the need for the project and the contact details for the project team.
Notice boards	Notice boards (community and work site entrances) are a good tool to use for communication of up-to-date project information such as timing and duration of works, upcoming consultations, project progress and other relevant project information.
Letters	Formal method of communication usually intended to convey very specific messages. Alternatively, it is used as a formal method for request of information.
Emails	Using emails for in-country stakeholders can pose a challenge because of limited internet access due to insufficient telecommunications and/or supporting IT infrastructure. NGOs and most of the Government Ministries do have access to email which can be utilised for communications but arranging of formal community consultations is best arranged through other methods of communication.
Media	
Internet	With 4G internet access, the public may have better access to knowledge and information about the project via the TCAP website, Facebook page and Twitter account. The website and social media accounts may be used to update the public on implemented and planned activities as well as announcements.
Radio	In Tuvalu, radio is the primary medium for raising awareness and prepare stakeholders for larger events or refined communication to take place.
Other	
PMU	PMUs will be the 'familiar faces' of the project and will, for many stakeholders at the community level, represent the most direct channel to the project.
Telephone	Use of the telephone / mobile phone is still regarded as the preferred method for communication because of accessibility and speed. Having a discussion over a phone in order to ensure mutual understanding between two parties is quicker and easier compared to sending an email, waiting for reply.

The mode of consultation will vary according to the subproject and the participants, but in all cases will promote participation by ensuring that the venue is accessible, the timing convenient and the manner of conduct of the consultation socially and culturally appropriate. Consultations will be announced to give sufficient notice for participants to prepare and provide input to project design.

8.2.2 Implementation Plan

The Implementation Plan (Table 10) for the TCAP Project lifecycle constitutes the following components:

Activity: the various operational consultation activities that will be undertaken as part of the SECP

Objective: the target that each activity needs to reach

Stakeholder: the various stakeholders to be targeted during implementation of the SECP activity; and

Medium: the method by which the engagement or consultation will be done

Some elements of the implementation plan have yet to be confirmed. As project details develop, this SECP and implementation plan shall be updated by the PMU Project Manager to reflect the current project status and timeframes. In practice, the PMU will notify stakeholders, the Kaupule, and the Nanumaga and Nanumea communities at least 7 days prior to community consultations. Updates of project activities will be presented at this time as outlined in Table 10.

Table 10: Stakeholder Engagement and Consultation Implementation Plan

No	TCAP Project Activity	Timetable	Objective	Stakeholders	Medium
A: Physical Investments (Nanumaga and Nanumea)					
A1	Feasibility, decision on the sites / technologies and preliminary designs	From Project effectiveness through to tendering.	Bring stakeholders into the decision making around the site and type of investments. Discuss potential impacts and mitigation measures.	All identified	Community Consultations Focused group meetings Public meetings Emails and letters
A2	Disclosure of updates to the ESIA	Prior to tendering (ESIA) Prior to works starting (development of C-ESMP)	To disclose ESIA	All identified	Newspaper Website
			Advise stakeholders of final design, construction methods and updated mitigation and management plan. Advise stakeholders of GBV prevention strategies and management of labour influx	Communities Site occupants (State owned enterprises. Government agencies) Site users (if different from above)	One-on-one meetings Community consultations Executive Summary

No	TCAP Project Activity	Timetable	Objective	Stakeholders	Medium
A3	Detailed design	Once Contractor is on board and prior to works starting	Keep stakeholders involved in any design updates. Public announcements	Government agencies, site occupants, site users	Emails, One-on-one consultations Radio and websites Noticeboards
A5	Commencement of Works	Week before commencement of works.	To advise all stakeholders of commencement of civil works.	All identified stakeholders Site occupants (State owned enterprises. Government agencies)	Newspaper Email One on one meetings
			To reconfirm ongoing consultation, feedback and complaints processes	Community Site occupants (State owned enterprises. Government agencies)	Community Notice Boards Community workshops and consultations Website Community Liaison Officer

8.3 Resources and Responsibilities

The TCAP PMU will take the lead role in the implementation of the SECP and will be responsible for arranging and facilitating the meetings as it appropriate with their in-depth knowledge of the natural, social and traditional environments within Nanumaga, Nanumea and Funafuti. The PMU will also be the focal point for all stakeholder queries and contacts in relation to the implementation of the SECP.

8.4 Public Consultations to Date

A series of public consultations and stakeholder meetings have been held in 2019 and 2020 with the aim of having meaningful consultation with affected communities and to provide an opportunity for all parties to provide input into the Project. Consultations also combined with the SPC Geotechnical Investigations[67]. The meetings primarily targeted the Nanumaga and Nanumea Falekaupule and community members, although Government agencies, authorities and development partners in Funafuti were also consulted. The community consultation also included a project management training event with the Kaupule and Department of Local Government staff in Nanumea. The consultation for the various groups took place according to the schedule below.

[67] Preliminary ESIA, Geotechnical Report, Coastal Hazard and Risk Assessment, SPC (2019)

Date	Location	Stakeholder Meetings
30th Aug2019	Nanumea	Nanumea Kaupule for initial project visit: 4 members
13th Sept2019	Nanumaga	Nanumaga Kaupule for geotechnical assessment and community initial views about the project: 5 members
13th Sept2019	Nanumaga	Nanumaga Community Consultation for geotechnical assessment and community initial views about the project : 35 community members (10 females and 25 males).
20th March, 2020	Nanumea	Nanumea Kaupule and Department of Local Government Training on project management: 25 participants (12 males, 13 females)
20th March, 2020	Nanumea	Nanumea Community to discuss community concept design: 54 members (16 Females, 38 Males)
23rd May, 2020	Nanumaga	Nanumaga Kaupule: 4 members (Objective: to discuss the BTB concept design and the possibility of shifting the boat harbor and church
29 June, 2020	Funafuti	National Disaster Management Office

Information gathered during the consultation process on the social, economic or environmental situation of Nanumaga have been included in the baseline description (Section 5). Wherever possible, the remaining concerns have been addressed either through design solutions or mitigation measures and included in this document. Full minutes of the SPC led stakeholder meetings can be found in the SPC TCAP Preliminary Geotechnical Report, Coastal Hazard and Risk Assessment (Appendix 7 and 8).

8.5 Complaints Register

A complaints register will be established to record any concerns raised by the community during construction. Any complaint will be advised to the UNDP and DoE promptly upon receiving the complaint. The complaint will be investigated and following the investigation, if it relates to a significant incident, the matter will be referred to the UNDP for commentary and/or advice.

8.6 Grievance Redress Mechanism

During the construction and implementation phases of any project, a person or group of people can be adversely affected, directly or indirectly due to the project activities. The grievances that may arise can be related to social issues such as eligibility criteria and entitlements, disruption of services, temporary or permanent loss of livelihoods and other social and cultural issues. Grievances may also be related to environmental issues such as excessive dust generation, damages to infrastructure due to construction related vibrations or transportation of raw material, noise, traffic congestions, decrease in quality or quantity of private/ public surface/ ground water resources during irrigation rehabilitation, damage to home gardens and agricultural lands etc.

Should such a situation arise, there must be a mechanism through which affected parties can resolve such issues in a cordial manner with the project personnel in an efficient, unbiased, transparent, timely and cost-effective manner. To achieve this objective, a grievance redress mechanism will be developed and implemented as part of the project.

The Grievance Redress Mechanism will be designed to be problem-solving mechanism with voluntary good-faith efforts. The Grievance Redress Mechanism is not a substitute for the legal process. The Grievance Redress Mechanism will as far as practicable, try to resolve complaints and/or grievances on

terms that are mutually acceptable to all parties. When making a complaint and/or grievance, all parties must act at all times, in good faith and should not attempt to delay and or hinder any mutually acceptable resolution.

All complaints and/or grievances regarding social and environmental issues can be able to be received either orally (to the field staff), by phone, in complaints box or in writing to the TCAP project team, UNDP, DoE or the Construction Contractor. A key part of the grievance redress mechanism will be the requirement to maintain a register of complaints and/or grievances received at the respective project site offices. All complainants shall be treated respectfully, politely and with sensitivity.

9 DETERMINATION OF POTENTIAL IMPACTS

9.1 Introduction

The planned works on Nanumaga and Nanumea have the potential to create a variety of impacts through their implementation. These impacts can be either positive (e.g. improved coastal protection for community members) or negative (e.g. loss of trees, landscape changes caused by the BTB's) depending on the activity and receptors involved. The impact of this project on the physical, biological and social environment has been assessed using methodology described in this chapter.

9.1.1 Environmental and Social Receptors

The ESIA focuses on environmental and social components that could be most affected by the Project and those that are a concern to governments, community members and stakeholders. The components are called Environmental and Social Indicators (ESI). Below are the identified ESI for this Project, and the specific factors that were considered for each in order to undertake the impact assessment.

Table 11: Environmental and Social Indicators and parameter considered under each indicator during the impact assessment

Environmental and Social Indicator	Factors to be considered
Water Quality	• Water quality of coastal marine environment • Quantity and quality of surface water • Turbidity in marine environment
Erosion, Drainage and Sediment Control	• Sedimentation build up in coastal marine environment • Management of project site run off • Existing erosion and sediment deposition regimes in coastal zone
Air Quality	• Dust generation • Air quality
Noise and Vibration	• Noise nuisance in sensitive areas • Vulnerability of property to damage from vibration
Flora and Fauna	• Vegetation within the direct and indirect project footprint • Loss of native fauna • Degradation of marine habitats • Introduction of new invasive marine or terrestrial species • Spread of existing invasive species in project sites
Waste Management	• Excavation of household waste during construction • Disposal arrangements of solid project and construction waste • Management of hazardous waste • Treatment and disposal of wastewater (black and grey)
Chemical and Fuel Management	• Storage and handling of hazardous substances • Contamination of soils and water from spills
Community Services and Infrastructure	• Boat landing access (especially challenging on Nanumaga) • Water supply facilities • Island roads
Land and Resource Use	• Church location • Agriculture and food bearing trees

	• Changing land use • Utilisation of private, native land
Social Environment	• Gender and social inclusion • Community perceptions and expectations • Employment
Community Health and Safety	• Gender based violence • Worker safety

9.1.2 Impact Identification Methods

In assessing the potential impacts, a series of methodologies have been used. These include consultations with relevant stakeholders, scoping of the ESIs, development of baseline data sets, scaled checklists, review of project documentation and expert opinion. A precautionary approach was taken with any interactions with a meaningful degree of uncertainty.

The impact assessment methods address both project related and cumulative environmental and social effects. Project related impacts are changes to the biological, physical or social environment that will be caused solely by a physical work or activity of TCAP. Cumulative impacts are changes to the biological, physical or social environment that are caused by an action associated with TCAP in combination with other projects or activities that have or will be carried out.

Using a list of all relevant ESIs identified during initial TCAP scoping, each project impact is evaluated against a scaled checklist (Table 12) and assessed under the defined parameters.

For identified adverse impacts, effective mitigations are needed to eliminate or reduce them to an acceptable level. Mitigation measures are developed for each impact according to the hierarchical preference in Table 13.

Defined Parameters:

- *Activity* – phase of the development that the action takes place in.
- *Environmental and Social Indicator* – sensitive component of the ecosystem that demonstrates a reaction to or is influenced by environmental stressors.

Table 12: Scaled Checklist for Impact Assessment

Rank	Description
Low	No substantive interaction. The impacts are rated not significant and not considered further in the ESIA. The environmental and social impacts of these activities are rated not significant with a high level of confidence
Moderate	If a potential interaction between an activity and an environmental or social component is identified but not likely to be substantive, long term or irreversible in light of planned mitigation.
Major	If an interaction between a planned activity and the environmental or social component is identified that may result in more substantive, long term or irreversible impacts despite the planned mitigations, or if there is less certainty regarding the effectiveness of mitigation

Table 13: Preferred mitigation hierarchy for addressing TCAP impacts.

Measure	Description
Prevent	The most effective way to eliminate any adverse impact is to prevent the creation of the impact at the source.
Reduce	If prevention is not possible then mitigation measures will attempt to minimise impacts at their source
Rectify	Restoring temporary impacts to pre-construction or a better state
Precautionary	Measures to reduce construction impacts
Compensatory	Provide suitable, replacement or substitute resources of greater or equivalent value

9.2 Identified Impacts & Mitigation

9.2.1 Overview of Impacts

The following potential environmental and social impacts have been identified in relation to the proposed activities on Nanumaga and Nanumea as described in Section 3 of this ESIA.

In the following subsections, those impacts assessed to be moderate or major negative (against the scaled checklist) prior to the application of mitigation measures are detailed. The impacts are presented according to their ESI.

Each subsection below also lists some of the key protective measures that have been designed to mitigate or avoid environmental and social impacts. A full list of all protective measures for all identified impacts is included in the mitigation table in Appendix B.

9.2.2 Water Quality

The projects involve the construction of coastal protection infrastructure to reduce wave overtopping and associated marine flooding.

The coastal protection infrastructure may result in the movement of sediment during construction into the marine environment. For the majority of the TCAP project corridor on Nanumaga and Nanumea, any released sediments would either be held in the beach environments, or will be released onto the reef flats and gradually dispersed either further along the beach or along the reef flat with the tide. Some sediments may make their way into the marine environment over the reef crest but would be rapidly dispersed by wave and current action. Any sediments released would be from the local source and are the same as naturally occurring in that area. Any sediments which are lost from the TCAP site would enter into the natural sediment transport system that is already moving significant quantities of sediment on/offshore. As the reef flats are generally bare, with only small scattered corals, short term increases in sediments on the flat do not pose a significant environmental impact to marine species especially considering the total volume of sediment involved in TCAP is small compared to that naturally occurring and already being moved by natural processes.

One area of potential concern is the BTB works on the northern end of the Nanumea project corridor, at the tip of the beach where the reef flat moves into the lagoon (Figure 53). The BTB works in this area are proposed to be within the vegetated zone, where excessive movement of machinery on the beach or clearance of the vegetation line could result in sediments entering the lagoon environment. The introduction of any sediments into the lagoon environment can be managed at the construction stage and would be short term and localised in scale. Construction protocols to minimise these impacts will need to be included in the C-ESMPs. There is not expected to be any significant negative impacts in the lagoon environment, particularly when considered in comparison to the natural movement of sediment into the lagoon from the beach and inland areas during storm events.

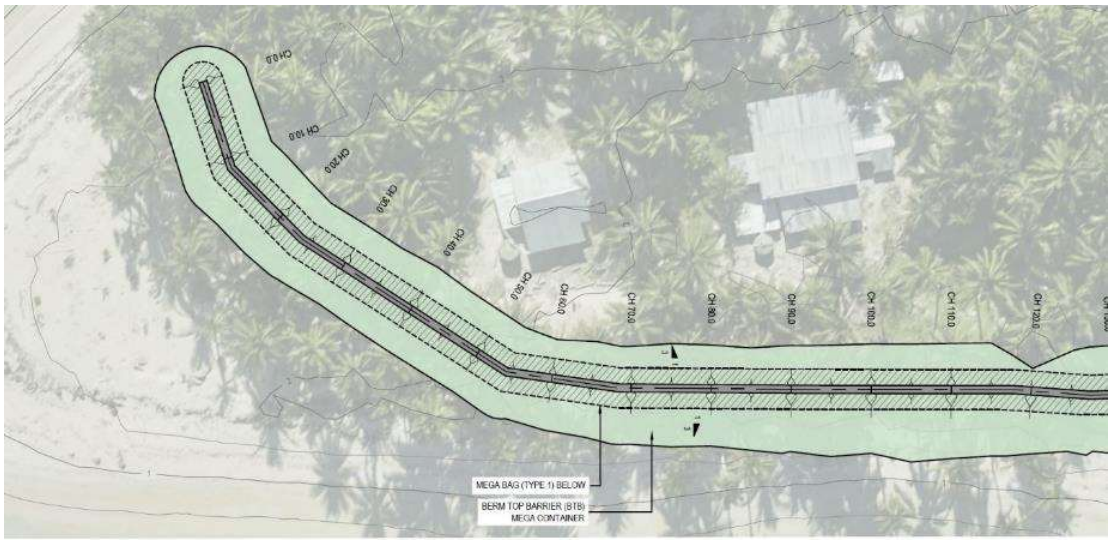

Figure 53: BTB at the northern tip of Nanumea adjacent to the lagoon entrance.

There are also potential impacts to ground and coastal marine water quality from the introduction of hazardous substances (fuels, oils, etc.) that will be used or generated during construction. While this risk does exist, it is considered to be low risk considering the construction works will not require large quantities of fuel which can be easily managed with standards best practices (see Section 9.2.8).

On Nanumea, where the Seabee revetment wall will be constructed along the footprint of the former collapsed revetment, there could be changes to small and medium scale hydrodynamic processes that could result in short term and temporary changes to water quality within specific locations. However, as the revetment is to be built over the footprint of the former failed seawall, it is expected that the coastline has already adjusted to hard infrastructure at this location. Indeed the former seawall was relatively vertical and of poor design so it is expected the improved sloped Seabee design will lessen potential impacts over the influence of the former design.

9.2.2.1 Protective Measures

Protective measures will include:

- Develop and implement a site-specific Erosion, Drainage and Sediment Control Plan to address drainage control, sediment and erosion controls and stockpiling of materials including soil during construction.
- No machinery will be permitted on the beach on the northern tip of the Nanumea BTB footprint
- Storage areas for all hazardous substances will have compacted impermeable bases and be bunded to contain any spillage.
- Schedule works in stages to ensure that exposed soils are revegetated and stabilized progressively.
- Longer term stockpiles of construction materials will not be within 50m of the coastal marine environment.
- Construction equipment will be stored away from the coastal marine environment.
- Machinery on the beach will work in clearly defined and minimal areas
- Refueling will occur in designated bunded areas away from the coastal marine environment.
- Disturbance of vegetation to be limited to that required and approved for construction works.
- Check all vehicles and machinery daily to detect any spills or leaks.

- Rubbish and waste material must be stored in such a way that no leachate can enter the ground water.
- Excavated waste along the BTB footprint will be disposed as per the protocols of each island.
- MetOcean forecasts on each island will be used to plan works, construction footprints and will be used to determine the location and covering of stockpiles
- Any vessels chartered for shipping shall be compliant with the International Maritime Organisations conventions of which Tuvalu is a signatory.

9.2.3 Erosion, Drainage and Sediment Control

The excavation of the BTB trench and the clearance of low-lying vegetation along the project corridor will expose bare soils and sands. Additionally, there will be the need to clear area(s) for stockpiling, access tracks and construction camps. This clearance could lead to the erosion of surface soils along the length of the project corridors.

Run off from stockpile sites could also lead to localised erosion around the site and potentially into the coastal beach environment. However, the low topography of the islands reduces the runoff velocities thereby minimising erosion forces. The porous nature of the substrate also helps to reduce runoff. As there are no waterways in the islands, flow is overland (i.e. spread). Construction may form preferential flow paths, although these would generally be relatively short and defined in their nature, therefore readily managed.

During heavy rain events, there is the possibility for storm water runoff to flow from construction sites carrying potential pollutants with them into the surrounding environments. In addition to this, for any areas where concrete is produced or machinery is washed down, there is the potential for contaminated wastewater to drain into the surrounding environment in normal conditions.

While it is not yet known how many and what type of machinery or equipment will be used by the Contractor, it can be expected that there will be a requirement for construction machinery to work on the beach on both islands to extract the required volume of sand, to build the BTB in areas where the berm top runs close to the shoreline on Nanumea and to construct the Seabee wall on Nanumea. It is likely that the beach profile will change in the working area of the machinery. On Nanumaga, it was observed in 2018 that the church foundations next to the boat ramp had been dug with a 6-ton excavator which accessed the work site via a ramp on the beach. This provides an opportunity to see the type of changes that we can expect at the beach during construction (Figure 54). The tracks create a change in the beach profile, however due to the height of the berm scarp above sea level and the restricted nature of the construction foot print, the impacts are expected to be limited in magnitude and reversed over time as the seasons change.

Figure 54: Construction works on Nanumaga beach surrounding the church foundations in 2018

It can be expected that the TCAP project will create a similarly scaled impact and that these impacts will be short term and reversible in nature when coupled with effective construction management.

9.2.3.1 Storm Sand Deposit Extraction

One of the potentially more significant potential impacts related to this project is the potential changes to the natural erosion and sediment deposition rates that can be created from excavation of sand materials from the storm deposits on the northern tip of Nanumaga and the southern tip of Nanumea. Unsustainable extraction of sands from beaches (known as beach mining) can have long term and significant environmental impacts, including destruction of natural habitats and the ecosystems they protect. Destruction of nearshore marine habitats, reduced protection from storm events and tsunamis, which in an island environments can accelerate coastal erosion[68] and reduce the overall sand budget in a 360^{o} system. The threats posed by unsustainable or extensive beach mining on the islands are made even more critical given the increased frequency of significant wave events experienced in Tuvalu and the prospect of a significant rise in sea level over the coming decades.

As the Nanumaga and Nanumea storm sand deposits are the only feasible and reliable sources of material for the project, TCAP have carried out extensive analysis of the existing sand deposits. Due to the highly dynamic and intricately variable nature of coastal process, modelling is an unreliable way of assessing impacts in this instance and therefore expert opinion based geotechnical surveys, high resolution LiDAR imagery, historical aerial and drone shoreline change analysis[69] has been provided to inform this impact assessment.

Given the small volumes of sand required by the project to construct the BTB are compared to the available sediment budget, there is very little risk of impacts being experienced by the community or landowners behind the extraction site. It is also evident from the historical shoreline change analysis

[68] Young, R. and Griffith, A., Documenting the global impacts of beach sand mining, EGU General Assembly Conference Abstracts, 2009, EGU General Assembly Conference Abstracts

[69] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

carried out as part of TCAP that the storm deposits are, with each storm event, moving towards the edge of the reef system and some is lost from the island system altogether with each storm event. As described in Section 6.3.2.1, Nanumaga is in a climax state and Nanumea is leaking sediment into the lagoon which demonstrates that (on a small scale) any sediments removed by TCAP would be replaced over time by the natural production rate of the reef system. By taking some of this sand now and repurposing it for coastal protection on Nanumaga and Nanumea, the project is effectively returning the sand back into the natural coastal defense system for the high value shorelines.

Technical analysis has estimated that on Nanumaga the 'harvestable' deposit could be up to an order of magnitude larger than the requirements of TCAP, that is to say that it is estimated TCAP would require less than could foreseeably be lost in the next TC event or could be replaced by the natural production of the reef within a few months.[70]

The same analysis for Nanumea concedes that a larger volume will be needed for those works, and therefore a higher proportion of the available deposit will be required. However, the analysis still shows that there is 4 to 5 times more sediment available at the deposit site than is needed for the project, that is to say, TCAP would require between 20 to 25% of the available sand. While this is a larger volume than is required for Nanumaga, it is estimated that up to half of that volume could be lost in the next storm event and that the natural reef system would produce sediment to replace this sand, albeit over a slightly longer time period than on Nanumaga.

To summarise, while it is evident that there would be medium-term impacts to both islands in the form of a loss of sand from the storm deposits and potentially reduce the size of these deposits and any protection they give to the former shoreline position (pre-TC Pam) in the medium term, TCAP would not be creating any long-term irreversible impacts. This is because the sediment will be replaced by the natural reef production processes and it is feasible that the entire deposit could be lost permanently from the island if another large storm strikes Tuvalu. These are ephemeral deposits, they will otherwise remain wave swept, dynamic and subject to dramatic change during subsequent storms, they will not form stable land of long-term benefit to the community. The benefits to the islands of implementing TCAP are assessed to outweigh any medium-term negative impacts. Expert selection of the extraction site locations, along with timing and careful monitoring of the extraction methods and volumes will reduce the scale of any impacts. Additionally, there is the potential to create mini temporary BTB in areas that may be perceived as having an increased vulnerability while the beach is recovering.

9.2.3.2 Protective Measures

Protective measures will include:

- Develop and implement an Erosion, Drainage and Sediment Control Plan for any surface works, sand extraction, embankments and excavation work and storm water pathways.
- Sand extraction sites and volumes will be determined by the TCAP coastal experts and engineers and will not exceed volumes discussed in this ESIA without updated analysis.
- All relevant approvals to be in place from the island Kaupule for specific volumes of sand to be extracted.
- Any machinery washdown or concrete production areas will be bunded and all water will be collected and treated before being discharged.
- Designated areas of storage of hazardous substances will be on impermeable bunded surfaces with drainage filters and will be protected from the wind and rain.

[70] Lewis, J and Webb, A. 2020. TCAP Concept Design Report (draft)

- Ensure that any erosion and sediment control devices are installed, inspected and maintained as required.
- Schedule/stage works to ensure that major vegetation disturbance and earthworks are carried out during period of lower rainfall and windspeeds.
- Machinery on the beaches will worked within clearly defined and minimal areas.
- Strip and stockpile topsoil for use during revegetation.
- Locate stockpiles away from sensitive locations
- Design stormwater management measures to reduce flow velocities and avoid concentrating runoff.
- Vegetated buffer strips shall be retained during construction to reduce water velocity and retain low levels of uncontaminated sediment.
- Ensure that beach is rehabilitated as to not leave an unsafe condition for the public while the beach is naturally recovering

9.2.4 Noise and Vibration

All construction activities have the potential to cause noise nuisance on Nanumaga and Nanumea. Vibration disturbance to nearby residents and sensitive habitats is likely to be caused through the use of excavation equipment, heavy trucks to haul aggregates, the pumps to fill the mega bags, during burial of the mega bag and final forming of the BTB's. Effective communication of working hours will go towards alleviating any impacts during the construction phase.

There are sensitive receptors such as schools, mwaneaba, residential homes and churches along the project sites and haulage routes on both islands however, these impacts will be short-term and affect different people at different times.

9.2.4.1 Protective measures will include:

- Minimise nuisance from noise, especially closer to residential areas and sensitive receptors, through establishment and communication to affected parties of working hours, including night works and avoid increase of noise and number of work equipment at outside of advertised hours. Advertise working hours at the site entrance.
- Workers in the vicinity of sources of high noise shall wear necessary protection gear rated for the situation they are being used.
- Provide temporary construction noise barriers in the form of solid hoardings where there may be an impact on specific residents.
- Signage to outline complaints procedure and contact details of recipient of complaints.
- Contractor will develop a work schedule or operations with Kaupule to identify hours and days of no work due to religious and cultural activities.
- Mostly limit construction activities to daytime hours. If construction is proposed at night, contractor will develop a work schedule of operations with Kaupule.
- The Contractor should conduct employee and operator training to improve awareness of the need to minimise excessive noise in work practices through implementation measures.
- Identify properties and structures what will be sensitive to vibration impacts resulting from construction.

9.2.5 Air Quality

Air pollution can arise due to improper maintenance of equipment, dust generation and emissions from equipment. No significant sources of air pollution are likely as a result of the TCAP, the primary sources will be related to the operation of machinery (vehicle emissions) and the movement of sediments, which are generally deficient in fines – the primary cause of nuisance dust. Impacts are expected to be localised and short term with only minor negative impact on the ambient air quality in the vicinity of the construction areas.

No ongoing impact to air quality is expected after completion of works.

9.2.5.1 Protective measures

Protective measures will include:

- Implement effective dust management measures in all areas during design, construction and operation.
- Manage dust/particulate matter generating activities to ensure that emissions do not cause an environmental nuisance at any sensitive areas.
- Implement scheduling/staging of proposed works to ensure major vegetation disturbance and earthworks are minimised.
- Locate material stockpile sites as far as practicable from sensitive receptors.
- Revegetate excavated areas and the BTB as soon as is practicably possible.
- Waste storage areas and receptable should be covered and located as far as possible from sensitive locations.
- Restrict speed limits of all vehicles on unsealed roads.
- Cover loads of haul and equipment and plant when not in use and in transit.
- Ensure all equipment and machinery is in good working order and regularly maintained.
- Turn off or shut down all machinery or vehicles when not in immediate use. No idling of unattended vehicles is permitted.

9.2.6 Flora and Fauna

The TCAP project site lies within areas that are already disturbed by human activity and village development although vegetation does exist along the length of the project corridor on both Nanumaga and Nanumea. Furthermore, there are no important marine habitats within the project footprint.

9.2.6.1 Terrestrial

Coastal vegetation has a critical role to play in the stabilisation of the shoreline and the prevention of wave induced erosion. Where the vegetation line has been able to maintain its integrity on Nanumaga and Nanumea, it provides excellent natural protection to the impacts of storms. Damage to or removal of the vegetation line will have a direct impact on the resilience of that section of shoreline and will be avoided for all except critical reasons during construction. It is expected that the only critical reason for the removal of shoreline vegetation will be to create access to the storm sand deposits during extraction.

There will be disturbance to the existing vegetation during the installation of the BTB on Nanumaga and Nanumea, however the mega bags that are proposed for the BTB are highly flexible being filled with sand and it is therefore planned that, to the greatest extent possible, mature and important tree specimens will be avoided by the BTB taking a meandering path that will be dictated by the vegetative obstructions. There will be instances where it is not possible to avoid mature trees and where this

occurs, there are processes to be followed to identify and compensate the correct owner of any productive trees.

While the removal of some important tree specimens may be unavoidable, this will not significantly degrade the natural flora or fauna and replanting measures will mitigate the loss to the ecosystem.

It is expected that materials and equipment will be imported for the TCAP works. If imported consignments are not properly treated and/or washed before shipping, there is the risk of introducing non-native and potentially invasive plants, animals and disease. Tuvalu already has an ongoing problem with invasive species, particularly Nanumaga which has a significant problem with the invasive YCA and the Kou Leafworm on Nanumea. The introduction of additional harmful species to small island nations such as Tuvalu, who have a naturally low level of biodiversity, can be devastating to the local ecosystems, flora and fauna. It is also possible to import diseases such as foot and mouth disease and invasive marine algae in ships ballast water.

9.2.6.2 Marine

Offloading of imported machinery and equipment on Nanumaga and Nanumea is likely to be via a Ro-Ro type barge on the reef edge during low tide. It is not possible to bring a large barge to the shore at any tidal range, therefore offloading via Ro-Ro at the reef edge and driving the equipment across the reef flat is the most feasible and safest option. This action of placing the Ro-Ro ramp and driving the equipment over the reef edge will undoubtedly cause damage to the reef crest habitat in that immediate impact zone, which will likely result in the loss of any live coral and niche habitats.

The offloading location will be sited to minimise the travel distance across the reef flat and beach. On Nanumaga, reef surveys in the most likely offloading area (close to the existing boat channel) have determined that percentage live coral cover is 1% on the reef crest, increasing to 12.5% on the reef slope. The coral species assemblage is not considered to be unique or important. Considering the low quality of the coral reef in this area and the relatively small size of the Ro-Ro impact area, no significant impact is considered likely and coral regeneration could occur over time in that location. Likewise, the loss of niche habitats on the reef crest is not considered to be significant as reef crests by their nature are formed from a multitude of complex areas providing many niche habitats. It can be expected that the reef assemblage in Nanumaga is representative of that in Nanumea and therefore the same types of impacts can be expected.

Offloading the barges at the reef crest will result in heavy machinery crossing the reef flats of both islands which has the potential to cause damage to the surface of the limestone reef flat. Given the flat and level nature of the reef flat, and the lack of sediments, macroalgae or live coral in the habitat, it is expected that the impact will be limited to indentations in the limestone, which has no significant bearing on the marine environment. On Nanumaga, equipment has been offloaded in this manner previously and no obvious signs of long-term damage from this have been observed.

There is the potential for hydrocarbon spills from the machinery or vessels into the marine environment. Given that the largest potential volume of the fuel or oil spill is limited to the contents of the fuel and oil tanks, the potential impact will be limited in magnitude and short term in duration and can be managed with good environmental controls and by ensuring any vessels chartered by the Contractor is operating to IMO standards for training, maintenance, safety and pollution management. This is therefore considered to be an important mitigation factor, but not considered to be a significant impact.

9.2.6.3 Protective Measures

Protective Measures will include:

- No permanent gaps will be created in the vegetation line. All trees and plants will be avoided if possible and any which are removed will be replanted or replaced on completion of works.
- No trees in the vegetation line outside the direct BTB corridor will be removed or damaged during construction works
- Clear boundaries will be set during construction to protect the front of the berm and the vegetation line. Boundaries will be physically marked with temporary construction fencing.
- Limit vegetation clearing and minimise habitat disturbance through adequate protection and management of retained vegetation.
- Ensure all site personnel are trained on the requirements to protect all vegetation outside the construction area.
- When clearing any areas, topsoil shall be set aside and saved for rehabilitation and revegetation.
- Rehabilitation of construction areas will include scoring compacted surfaces, replacing the previous excavated topsoil and replanting with species already present on the island.
- BTB will be covered with stockpiled topsoil and planted with coastal species suited to the environment and already present on the island. The Contractor will work with the Kaupule to create a nursery from species existing on the island in preparation for replanting.
- All imported materials, equipment and aggregate will be subject to importation under the quarantine and biosecurity regulations of Tuvalu.
- Works will be staged or scheduled to ensure that there is no transferral from project materials or equipment from Nanumea to Nanumaga. Transferral should only occur from Nanumaga to Nanumea to prevent the spread of the kau leafworm to Nanumaga.
- Any chartered shipping vessels from offshore will change their ballast water no closer than 5nm from Tuvalu's coastline.
- Place BTB mega bags in such a way as to minimise disturbance to mature vegetation, particularly canopy trees. Small trees and shrubs shall be removed in preference to large trees.
- Vegetation to be removed shall clearly be marked using paint or flagging tape.
- Only one small pre-selected section of reef will be used to offload equipment barge loads
- Movement of machinery and equipment across reef flat will be restricted to demarcated pathways
- Offloading of barges will only take place at low tide ranges, under small wave conditions with light winds.
- All vessels will be equipped with spill kits and will be compliant with the IMO conventions of which Tuvalu is a signatory.

9.2.7 Community Services and Infrastructure

The project could potentially affect existing and planned basic utilities that support community economic, health and water security in a changing environment. These utilities particularly pertain to: access to the existing boat landing; water harvesting, storage and distributive facilities; and solid and liquid waste disposal and management facilities.

9.2.7.1 Solid and Hazardous Waste Generation

The key waste streams that are likely to be generated through the project works on Nanumaga and Nanumea include excavation wastes that were unsuitable for use in the project or surplus to requirements during the works; waste from construction equipment use and maintenance (including liquid hazardous waste); waste water from general project works and workers accommodations; and, general wastes including scrap materials (including biodegradable materials).

Biodegradable wastes can be managed within each of the islands through the Kaupule composting schemes.

For any non-organic, non-reusable and non-recyclable materials, there is a significant potential for overburdening the local landfills if they are used for disposal of the refuse. The island landfills are small scale and designed to cope with the needs of the local community rather than civil works project waste and on Funafuti, the small landfill already operates at capacity in a sensitive coastal location. Overburdening of landfill in small islands can lead to leachate pollution of groundwater and the marine environment, disbursement of solid wastes into the marine environment due to over filling of landfill and a human health hazard due to inappropriate dumping of hazardous materials.

Additionally, poor management of solid waste at work and accommodation sites can lead to a number of impacts such as pollution of local environments, community and worker health hazard and increase in pests such as rats, flies and YCA.

9.2.7.2 Use of Vehicles and Machinery

The roads on Nanumaga and Nanumea are narrow and unsealed. A moderate number of scooters, three-wheel motorcycle trucks and small trucks use the roads. Pedestrians also use the roads as the main walking paths. There are several small tractors which use the roads along with a few small pieces of construction machinery. Any introduction of increase traffic through motorbikes or construction equipment will create a significant safety risk to the community and increase the pressure of the road network. It is likely that the ancillary project sites (laydown, stockpile, workers accommodation) will be scattered around the village therefore increasing the pressure on the road network and increasing the hazards to the community. Careful management of vehicle movements and consultation with the community will be required to ensure that any impact is minimized. The Contractor will be required to develop and implement a small-scale Traffic Management Plan as part of their C-ESMP.

9.2.7.3 Influx of Labour

The presence of workers on the island will also lead to an increased pressure on the island's food and water supply. The majority of food currently consumed comes from resources on the island (breadfruit, taro, fish, eggs, chicken) with supplemental foods being imported via Funafuti. Agriculture activities on the island are at a subsistence level rather than commercial, therefore there will not be enough grown locally to support additional demands from a large number of workers.

It is anticipated that the Contractor will have to supply all food needed for the workers, which brings with it a potential for the community members to miss income generating opportunities should they not be used to cook the food unless appropriate measures are put in place.

The nature of the work means that workplace accidents may occur. It is also possible that the foreign project workers will become injured outside of working hours. Any injury or accident requiring medical attention from the islands medical clinic, would result in an increased demand on the already vulnerable resources of the island.

Looking at risks to women from the influx of labour, there is currently no written documentation on sex work and trafficking on Tuvalu. However, anecdotal evidence suggests that sex work, driven by poverty, may be occurring, especially to 'serve' the foreign seafarers who reside on Funafuti while trans-shipping. Associated risks to sex work may be emotional and/or physical violence, sexually transmitted diseases (STDs), unwanted pregnancies and associated unsafe abortion and social stigmatization, although there is currently no documented evidence of such incidences in Tuvalu. The risks from TCAP are considered to be very low, but to ensure that messaging for workers and community is strong, the SECP includes prevention of GBV and risks associated with influx of labour.

Although there is no evidence of human trafficking in Tuvalu, the Attorney General's office is in the process of signing an international convention on human trafficking to address this issue 'in theory' and ensure that legal frameworks would cover this case if there are issues.

9.2.7.4 Water Supply Facilities

The existing water supply on Nanumaga island in normal times does not appear to be problematic although severe shortages were reported by men, women and youth consulted in 2018 for extended periods of no rain (1 to 3 months). While most households have their own water systems (see section 2.10.1), two of the three larger communal storage cisterns may be currently defunct due to the 2015 TC Pam destruction. These include the old main church and clinic cisterns. An underground cistern is currently being constructed where the old main church once sat, adjacent to the boat landing, with the intention of reconstructing the new church over it.

The project team is not able to guarantee that the proposed extent of the TCAP works on this part of the shore will be able to protect the cistern and the church, should it be built over the former footprint of the church. Moreover, the TCAP is not sufficiently resourced or accredited to implement the scale of engineering required to protect the present church location because it is too close to the active shore and thus subject to wave impacts during large storms.

On both islands, the BTB may also have a short term negative impact on the quality of household water supplies from wind-blown sand disturbances to nearby house rooftops where water is harvested during stockpiling or handling of sand within the settlement areas. It is expected that this would be low risk and will be easily mitigated through stockpile management measures.

9.2.7.5 Protective Measures

Protective measures will include:

- Determine if the BTB construction could negatively impact existing household toilets, septic tanks and waste management practices and identify and implement the necessary adjustments to protect the existing system where required.
- Waste management practices will prioritise reduce, reuse, recycle
- Preference shall be given to materials that can be used to construct the project that would reduce the direct and indirect waste generated.
- Consideration shall be given to the use of recycled aggregates and fly-ash cement mixes for construction of the Seabee wall on Nanumea.
- Daily waste practices shall be carried out.
- The use of construction materials shall be optimised and where possible a recycling policy adopted.
- Separate waste streams shall always be maintained i.e. general domestic waste, construction waste and contaminated waste. Specific areas on site shall be designated for the temporary

management of the various waste streams. Adequate signage and colour coded bins will be used for each waste streams.

- Recyclable waste shall be collected separately and disposed of correctly.
- Food wastes will be separated and stored securely to avoid YCA and other wildlife.
- All hazardous or contaminated waste will be exported from Tuvalu under the conditions of the Wagnini Treaty and will be coordinated through the WMD
- Disposal of waste shall be carried out in accordance with the Government of Tuvalu requirements. For waste which cannot be disposed of in Tuvalu, recycled, reused or composted will be exported and disposed of offshore in a licensed facility.
- Concrete slurry will be allowed to harden and disposed of as clean fill.
- Disposal of trees shall be undertaken in the accordance with one or more of the following methods: (i) left in place at the request of the owner; (ii) chipped and mulched; or provided to the community for reuse.
- Hydrocarbon wastes shall be stored in colour coded and labelled drums placed in secure, covered and bunded locations until their disposal.
- Any waste oils and lubricants are to be collected and transported to recyclers or designated disposal entities as soon as possible.
- Any dangerous goods (including batteries) stored on site shall be stored in accordance with Tuvalu regulations and international best practice
- Traffic management measures to protect all road users in Nanumaga and Nanumea will be described in the C-ESMP.
- The Contractor will be responsible for repairing any damage to the existing road network caused by construction works.
- Contractor will supply all required food for workers to the community to enable community members to be appointed to cook and prepare food for a fee.
- Contractor will provide first aid facilities and trained first aiders on Nanumaga and Nanumea for all workers
- The timing of the BTB installation and use of the landing may need to be planned such that the area continues to be accessible to the community for facilitating travel and the transportation of cargo in and out of the island.
- Determine the feasibility of developing the current cistern at the boat harbour on Nanumaga and develop a risk management plan for its operation.
- Adjustment of tank positions and water harvesting system features where required.

9.2.8 Hazardous Substances Management

The key types of chemicals and fuels likely to be stored at the laydown site during construction include, but are not limited, to diesel and unleaded petrol for the refueling of plant equipment and small portable generators. It is expected that the fuel will be delivered to the island in 44-gallon drums and that there would be several drums needed.

If not handled, stored or used appropriately, contamination of land and the coastal marine environment and groundwater systems could occur. The accidental discharge of hazardous materials during construction activities is a potential risk to the local environment. Accordingly, all oil, grease, diesel, petrol and chemicals should be stored at the laydown site within a bunded area.

Potential activities which could result in spills are:

a. use of machinery and vehicles – potential for fuels, oils and lubricant spills

b. transport, storage and handling of fuels, machinery oils, grease
c. Impacts associated with hazardous materials will primarily be associated with the storage and handling during the construction and operation phase.

9.2.8.1 Unexploded Ordinance

As Nanumea had a role to play in World War 2 as an American base, it may still contain unexploded ordinance (UXO). In 2015 the US Department of State Quick Reaction Force (QRF), along with the Tuvalu Police Service (TPS), undertook a mission to locate, recover and dispose UXO on three islands, including Nanumea. The QRF also trained members of the TPS in safe disposal of UXO. During this mission 2,500 Small Arms Ammunition (SAA) and one 155mm HE projectile were located and destroyed. The locations of these ordinance were not recorded during the survey and will need to be verified before works commence. One 500-pound GP bomb has been located in the Nanumea Lagoon at coordinate 05° 40.062' S and 176° 06.922' E at a depth of 14.3m (Figure 55) and does not pose a risk to the TCAP works.

No UXO were encountered during site visits or the geotechnical survey, however given the 2015 QRF survey finds, it is possible that during any excavation works for the BTBs, that there might be a chance find of UXO items.

Figure 55: Submerged UXO identified during 2011 QRF Survey

9.2.8.2 Protective Measures

Protective measures will include:

- Prepare spill management plan addressing measures
- Store and handle all chemicals, fuels, oils and potentially hazardous materials as specific in relevant standards and guidelines. All hazardous materials to be approved for use onsite. All hazardous materials and construction fuel will be stored in appropriate storage facilities (e.g. fuel and chemical will be stored in a bunded area).
- Hydrocarbon wastes shall be stored in colour coded and labelled drums placed in secure storage areas on site.
- Where possible, fuel and chemical storage and handling shall be undertaken at designated petrol stations on the island, or at the project site on impermeable bunded surfaces (preferable over drip trays). Ensure onsite refueling activities occur in designated areas of the site where appropriate temporary protection measures have been designed/located and are no less than 20 meters from surface waters and drainage lines.
- Onsite storage of fuel and chemicals shall be kept to a minimum.
- Emergency clean up kits for oil and chemical spills will be available onsite and in all large vehicles.
- In the event of a UXO discovery, the Contractor must immediately stop work and clear the work site of all personnel. The discovery must immediately be reported to the Supervision Engineer, Kaupule and TCAP National Project Manager. The TCAP National Manager will inform the TPS and it is the responsibility of the police force to report and coordinate the removal of the UXO. No works shall recommence on site until instruction has been received from the TPS and the TCAP NPM.
- The Contractor's C-ESMP will detail how they will identify previous ordinance removal areas on Nanumaga, search the project footprint and handle any UXO.

9.2.9 Land and Resource Use

9.2.9.1 Church Location Nanumaga

As the Nanumaga church was located on the coastal berm within the inundation zone, the reconstruction of the church in that location, will have significant negative consequences on the projects planned outcomes of reducing the communities' vulnerability and increasing their resilience to climate change in the medium to long term. The church footprint sits alongside the former TCS supermarket which was severely damaged in TC Tino. The location of these two pieces of infrastructure on the storm berm and within the inundation zone restricts the BTB's extension along this part of the shoreline. Hence, the current BTB design discontinues along that section of shoreline.

The project engineers have assessed that it is not technically possible to protect this part of the shoreline and this highly vulnerable location is not recommended to house any infrastructure. Furthermore, TCAP is not sufficiently resourced or accredited to implement the scale of engineering required to achieve protection of the present church location. Moreover, justification for such an investment may be reduced if the new wharf is established away from the existing boat channel.

9.2.9.2 Food Bearing and Canoe Building Trees

The impact of the BTB construction and operations on local food production has been carefully considered. The BTB is expected to sit at the crest of the berm within the tree line, well back from the active shore. This means trees along the BTB path will have to be cleared and this exercise may include local staple food source and food bearing trees. A post-disaster assessment for TC Tino this year showed that all households in Nanumaga indicated that they were affected by the destruction of food bearing trees, especially breadfruit (100%) but also banana (69%), papaya (41%), coconut (25%), and pandanus

(24%) as shown in Table 14. The same survey on Nanumea showed that all households in Nanumea indicated that they were affected by the destruction of food bearing trees, especially breadfruit (100%) but also banana (45%), papaya (36%), pandanus (37%), and coconut (28%). With food cultivation on atolls largely limited to pulaka, food/fruit trees provide a vital source of nutrients to local communities.

Pulaka, a key and perhaps the more resilient food source is cultivated in the north-eastern part of the island while sand is planned to be extracted from the north-western corner.

Table 14: Households in Tuvalu with crops and food trees affected by TC Tino

Agriculture Assessment Affected		Nanumea	Nanumaga	Niutao	Nui	Vaitupu	Nukufetau	Funafuti	Nukulaelae	Niulakita
		Percentages of households affected (%)[1]								
Swamp Taro	68 066	16	5	17	100	0	41	0	0	0
Taro	5 751	20	0	6	100	0	7	10	0	0
Coconuts	724	28	25	15	26	6	13	4	40	0
Breadfruit	616	100	100	52	87	9	36	33	3	0
Pandanus	344	37	24	35	38	12	10	21	23	0
Bananas	7 536	45	69	93	100	34	59	30	7	0
Papaya	1 597	36	41	58	69	19	44	15	0	0
Pig Pens	184	No data available								
Chicken Sheds	30									

9.2.9.3 Beach Access

Community members, especially women and youth, were concerned that the BTB and sand extraction activities would negatively affect the communities' daily access to the beach. These concerns related mainly to:

- being able to see the ocean from house
- accessing shells for handicraft (sand extraction may affect supply)
- being able to see and monitor boat traffic or boats fishing without a license
- being able to see when emergency related situations on the beach arises (e.g. injury and accidents)
- children's safety if they play on the BTB
- people (e.g. drinkers) may tumble on the BTB and hurt themselves

Community members have been fully consulted in the design process of the BTB and this will continue to be the case as the project progresses to ensure that all concerns can be captured and addressed either through the design or through suitable mitigation measures.

9.2.9.4 Changing Land Use

The TCAP project introduces two key technologies that could divert settlement patterns on the island. On both islands, the BTB will enhance the 'natural' barrier of the existing berm in a way that discourages settlement from extending seaward, a common trend found in many coastal communities in the Pacific Islands. While such a move reduces the number of households exposed to coastal hazards, it may also trigger an ad hoc retreat process towards the 'safer zone' that changes land use demands for livelihoods

and wellbeing. If a triggered retreat process is not adequately planned and managed at the village governance level, it has the potential to, over time, create tension over land access and tenure.

Given the proposed reconstruction of the Nanumaga church in the inundation zone, a LiDAR informed hazard zone map has been generated (Figure 56). This map has the potential to induce community expansion inland on Nanumaga showing that the two identified 'safer' zones separately adjacent to Tonga village to the North and Tokelau village to the south. The relocation of the main church to the 'safer zone', should the community decide (if not now then perhaps later), could likely assist to drive an inland retreat.

Figure 56: Nanumaga Coastal Hazard Zone Map showing safe areas for development and areas prone to inundation (in red). Source: SPC TCAP Preliminary Geotechnical Investigation Report, 2020

9.2.9.5 Protective Measures

Protective measures will include:

- Conduct an inventory of food producing trees that will be cleared for the BTB installation and ensure seedlings are replanted in areas that are accessible to households that rely on cleared trees.
- Ensure sand excavation impacts from extraction and transportation of excavators, are minimized or avoid negative impacts on the pulaka pit and food bearing trees.
- For both islands, conduct a whole of island vulnerability assessment and adaptation plan that effectively identifies and responds to risks associated with community livelihood assets and human securities in changing climate-induced environmental conditions in the medium to long term.
- Initiate further participatory consultations and focus group discussions with the Nanumaga Kaupule and the community women, men, youth, disabled, elderly and other sub-units to collectively discuss and consider the costs and benefits of rebuilding the church in the following three site options. While a bottom-up approach to the cost-benefit discussion facilitates ownership of the community adaptation process, key inputs from the project technician as

described in the table (Table 15: Site option discussion table for Nanumaga Kaupule and community regarding church siting.) Below should also be shared for a multiple knowledge system approach to the process.

Table 15: Site option discussion table for Nanumaga Kaupule and community regarding church siting.

Site Option	Benefit	Risk/Cost
Option 1: Existing church site	▪ Cultural meaning associated with re-building on same location ▪ Construction will be cheaper	▪ Structure would stand only until the next major storm or cyclone hits or at least the next 5 to 10 years ▪ Cannot site the BTB in adjacent shoreline for risk of nearby structures (*mwaneaba*, pastor's house, and *malae*) would be relatively higher than other parts of the community. ▪ Upkeep and maintenance cost of church and nearby structures on an annual basis will be higher ▪ Less likely to secure external resourcing compared with Option 3.
Option 2: Immediately adjacent to *mwaneaba* on current *malae* ground, and moving malae shoreward (i.e. church and *malae* ground to swap spots)	▪ Cultural meaning associated with re-building on same location maintained ▪ Allows for BTB installation on berm crest, enhancing protection of adjacent buildings and facilities ▪ *Malae* ground will directly benefit from sea breeze ▪ *Malae* ground will be bordered by sloping BTB where spectators can sit ▪ Upkeep and maintenance cost of church and nearby structures on an annual basis likely to be less than Option 1.	▪ Structure may withstand at least 20 years to 50 years if roofing and maintenance is adequately responded to ▪ Construction will cost slightly more than Option 1. ▪ Less likely to secure external resourcing compared with Option 3.
Option 3: Rebuild the church several meters inland from footprint to accommodate the continuation of the BTB	▪ Cultural meaning associated with re-building on same location maintained ▪ Allows for BTB installation on berm, enhancing protection of adjacent buildings and facilities ▪	▪ *Malae* ground area will be reduced in size by a couple of square meters ▪ Construction will cost slightly more than Option 1. ▪ Less likely to secure external resourcing compared with Option 3.
Option 4: Rebuild church on mapped 'safer zone' inland.	▪ Most expansive option ▪ More likely to secure external resourcing if used also as an evacuation centre in a 'safer' zone	▪ More expensive than Options 1 and 2 ▪ Losses to cultural meaning associated with existing site ▪ Cost of relocating pastor's house

	▪ Allows for BTB installation on berm crest, enhancing protection of adjacent buildings and facilities ▪ Facilitate community retreat with sufficient safe land area for homes to 'building-back safer' if houses are destroyed by storms and cyclones in the near distant future ▪ Upkeep and maintenance of church (and evacuation shelter) may be built into adaptation programming ▪ Opportunity for social innovation and to recreate and establish cultural meaning in new site as well as improve community wellbeing based on lessons from the past	▪ Decision on which part of the safe zone to rebuild on (i.e. Tonga or Tokelau side) may be prolonged and may create social tension

9.2.10 Social Environment

9.2.10.1 Gender and Social Inclusion

The TC Tino Recovery and Vulnerability Reduction Plan 2020 states (page 13):

> *"The knowledge men and women brought to their households made it possible for communities to survive the challenges of TC TINO.*
> *Women in the family setting have a deeper insight into the welfare of the children and elders, and men have a deeper insight into the operational reliability of their family and possessions.* ***Planning for disasters needs to value and bring to light the respective intelligence of both men and women****.*
> *However, in most circumstances there are gender based differences and inequalities, which tend to favour men or men in leadership roles. Attitudes that in turn looks condescendingly at views/perspectives of women and other vulnerable groups, disregarding potentially innovative solutions to existing problems. If gender based inequalities are eliminated, it caters for more productive and efficient use of available resources. The case of young men putting themselves in danger to protect their families is not a light matter of say "that is a job for a man." Such attitudes are dangerous and especially so in disasters such as cyclones.*
> *Therefore, the vulnerable members of the community are of great importance to the capacity of any community to plan and reach every member of the community.* ***Any decision set forth by those in power/authority is unequivocally felt by those most vulnerable in our society, whether good or bad."***

As shown earlier, the changes brought on by the BTB installation on both islands physical landscape has the potential to positively and negatively influence the island community's social environment in varied ways over time. It is worth noting that this change will occur in a cultural context where traditional and modern values are interacting and where men dominate decision-making spaces of which this project will not exempt.

Care will need to be taken to ensure the way decisions are made and implemented with regards to the project does not contribute to deepening existing gender inequities or contribute to existing limitations for inclusive problem-solving processes that engages multiple gender and age influenced perspectives. For example, the wider community with equal participation from men, women, youth and disabled should part take collectively in discussing and considering the benefits and risks associated with the

three site options for the church reconstruction. Similarly, discussions related to mitigating the potential negative impacts of the BTB construction should be an inclusive one.

9.2.10.2 Community Perceptions and Expectations

Unaddressed concerns regarding the risks associated with the project and unmet expectations has the potential to stall or undermine timely implementation of the project. For example, during the community consultation process, members from both islands identified project risk and mitigation measures that may be considered indicative of community perceptions and expectations of the project that would need to managed in future SECP related activities. Some of the key perceived risks and response measures identified include:

- Is the 1.0m-2.0m height of the berm that is proposed will be sustainable to protect the shoreline and homes for instance, in TC Pam the waves were at a height taller than 1.0m (although this needs to be verified with Moritz modelling).
- Why tetrapod-based coastal protection measures were not adopted for Nanumaga given its effectiveness in the Maldives and Japan
- A suspicion that the ESIA process adopted for the project would be largely donor driven
- Can the BTB cause flooding?
- Unlikely that the church would be rebuilt in the identified safer zone as no landowner in that area will be willing to their land for free for the rebuilding of the church

While the TCAP and SPC respondents effectively responded to community questions with evidence-based reasoning, the nature of questions suggests the need to ensure greater socialisation of the philosophy, benefits and limitations of the BTB design.

The use of culturally appropriate mediums such as via church and culture-based events as well as audio, audio visual, written communication products could prove effective. The importance of participatory planning, decision-making and implementation processes to facilitating community ownership and cooperation towards the project may also facilitate trust in its process.

9.2.10.3 Employment

Income generating opportunities for community members will arise in the design, construction and operational phase of the BTB establishment. Labour for the BTB will be mostly sourced from the two Nanumaga and six Nanumea communities and time compensated for via monetary payment. Measures will need to be put in place to ensure equitable sharing of responsibilities and income between the two islands communities as well as between men and women in the design, construction and operational phases.

9.2.10.4 Protective Measures

Protective measures will include:

- Ensure opportunities to incorporate men and women's views and interests into project decisions and implementation are purposefully created and enabled in the stakeholder engagement processes throughout the project life.
- Develop and implement and communication plan for the project and in particular the philosophy of the BTB design that is tailored for the Nanumaga and Nanumea communities as well as other stakeholders. It is recommended that 3D visualisation is used to recreate Tino/Pam activity with the assistance of SPC outputs to show the benefits of the BTB (i.e. by showing visualisations with/without BTB)

- Develop and implement a community based coastal protection plan and monitoring and evaluation system that engages a wide cross-section of the community in practical adaptive learning and resilience building.
- The design of the coastal protections calls for a number of site visits to Nanumaga and Nanumea from the TCAP and SPC teams safeguard specialists and the design engineers. For any consultations undertaken with the Kaupule or Falekaupule, the women of the community will provide trays of food sufficient for the number of participants and paid for as part of the project costs. Each tray of food costs approximately AUD$60 and is sufficient to feed 6 people. The money paid for these food trays go directly to the women involved in the cooking. It is therefore, important for all site visits during the design phase to allow a budget for consultation catering. Site visitsmay also call for overnight accommodation for the project team. In this case, guesthouses are used, catering is needed, and cleaning/laundry services are used which all generate income for the community.
- A number of income generating activities will stem from the construction works. These range from direct employment of local labour, through to provision of cooking and housekeeping services provided at the workers accommodation. The islands have a cultural arrangement whereby any employment generated from projects such as this is shared fairly throughout the community on a rotational basis. It is a requirement for all projects to adhere to this cultural practice. To facilitate this effectively, the Contractor will be required to undertake training for all nominated workers at the start of works to avoid delays linked to the need for additional training as the workers rotate.
- The communities in coordination with their Kaupule will provide the contractor with a list of skilled and unskilled laborers. The Kaupule will also coordinate with the villages to ensure that job opportunities are fairly disseminated. Women are encouraged to participate in the workforce and job opportunities. Persons with disabilities are also encouraged to participate in the workforce and with jobs that are appropriate and significant.
- The women of the island will have the opportunity to provide food, beverage and housekeeping services for incoming workers to the islands for 3-4 months. Food services may include lunch and dinner, providing fresh water or coconuts, selling of food items such as local fruits, root crops, vegetables, etc., selling of handicrafts, and laundry services are examples of income generating activities.
- Additionally, there may be other opportunities such as scooter rental, boat rental for excursions, sales of luxury items imported from Funafuti, etc.
- The Kaupule's will provide a list of skilled and non-skilled members of the community will form the islands labour pool for the construction works. The number of workers available will be confirmed once the Kaupule's inventory is complete. The Contractor will provide the islands workers with training to ensure that they are able to, among other things, satisfy the necessary requirements for OHS, environmental compliance and understand correct construction techniques. The long-term impact of this is an upskilled workforce on the island who will be able to bring these training and experience benefits to other construction work on the island. It is recommended that these "short courses" provided by the contractor/PWD/government result in an appropriate accredited certification and a digital resume for each worker that may be used in the future.

9.2.11 Community Health and Safety

9.2.11.1 Gender Based Violence

The perpetrators of GBV can be anyone associated with the Project and may include not only construction workers, but also consultants and project staff supervising the works or undertaking technical assistance activities or studies hired to protect a project site.

The TCAP project will likely be of low risk in relation to project related GBV due to the minimal level of labour sourced from outside, the fair and equitable approach to recruitment of local workers and the strong role the Kaupule and women's group plays on the island and the proposed approach to engaging the community in a participatory way in the construction and operationalization of the project.

Instances of GBV within Tuvalu usually come to the attention of the Tuvalu Family Health Association (TFHA) as a primary contact with supporting services from the Gender Affairs Department (GAD) and the Tuvalu National Council of Women (TNCW). Gaps identified in these three survivor support services were identified through GBV work under TvAIP and training was given to these three agencies and several other Tuvaluan NGOs and civil societies by the Fiji Women's Crisis Center with the result that there are now many qualified councilors within these organisations train in GBV and SAE psychosocial counseling. This training was also extended to the outer islands and there are also female community workers on the islands who has been trained to this level.

9.2.11.2 Protective Measures

Protective measures will include but are not limited to:

- Incorporation of GBV into the Stakeholder Engagement and Consultation Plan
- Code of conduct that includes a drug and alcohol policy will be signed by all workers (including project management) to demonstrate commitment to prevention of GBV and the prevention of the spread of STDs such as HIV/AIDs. Code of Conduct and training requirements is included in the Contract.
- Create opportunities for women to participate in decision-making of the project as well as benefit economically via employment through this project.

9.3 Uncertainties in Identifying Impacts

Despite the measures that will be taken to mitigate or avoid the foreseeable impacts of the project works, there is always the possibility of impacts that have not been accounted for or were not anticipated, or the extent of predicted impacts can turn out to be greater than predicted, or the mitigation measures may not be as effective as expected. To ensure that such incremental impacts do not suddenly appear without warning, the project will monitor key parameters in the vicinity of the development that can serve as environmental indicators. The AOI has been surveyed and a baseline has been established. As per the ESIA, these areas will be monitored during all phases of the project, to provide an indication of impacts before they become too advanced for corrective action.

10 MITIGATION AND MONITORING PLANS

10.1 Introduction

Appendix A and B contains the recommended mitigation measures for the Nanumaga and Nanumea investments for pre-construction and construction phases. The tables for each phase includes details of the mitigation measures required, the cost allocation, responsible entity and the applicable project phase.

Monitoring measures are also provided for each project phase. The tables are divided into two sections: (i) one-off preconstruction checklist; and, (ii) weekly checklist for the construction phase.

The MCT PMU carries overall responsibility for safeguards supervision. MCT and the Nanumaga and Nanumea Kaupule are responsible for incorporating the operational phase maintenance needs into their annual work plans.

10.2 Contractors Environmental and Social Management Plan

The Contractor for the TCAP works will be required to produce a Contractors Environmental and Social Management Plan (C-ESMP). The C-ESMP will be the Contractors governing document for the implementation of this ESIA during works. The C-ESMP will contain the contractor's methodology and planning for adhering to their safeguard requirements. Additionally, the C-ESMP will detail how the Contractor plans to resource their team with personnel and financial resources as per the Contract.

The C-ESMP and associated management Plan will be developed, reviewed and approved by the TCAP PMU or technical experts and disclosed prior to commencement of civil works. The Contractor is required to produce the following management plans as part of their C-ESMP. These management plans are referred to throughout the ESMP. In addition to these management plans being a requirement for the C-ESMP, they will also be required as part of the tendering process to demonstrate that the Contractor has started to consider these environmental and social impacts and has the capacity within their team to plan their safeguard management strategies.

Spill Response Plan: The Contractor will have a spill response plan in place to account for all potential instances. A Spill response plan will be developed to ensure that all fuels and lubricants used during the construction phase in machinery, equipment, generators and also on marine vessels are contained, collected, treated and disposed of. The spill response plan will: (i) identify areas within the project sites and nearby vicinity that are sensitive to spills and releases of hazardous materials and locations of any water intakes; (ii) outline responsibilities for managing spills, releases, and other pollution incidents, including reporting and alerting mechanisms to ensure any spillage is reported promptly to the Kaupule; (iii) Include provision of specialized oil spill response equipment (e.g. containment booms, recovery devices, and oil recovery or dispersant application vessels, etc.), and; (iv) include regular training schedules and simulated spill incident and response exercise for response personnel in spill alert and reporting procedures, the deployment of spill control equipment, and the emergency care/treatment of people or wildlife impacted by the spill.

Erosion, Drainage and Sediment Control Plan (EDSCP): This plan will address the drainage control, sediment and erosion controls and stockpiling of materials including soil during construction of all works. The plan will include measures to be inspected regularly to ensure all devices are functioning effectively. Specifically, the plan will be designed to ensure that: (i) there is no build up of sediment in the coastal marine environment, Nanumaga boat harbour and/or groundwater as a result of the construction activities; (ii) there is no degradation of water quality on or off project sites; (iii) all water exiting the project area and/or into the groundwater systems is to have passed through best practice

erosion, drainage and sediment controls; (iv) there are no changes to existing erosion or sediment deposition regimes form taking of sediment from the coastal zone; (v) ensure effective implementation of site specific EDSCP.

11 ESMP IMPLEMENTATION

11.1 Integration of ESMP into Project Procurement

This ESIA should be included in the bid document package.

The safeguard requirements of this ESIA will be referenced in appropriate parts of the technical specifications, Contractors contract and any TORs for supervision or issued under the TCAP. The TCAP Project Manager will be required to review all bid documents prior to approval.

11.2 Roles and Responsibilities

The TCSP GCF Project Proposal Document ESMP outlines the implementation responsibilities for the environmental and social management which also applies to this ESIA

11.2.1 General Management Structure and Responsibilities

The UNDP and DoE are accountable for the provision of specialist advice on environmental issues to the contractor and for environmental monitoring and reporting. The DoE will assess the environmental performance of the contractor in charge of construction throughout the project and ensure compliance with the ESMP.

The DoE will be responsible for monitoring the implementation of the ESMP by relevant supervisory staff during construction. During operations, the contractor will be accountable for implementation of the ESMP. Contractors working on the projects have accountability for preventing or minimising environmental and social impacts.

11.2.2 Administration

The DoE will be responsible for the revision or updates of this document during the course of work. It is the responsibility of the person to whom the document is issued to ensure it is updated.

The site supervisor will be responsible for daily environmental inspections of the construction site. The DoE will cross check these inspections by undertaking monthly audits.

The contractor will maintain and keep all administrative and environmental records which would include a log of complaints together with records of any measures taken to mitigate the cause of the complaints.

The contractor will be responsible for the day to day compliance of the ESMP.

DoE will be the implementing agency and will be responsible for the implementation and compliance with the ESMP via the contractor. The ESIA will be part of any tender documentation.

The Supervising Engineer/Project Manager will supervise the contractor, while the DoE will be responsible for environment and social issues.

11.2.3 Design Consultants

It is the Design Engineers responsibility to:

- Comply with this ESIA in the final development of the concept designs, detailed design, procurement bid documents and other advice to the PMU;
- Avoid or minimise environmental and social impacts by design;
- Undertake meaningful consultation with stakeholders and communities to inform the design process.

11.2.4 Supervision Engineer

The Supervision Engineer is responsible for the day to day oversight of the construction works for the project, including safeguard compliance. The Supervision Engineer will work closely with the Contractor on a daily basis to ensure that the project is implemented in a compliant manner consistent with the detailed designs provided and the ESIA. They are responsible for:

- Daily monitoring of the Contractors work for compliance with the ESIA through their C-ESMP as per the measures detailed in Appendix B providing safeguard monitoring results in their monthly reporting to PMU
- Managing the review process of C-ESMPs for approval. The Supervision Engineer must ensure that all current safeguard instruments have been reviewed internally as well as by the PMU and UNDP.
- Updating the ESIA as necessary to reflect notable changes in the designs.
- Working with the Contractor and the PMU to provide meaningful input and direction into community consultations.
- Managing instances of non-compliance by the Contractor and reporting all instances to the PMU. They are also responsible for escalating recurring instances of non-compliance by the Contractor to the PMU for action.
- Managing and responding to all direct complaints/incidents received by their representatives reporting all instances to the PMU for inclusion into Project database.

11.3 Institutional Capacity

A Project Management Unit working under the National Project Manager has been tasked with the delivery and management of TCAP. The PMU has been resourced with support staff based in Funafuti and Fiji specifically tasked to manage project implementation across management, finance, procurement, communication and technical. As such, the PMU carries much of the institutional capacity to implement the Project and to monitor the works for technical compliance. The PMU has also recently recruited and in-house safeguard specialist to ensure that they are able to monitor for compliance with the requirements of the ESIA, UNDP Social and Environmental Standards and national legislation. While the UNDP is available to provide support and Project Assurance, this capacity is best delivered in the form of a dedicated safeguards specialist for the PMU with technical support from a part time international safeguards specialist when needed.

Other parties who have monitoring or implementation responsibilities during project implementation (Supervision Engineer, Contractor) will be required as part of the contract to be resourced with a suitably experienced and qualified safeguard specialist.

It is the responsibility of the Contractor and Supervision Engineer to ensure that they allocate budget lines to have the necessary specialist capacity, tools and equipment for the mitigation and monitoring measures as stipulated in the ESIA. Budget line items will be provided in the bid documents and Bill of Quantities to allow for the provision of adequate safeguards implementation, monitoring and training. This section will be updated prior to the release of the bid documents and once the BoQ has been prepared.

11.3.1 Contractors

It is the Contractors responsibility to:

- Ensure the Contractors project team includes experienced safeguard specialists with sufficient in-country time allocation and financial resources specified in the Contract
- Prepare and have cleared by the Supervision Engineer the C-ESMP in accordance with this ESIA prior to commencement of works
- Carry out the project implementation in accordance with the C-ESMP
- Not to undertake any works or changes to works unless first approved in an updated C-ESMP
- Conduct daily and weekly safeguard inspections of the works to ensure compliance and reporting the results of these inspections to the Supervision Engineer
- Undertake community consultations on the draft C-ESMP in coordination with the PMU
- Post all notifications specified in this ESIA at the site entrance
- Report all environmental and OHS incidents to the Supervision Engineer for any action
- Provide monthly reports of all safeguard monitoring, incidents, complaints and actions to the Supervision Engineer
- Maintain a database of all complaints, incidents or grievances received. Any issues which cannot be dealt with immediately should be reported to the Supervision Engineer.

12 CONTINGENCY AND EMERGENCY RESPONSE

The TCAP National Project Manager (NPM) is the contact person for emergency situations that may arise during the implementation of the TCAP works on Nanumaga and Nanumea. The NPM will be available 24 hours a day, seven days a week, and has delegated authority to stop or direct works. In the event of an environmental emergency, the procedures outlined below are recommended for TCAP to consider for implementation.

12.1 Contingency Plan

As part of their C-ESMP, the Contractors are required to prepare a Contingency Plan encompassing the COVID-19 global pandemic, cyclone and storm events. The purpose of the plan is to ensure all staff are fully aware of their responsibilities in respect to human safety and environmental risk reduction. Procedures should clearly delineate the roles and responsibilities of staff; define the functions to be performed by them, the process to be followed in the performance of these functions including tools and equipment to be kept in readiness, and an emergency medical plan. All the Contractor's staff should undergo training/induction to the plan.

While it is preferable to undertake construction works outside of the wet season, it is probable that storm and heavy rain events will occur while works are underway.

The Contractors are responsible for monitoring weather forecasts, inspecting all erosion and sediment control measures and undertaking any remedial works required prior to the forecast rain or storm event.

In general, the Contractors will:

- Inspect daily weather patterns to anticipate periods of risk and be prepared to undertake remedial works on erosion and sediment control measures to suit the climatic conditions.
- Monitor the effectiveness of such measures after storms and incorporate improvements where possible in accordance with best management practice.
- Ensure appropriate resources are available to deal with the installation of additional controls as and when needed.
- Inform the Supervising Engineer if there are any concerns associated with the measures in place.

12.2 Emergency Response Plan

In the event of actions occurring, which may result in serious health (including pandemic), safety and environmental (catastrophic) damage, emergency response or contingency actions will be implemented as soon as possible to limit the extent of environmental damage.

It is assumed that there are residences located near the construction activities.

The contractor will need to incorporate construction emergency responses into the projects complying with the requirements under the Occupational, Health and Safety Policy of the contractor or the work-related Government of Tuvalu legislation.

The DoE and UNDP staff must be notified immediately in the event of any emergency, including fire or health related matter including those that have resulted in serious environmental harm. The Contractor will be required to develop an Emergency Response Plan as part of their C-ESMP and they are required to ensure that the following health and safety measures are included:

- Flammable and combustible liquids bunding/storage areas to be designed in accordance with appropriate international standards.
- Fire extinguishers are to be available within all site vehicles.
- No open fires are permitted within the project area
- No cigarette butts are to be disposed of onto the ground throughout the project areas, all smokers must carry a portable disposal bin to reduce the risk of a spot fire starting and general litter.
- Any stockpiles of mulch, sawdust or any other flammable materials are not to exceed two meters in height and width and must be turned regularly.
- Train all staff in emergency preparedness and response (cover health and safety at the work site)
- Check and replenish first aid kids and dedicated first aiders are within the project personnel on site
- Personal Protection Equipment is provided, and staff are trained on their correct use.

APPENDIX A: MITIGATION TABLE

Project Activities	Pre-Construction Mitigation Measures	Cost	Responsibility	Start	End
General	• The ESIA will be included in the Contractors and Supervision Engineers specification and contract • Specific mitigation measures for the contractor or Supervision Engineer shall be highlighted in the contract clauses	Minor, included in tendering costs	UNDP	Tender Preparation	Signing of contract
General	• Contractor and Supervision Engineer will include safeguards specialist within their key personnel. • Safeguards specialists will be adequately resourced to provide the necessary country support.	Minor, included in tendering costs	UNDP	Tender Preparation	Signing of contract
General	• Apply for and secure all permits and approvals under the appropriate national legislation. • Submit Development Consent application to DoE based on this ESIA	Minor	TCAP PMU	Pre-Construction phase	Prior to construction starting
General	• The Contractor shall develop a Contractors ESMP, including Erosion, Drainage and Sediment Control Plan and Spill Response Plan. The C-ESMP will be cleared by the Supervision Engineer prior to the commencement of civil works. • All relevant personnel will be trained on this plan and attendance will be recorded. • Contractor will maximise use of local labour to minimise need of foreign workers wherever practicable.	Included in Contract Costs	Contractor	Award of Contract	Prior to Construction Starting
Design of BTB	• BTB footprint to avoid mature canopy or food producing trees to the greatest extent possible • No trees in the vegetation line will be permanently removed as part of the design of the BTB. Replanting will be required for any plants removed in the BTB corridor. • Ensure that the Seabee wall does not exceed the pre-existing revetment footprint on Nanumea. • Vegetation to be removed shall clearly be marked using paint or flagging tape. • Determine if the BTB construction could negatively impact existing household toilets, septic tanks and waste management practices and identify and implement the necessary adjustments to protect the existing system where required. • Determine the feasibility of developing the current cistern and develop a risk management plan for its operation. • Adjustment of tank positions and water harvesting system features where required.	Included in Contract Costs	Design Engineer	Development of concept designs	Approval of final detailed design

Sand Extraction	• Sand extraction sites and volumes will be determined by the TCAP coastal experts and engineers and will not exceed volumes discussed in this ESIA without updated analysis. • Document consultation process with Kaupule and Falekaupule and landowners behind extraction sites. • Obtain written permission from Falekaupule to extract specified volumes of sediments. • New access tracks for storm sand deposits shall be kept to minimum length and width and will be temporary. • Working area for machinery on beaches will be clearly marked before construction starts and will be kept to a minimum size.	Minor, part of standard practices	PMU and Contractor	Pre-Construction phase	Prior to Start of works
Solid Waste Management	• Preference shall be given to materials that can be used to construct the project that would reduce the direct and indirect waste generated. • Consideration shall be given to the use of recycled aggregates and fly-ash cement mixes for construction of the Seabee wall on Nanumea. • The use of construction materials shall be optimised and where possible a recycling policy adopted • Contractor will consult with GoT WMD on export of hazardous substances. • All Project staff will be trained on these requirements and attendance will be recorded.	Minor, part of standard practices	Contractor	Pre-Construction phase	Prior to start of works
Spill Response	• As part of the C-ESMP, the Contractor will have a spill response plan in place to account for all potential instances. • Spill response plan will be developed to ensure that all fuels and lubricants used during the construction phase in machinery, equipment, generators and also on marine vessels are contained, collected, treated and disposed of. • Identify areas within the project site and nearby vicinity that are sensitive to spills and releases of hazardous materials and locations of any water intakes; • Outline responsibilities for managing spills, releases, and other pollution incidents, including reporting and alerting mechanisms to ensure any spillage is reported promptly to the port authority and Kaupule; • Include provision of specialized oil spill response equipment (e.g. containment booms, recovery devices, and oil recovery or dispersant application vessels, etc.) • Include regular training schedules and simulated spill incident and response exercise for response personnel in spill alert and reporting procedures, the deployment of spill control equipment, and the emergency care/treatment of people or wildlife impacted by the spill.	Minor, part of standard practices	Contractor	Pre-Construction phase	Prior to start of works

Mobilisation of machinery and equipment from source country	• Ensure all construction machinery and equipment is steam cleaned of all organic material in source country prior to deployment. • Provide an approved phytosanitary certificate and any other documentation required under Tuvalu legislation. • Ballast water of cargo vessels to be discharged no closer than 5nm from the shoreline. Confirm with ship captain and review of log. • Size of imported construction equipment (excavator, digger, etc) should be kept to a workable minimum. • Any vessels chartered for shipping shall be compliant with the International Maritime Organisations conventions of which Tuvalu is a signatory.	Included in Contract Costs	Contractor	Prior to mobilisation	Completion of all importing activities
Offloading / Removing construction equipment and materials	• Designate one area of reef for unloading barge • Define minimum width corridor for machinery to move across the reef flat and on land which avoids any vegetated area and minimised distance travelled over sand. • Works will be staged to ensure that no machinery is moved from Nanumea to Nanumaga. Machinery can only travel from Nanumaga to Nanumea (not other way round) to avoid transferring kou leafworm to Nanumaga.	None, part of standard practices	Contractor	Development of CESMP	Demobilization
Stockpile and Laydown sites	• The Contractor will have an EDSCP as part of their C-ESMP • Ensure the designated stockpile site is appropriately bunded or fenced to prevent sediment runoff. • Vehicle washdown and concrete protection areas will be at the laydown site and will be bunded with all wastewater collected and treated prior to discharge. • Consultation with Kaupule undertaken in finalizing location of stockpile and laydown sites • Management and operations of site addressed in C-ESMP prepared by Contractor and cleared by Supervision Engineer. • Ensure no significant environmental, social or infrastructure impacts because of location and operation of laydown and stockpile areas. • Laydown and stockpile sites will be located away from bodies of water. • Any temporary lease agreements for sites will follow the requirements of this ESIA and national legislation. • Stormwater management measures will be designed to reduce flow velocities and avoid concentrating runoff. • Vegetated buffer strips around sites will be retained.	Included in Contract Costs	Contractor	Development of C-ESMP	Prior to start of works

Workers and Project Accommodation	• Use of existing accommodation for project office and project personnel • Minimise number of workers from off-island. • Contractor will supply all required food for workers to the community to enable community members to be appointed to cook and prepare food for a fee. • Contractor will provide first aid facilities and trained first aiders on Nanumaga and Nanumea for all workers	Included in Contract Costs	Contractor and Supervision Engineer	Mobilisation	Prior to start of works
Recruitment of overseas workers	• All imported project staff will abide by Tuvalu immigration policy and provide all required documentation, including health checks. • Overseas workers will undergo cultural familiarisation induction upon arrival and sign a code of conduct applicable for the duration of their contract. • Overseas workers will have the technical skills and experience required for works under this component.	Minor, part of standard practices	Contractor	Upon recruitment	Prior to construction starting
Gender, Social Inclusion & GBV	• Ensure opportunities to incorporate men and women's views and interests into project decisions and implementation are purposefully created and enabled in the stakeholder engagement processes throughout the project life. • Incorporation of GBV into the Stakeholder Engagement and Consultation Plan • Code of conduct will be signed by all workers (including project management) to demonstrate commitment to prevention of GBV and the prevention of the spread of STDs such as HIV/AIDs. Code of Conduct and training requirements is included in the Contract.	Minor, part of standard practices	Contractor	Pre-Construction phase	Prior to construction starting
Employment	• The design of the coastal protection works calls for a number of site visits to Nanumaga from the TCAP and SPC teams safeguard specialists and the design engineers. For any consultations undertaken with the Kaupule or Falekaupule, the women of the community will provide trays of food sufficient for the number of participants and paid for as part of the project costs. Each tray of food costs approximately AUD$60 and is sufficient to feed 6 people. The money paid for these food trays go directly to the women involved in the cooking. It is therefore, important for all site visits during the design phase to allow a budget for consultation catering. Site visitsmay also call for overnight accommodation for the project team. In this case, guesthouses are used, catering is needed, and cleaning/laundry services are used which all generate income for the community. • The Nanumaga communities in coordination with the Nanumaga Kaupule will provide the contractor with a list of skilled and unskilled laborers. The Kaupule will also coordinate with the villages of Tonga and Tokelau to ensure that job opportunities are fairly disseminated. Women are encouraged to participate in the workforce and job opportunities. Persons with disabilities are also encouraged to participate in the workforce and with jobs that are appropriate and significant.	Minor, part of standard practices			

Community Engagement	• Implement the Stakeholder Engagement and Consultation Plan • Develop and implement communication plan for the project and in particular the philosophy of the BTB design that is tailored for the Nanumaga and Nanumea communities as well as other stakeholders. • Develop and implement a community based coastal protection plan and monitoring and evaluation system that engages a wide cross-section of the community in practical adaptive learning and resilience building.	Minor, part of standard practices Part of TCAP Budget	Contractor and NPM NPM	Project Design	Demobilisation
Hazardous Substances Management	• A Spill Response Plan will be developed as part of the Contractors C-ESMP • Designate an area for storage of all hazardous chemicals which is on impermeable surface, is bunded and is sheltered from the weather. • Emergency clean up kits for oil and chemical spills will be available onsite and in all large vehicles.	Included in Contract Costs	Contractor	Development of CESMP	Prior to start of works
Land and Resource Use	• Conduct an inventory of food producing trees that will be cleared for the BTB installation and ensure seedlings are replanted is areas that is accessible to households that rely on cleared trees. • Conduct a whole of island vulnerability assessment and adaptation plan that effectively identifies and responds to risks associated with community livelihood assets and human securities in changing climate-induced environmental conditions in the medium to long term. • Initiate a second and participatory consultation with the Nanumaga Kaupule and community focused on discussing and collectively considering the costs and benefits of rebuilding the church in the following three site options. While a bottom-up approach to the cost-benefit discussion facilitate ownership of the community adaptation process, key inputs from the project technician as described in the table below should also be shared for a multiple knowledge system approach to the process (See Table 15 in Section 9.2.9.4).	Minor Part of TCAP Budget	Design Engineer UNDP	Start of Detailed Design Ongoing	Before start of works Ongoing

TCAP CONSTRUCTION PHASE MITIGATION PLAN

Project Activities	Construction Mitigation Measures	Cost	Responsibility	Start	End
Offload, transport and operation of construction machinery	• All machinery to be in sound condition and free from any leaks of lubricants and fuel. • Maintain construction equipment. • Any machinery generating visible smoke is not permitted for construction activities. • Select landing area prior to arrival of equipment. Same location to be used for all offloading and demobilisation. • Offloading of equipment will only be undertaken at low tide and during low wind and wave conditions. • Define and clearly mark conservative working areas on the beach, berm crest, project corridor and reef flat for all heavy plant and machinery. No machinery will be permitted to cross the beach crest outside of predetermined areas. • No machinery will be permitted on the beach at the northern tip of the Nanumea project corridor. • Construction machinery will be stored away from the coastal marine environment, at the laydown site. • No new access tracks will be permitted onto the beach, except for sand extraction. • Traffic management measure to protect all users in Nanumaga and Nanumea will be described in the C-ESMP • Contractor will be responsible for immediately repairing any damage to the existing road network or infrastructure caused by construction works. • Spill kits to be placed at all fueling locations and on construction equipment. • Refueling only to occur in designated area within laydown site on hardstand area or over drip trays. • Pay appropriate construction damage compensation to affected parties as determined by the approved Government compensation schedule. • Training for all machinery operators on ESHS risks to marine environment and vegetation line from accidental damage during construction. • Turn off or shut down all machinery or vehicles when not in immediate use. No engine idling of unattended vehicles is permitted.	Included in Contract Costs	Contractor	Pre-mobilisation	Demobilisation
Traffic (pedestrian and vehicle) Management	• Implement the traffic management measures to ensure smooth traffic flow and safety for workers, passing vehicles and pedestrian traffic. • Where appropriate, employ flag operators on the road to prevent traffic accidents. The workers shall have relevant safety equipment and training. • Restrict speed limits of vehicles on unsealed roads • Cover loads of haul and equipment when not in use and in transit.	Included in Contract Costs	Contractor	Prior to works	Demobilisation

Sand Extraction	• Implement EDSCP • The Contract will seek the guidance of TCAP expertise at the time of sand extraction to determine the optimal sand extraction side. Sand will only be extracted from sites approved by the TCAP PMU under advice from TCAP experts. • Temporary breaks in the vegetation line will only be permitted to access to storm stand deposits and must be restored immediately on completion of extraction works. • Construction materials will not be stockpiled within 50m of the coastal marine environment. • Machinery on the beach will work in clearly defined and minimal areas • Refueling will occur in designated bunded areas away from the coastal marine environment. • Ensure that beach is rehabilitated as to not leave an unsafe condition for the public while the beach is naturally recovering • Access road will be immediately rehabilitated on completion of extraction which will include scoring compacted surfaces, replacing the previous excavated topsoil and replanting with species already present on the island. • Any spills of hazardous substances onto the beach will immediately be cleaned as per the Contractors Spill Response Plan.	Included in Contract Costs	Contractor	Prior to start of work	Completion of Extraction Works
Stockpile area	• Implement EDSCP • Bund the dredge spoil stockpile area to reduce sediment movement away from site. • Stripped topsoil will be kept in separate stockpiles. • Ensure that any erosion and sediment control devices are installed, inspected, and maintained as required. • No sediment disposal site to be closer than 50m from any Pulaka pits. • Maintain vegetated buffer strips during construction to reduce water velocity and retain low levels of uncontaminated sediment. • Longer term stockpiles of construction materials will not be within 50m of the coastal marine environment. • MetOcean forecasts on each island will be used to plan works, construction footprints and will be used to determine the location and covering of stockpiles	Minor, part of standard practices	Contractor	Start Excavations	Completion of works
Construction of Coastal Protection BTB and Seabee Wall	• Works will be staged or scheduled to ensure that there is no transferral from project materials or equipment from Nanumea to Nanumaga. Transferral should only occur from Nanumaga to Nanumea to prevent the spread of the kau leafworm to Nanumaga. • Clear boundaries will be set during construction to protect the front of the berm and the vegetation line. Boundaries will be physically marked with temporary construction fencing. • Place BTB mega bags in such a way as to minimise disturbance to mature vegetation, particularly canopy trees. Small trees and shrubs shall be removed in preference to large trees.	Included in Contract Costs	Contractor	Start of construction	Completion of works

	• No machinery will be permitted on the beach on the northern tip of the Nanumea BTB • Schedule works in stages to ensure that exposed soils are revegetated and stabilized progressively. • Machinery on the beach will work in clearly defined and minimal areas • Disturbance of vegetation to be limited to that required and approved for construction works • Ensure that any erosion and sediment control devices are installed, inspected and maintained as required. • Schedule/stage works to ensure that major vegetation disturbance and earthworks are carried out during period of lower rainfall and windspeeds. • Strip and stockpile topsoil for use during revegetation. • Design stormwater management measures to reduce flow velocities and avoid concentrating runoff. • No trees in the vegetation line outside the direct BTB corridor will be removed or damaged during construction works • Rehabilitation of construction areas will include scoring compacted surfaces, replacing the previous excavated topsoil and replanting with species already present on the island. • BTB will be covered with stockpiled topsoil and planted with coastal species suited to the environment and already present on the island				
Solid Waste Management	• Daily waste practices shall be carried out. • Separate waste streams shall be maintained at all times i.e. general domestic waste, construction waste and contaminated waste. Specific areas on site shall be designated for the temporary management of the various waste streams. Adequate signage and colour coded bins will be used for each waste streams. • Recyclable waste shall be collected separately and disposed of correctly. • Excavated waste along the BTB footprint will be disposed as per the protocols of each island. • Food wastes will be separated and stored securely to avoid YCA and other wildlife. • Disposal of waste shall be carried out in accordance with the Government of Tuvalu requirements. For waste which cannot be disposed of in Tuvalu, recycled, reused or composted will be exported and disposed of offshore in a licensed facility. • Concrete slurry will be allowed to harden and disposed of as clean fill. • Disposal of trees shall me undertaken in the accordance with one or more of the following methods: (i) left in place at the request of the owner; (ii) chipped and mulched; or provided to the community for reuse. • Hydrocarbon wastes shall be stored in colour coded and labelled drums placed in secure, covered and bunded locations until their disposal.	Minor, part of standard practices	Contractor	Prior to commencement of works	Demobilisation

	• Any waste oils and lubricants are to be collected and transported to recyclers or designated disposal entities as soon as possible. • Any dangerous goods stored on site shall be stored un accordance with Tuvalu regulations and international best practice • All construction workers will be trained on the correct and expected management measures for solid waste as part of the induction process. • Remove all inorganic, non-reusable and solid waste from the island generated as a result of the project. • Implement waste management in order to avoid, reduce, reuse, recycle. • No solid waste to be dumped in sea or lagoon waters. • Burning of solid waste is not permitted. • Compost all green and organic waste to assist soil improvement for the production of communal food crops or use as pig food. • Export of all hazardous waste will be subject to the measures in this ESIA and in coordination with the Waste Management Department.				
Hazardous Substance Management	• Store and handle all chemicals, fuels, oils and potentially hazardous materials as specific in relevant standards and guidelines. All hazardous materials to be approved for use onsite. All hazardous materials and construction fuel will be stored in appropriate storage facilities (e.g. fuel and chemical will be stored in a bunded area). • Hydrocarbon wastes shall be stored in colour coded and labelled drums placed in secure storage areas on site. • Where possible, fuel and chemical storage and handling shall be undertaken at designated petrol stations on the island, or at the project site on impermeable bunded surfaces (preferable over drip trays). Ensure onsite refueling activities occur in designated areas of the site where appropriate temporary protection measures have been designed/located and are no less than 20 meters from surface waters and drainage lines. • Onsite storage of fuel and chemicals shall be kept to a minimum. • Emergency clean up kits for oil and chemical spills will be available onsite and in all large vehicles.	Minor, part of standard practices	Contractor	Prior to commencement of works	Demobilisation
UXO	• In the event of a UXO discovery, the Contractor must immediately stop work and clear the work site of all personnel. The discovery must immediately be reported to the Supervision Engineer, Kaupule and TCAP National Project Manager. The TCAP National Manager will inform the TPS and it is the responsibility of the police force to report and coordinate the removal of the UXO. No works shall recommence on site until instruction has been received from the TPS and the TCAP NPM. • The Contractor's C-ESMP will detail how they will identify previous ordinance removal areas on Nanumaga, search the project footprint and handle any UXO.	Unknown	Government of Tuvalu	Ongoing	Ongoing

Spill Management and Response	• Spill Response Plan to be included in the C-ESMP and implemented during construction. • Comprehensive site induction prepared by the Contractor, with input from the Kaupule, will be required for all personnel involved with the project, with specific attention made to the particular environmental sensitive receptors of the project islands. • All personnel involved in the handling of dangerous goods should be trained and inducted in the handling, emergency procedures and storage requirements for different types of substances. • Vehicles and machinery will be refueled by authorized and trained personnel only in designated areas to reduce the likelihood of spillage in a sensitive environment. • Drip trays will be used during refuelling or servicing to prevent spillages onto the ground. • No refuelling of machines or vehicles will be permitted in the marine environment. • Development of procedures for cleaning up and reporting of accidental spills as part of the Spill Response Plan.	Minor, part of standard practices	Contractor	Prior to commencement of works	Demobilisation
Influx of labour	• All workers to have undertaken approved HIV/AIDS and GBV prevention training on Tuvalu and to have signed code of conducts as included in the contract. • All foreign workers must have valid visas. • Workers to respect village and landowner boundaries, observe codes of conduct and avoid damage to properties and resources. • Ensure enough food and water is delivered to the island for the duration or works. Schedule supplementary deliveries well in advance as needed. • No alcohol will be consumed by the workers nor provided by the employer.	Included in Contract Costs	Contractor	Prior to arrival of workers	Demobilisation
Air Quality	• Implement effective dust management measures in all areas during design, construction and operation. • Manage dust/particulate matter generating activities to ensure that emissions do not cause an environmental nuisance at any sensitive areas. • Implement scheduling/staging of proposed works to ensure major vegetation disturbance and earthworks are minimised. • Locate material stockpile sites as far as practicable from sensitive receptors. • Revegetate excavated areas and the BTB as soon as is practicably possible. • Waste storage areas and receptable should be covered and located as far as possible from sensitive locations. • Restrict speed limits of all vehicles on unsealed roads. • Cover loads of haul and equipment and plant when not in use and in transit. • Ensure all equipment and machinery is in good working order and regularly maintained.	Minor, part of standard practices	Contractor	Start of construction works	End of construction works

	• Turn off or shut down all machinery or vehicles when not in immediate use. No idling of unattended vehicles is permitted.				
Noise and Vibration Disturbance	• Minimise nuisance from noise, especially closer to residential areas and sensitive receptors, through establishment and communication to affected parties of working hours, including night works and avoid increase of noise and number of work equipment at outside of advertised hours. Advertise working hours at the site entrance. • Workers in the vicinity of sources of high noise shall wear necessary protection gear rated for the situation they are being used. • Provide temporary construction noise barriers in the form of solid hoardings where there may be an impact on specific residents. • Signage to outline complaints procedure and contact details of recipient of complaints. • Contractor will develop a work schedule or operations with Kaupule to identify hours and days of no work due to religious and cultural activities. • Mostly limit construction activities to daytime hour. If construction is proposed at night, contractor will develop a work schedule of operations with Kaupule. • The Contractor should conduct employee and operator training to improve awareness of the need to minimise excessive noise in work practices through implementation measures. • Identify properties and structures what will be sensitive to vibration impacts resulting from construction.	Minor, part of standard practices	Contractor	Start of construction works	End of construction works
Laydown sites	• Implement the EDSCP • Bunded and covered areas will be installed for the storage and handling of hazardous materials and/or substances, the wash down of machinery, the preparation of concrete and the prefabrication of solar arrays. • Run off from these bunded areas will be collected, treated and tested before being either reused for construction purposes or allowed to discharge into the ground, away from the marine environment. Discharge will be at a rate to allow absorption without causing surface flooding • Segregated storage for solid waste will be provided. This area will be clearly marked and designed to ensure that as waste is secure. • Worker inductions will include a tour of the laydown area and required practices from workers. • Spill response kits will be available, and workers trained in their use.	Included in Contract Costs	Contractor	Prior to commencement of works	Demobilisation
Concrete Production	• Concrete production will be located away from any body of water and foreshore vegetation. • Concrete will be prepared on bunded and covered hard stand surface of laydown areas.	Included in Contract Costs	Contractor	Start of construction works	End of construction works

	• All wastewater from concrete production will be collected and treated to lower the pH and allow particulates to settle out before being recycled for construction purposes. • Treated and tested wastewater may be discharged for absorption into the ground. Discharge will be at a rate to allow absorption without causing surface flooding. • Slurry from concrete production will be collected and treated. Treatment can vary depending on viscosity of slurry but can include the same measures described for treating concrete waste water or can be by facilitating the solidification of the slurry to form a gel which can be stored and disposed of according to the Solid Waste Management Plan. • Solid and cured concrete waste is considered safe to be reused by the community or the community for infrastructure maintenance. • The Contractor's will have a spill response plan in place to manage accidental spills or leakages of concrete wastewater or slurry.				
Demobilisation	• All residual material to be removed from the island unless specifically requested by the Kaupule. • Site rehabilitation works of laydown site, stockpile site and laydown area to include scarifying soil and spreading vegetative material to assist with natural regeneration processes unless the area is required for community use. • Replant coconut and other site-specific trees.	Minor, part of standard practices	Contractor	End of construction works	Demobilisation
Health and Safety	• Provide fully stocked first aid stations at each construction site with workers trained in emergency First Aid. • Provide appropriate Personal Protection Equipment (PPE) for all construction workers and ensure they are used • Maintain daily contractor's diary and record any OHS accidents or incidents. • Include any OHS accidents or incidents in monthly report. • Report any serious accident or incident to Supervision Engineer. • Prohibit usage of drugs and alcohol on construction sites and undertake regular alcohol testing.	Minor, part of standard practices	Contractor	Prior to commencement of works	Demobilisation
Employment	• A number of income generating activities will stem from the construction works. These range from direct employment of local labour, through to provision of cooking and housekeeping services provided at the workers accommodation. The five clans on Nanumaga have a cultural arrangement whereby any employment generated from projects such as this is shared fairly throughout the community on a rotational basis. It is a requirement for all projects to adhere to this cultural practice. To facilitate this effectively, the Contractor will be required to undertake training for all nominated workers at the start of works to avoid delays linked to the need for additional training as the workers rotate.	Included in Contract Costs	Contractor	Start of construction works	Demobilisation

	• The Nanumaga communities in coordination with the Nanumaga Kaupule will provide the contractor with a list of skilled and unskilled laborers. The Kaupule will also coordinate with the villages of Tonga and Tokelau to ensure that job opportunities are fairly disseminated. Women are encouraged to participate in the workforce and job opportunities. Persons with disabilities are also encouraged to participate in the workforce and with jobs that are appropriate and significant. • The women of the island will have the opportunity to provide food, beverage and housekeeping services for incoming workers to Nanumaga for 3-4 months. Food services may include lunch and dinner, providing fresh water or coconuts, selling of food items such as local fruits, root crops, vegetables, etc., selling of handicrafts, and laundry services are examples of income generating activities. • Additionally, there may be other opportunities such as scooter rental, boat rental for excursions, sales of luxury items imported from Funafuti, etc. • The Contractor will provide the islands workers with training to ensure that they are able to, among other things, satisfy the necessary requirements for OHS, environmental compliance and understand correct construction techniques. The long-term impact of this is an upskilled workforce on the island who will be able to bring these training and experience benefits to other construction work on the island.				
Community Health and Safety	• General public is not permitted in high risk areas and where heavy machinery is in operation. • Ensure reversing signals are installed on construction vehicles or provide flagmen as required to ensure safe operations. • Mark dangerous areas with reflective tape or other hazardous areas during the hours of darkness. • Provide safe access around work sites to keep public away from harm. Use safety barriers and fences as required.	Included in Contract Costs	Contractor	Start of construction works	Demobilisation
Community grievances	• Implement Stakeholder Engagement and Consultation Plan. • Maintain a grievance register. • Ensure that public consultation and disclosure communication is completed at regular intervals to ensure that the public are fully aware of the TCAP program of activities and the complaints process. • Signage should be used in public areas around the TCAP project sites advising the complaints procedure and contact details of key project individuals responsible for responding to issues raised.	Included in Contract Costs	Contractor and NPM	Prior to commencement of works	Demobilisation

APPENDIX C: MONITORING TABLE

TCAP NANUMAGA AND NANUMEA PRE-CONSTRUCTION PHASE MONITORING CHECKLIST

Pre-Construction Checklist		
Impact Area:	**Management Measures:**	**Frequency / Responsibility**
Environmental and Social Impacts	• Development consents and environmental permits are in place • C-ESMP has been developed and approved. • C-ESMP includes all required subplans • Approvals are in place for land use and sand extraction • Project workers have been trained on the requirements of the ESIA and have undergone cultural familiarisation	Once / PMU and Supervision Engineer
Solid and hazardous waste	• Waste collection at workers camp and laydown area is established and well signed • Waste collection storage arrangements in place and compliant with approved C-ESMP	Once / Supervision Engineer
Sand Extraction	• Extraction sites and working areas on beach selected and clearly mapped and marked. • Stockpile site is securely bunded against sedimentation. • Exact volumes to be extracted are recorded. • Access track to extraction sites is marked and minimised in length and width. • Documentation presented to verify transparent consultation and approval processes with Kaupule and Falekaupule	Once / Supervision Engineer and TCAP NPM
Employment	• Contractor is maximising use of the islands workforces in cooperation with PWD and the Kaupule	Once / Supervision Engineer
Community health and safety	• HIV/GBV/Code of Conduct training and acknowledgements have been completed • Medical clearance certificates provided for all foreign workers • Complaints process available for public inspection.	Once / Supervision Engineer
Protection of flora and fauna	• Clear demarcation of machine operating zone on reef flat, beach access and buildings.	Once / Supervision Engineer
Soil and water pollution	• Appropriate spill response plan in place	Once / Supervision Engineer
Materials Supply	• All imported materials with appropriate biosecurity clearances	Once / Supervision Engineer
Laydown and Stockpile Area	• Laydown areas established on pre-approved sites as per C-ESMP • Hazardous storage area set up and compliant • Water run off management systems in place to approved standard	Once / Supervision Engineer
Berm Top Barrier	• Inventory of food producing trees to be cleared for BTB has been completed and compensation process initiated • Design path avoids impacting on water collection and storage	Once/TCAP NPM

NANUMAGA AND NANUMEA CONSTRUCTION PHASE MONITORING CHECKLIST

Impact Area:	Management Measures:	Frequency / Responsibility
Nanumaga Harbour: Construction Phase Monitoring Plan		
Solid and hazardous waste	• Waste measures being effectively implementing as per approved C-ESMP • Waste collection at laydown area is secure, well signed and clean • Hazardous waste is stored according to C-ESMP • Good housekeeping around project sites and workers accommodation • All waste is disposed of offshore • Contaminants of Concern (COC) documentation in place and reviewed	Weekly / Supervision Engineer
Community infrastructure, health, and safety	• Traffic management measures are under effective implementation • Public signage of complaints procedure • Signs and fences restrict or direct pedestrians and public where appropriate. • No damage to public or community infrastructure • Dust suppression is effective • Noise is within permitted limits • Required signage is in place	Weekly / Supervision Engineer
Protection of Vegetation Line	• No unauthorised removal of trees in vegetation line • No damage to vegetation line • Construction machinery barriers are in place • No evidence of construction machinery working outside marked areas	Weekly / Supervision Engineer
Protection of coastal environment	• Construction machinery barriers are in place • No evidence of construction machinery working outside marked area • Signs of erosion along vegetation line • No stockpiles or solid waste on the foreshore.	Weekly / Supervision Engineer
Soil and water pollution	• Appropriate spill response plan/kit in place for waste area • No visible spills on soil or uncovered ground • Drainage, water treatment and soakage systems clear and fit for purpose • Division bunding around large areas of vegetation clearance	Weekly / Supervision Engineer
Hazardous substances storage	• Substances stored within bund on impermeable surface • Spill kit complete and accessible • Spill training completed • No evidence of spills on the ground • MSDS available at storage locations	Weekly / Supervision Engineer

Impact Area:	Management Measures:	Frequency / Responsibility
Laydown and Stockpiles Site	• Laydown areas established as per C-ESMP • Laydown areas dust levels managed efficiently • Traffic measures correctly implemented at laydown site • Water run off management systems operating correctly • Dust management effectively implemented • PPE present and correctly used • Refueling occurring over drip trays in dedicated areas • No stockpiling within 50m of Pulaka pit or water ways • Bunding is functional at stockpile site • No complaints received regarding noise disturbance or air quality • Concrete production management measures being implemented properly	Weekly / Supervision Engineer
Construction works	• BTB corridor is being revegetated as works progress • Mega Bags are being placed to minimise need to remove mature vegetation and to protect existing houses • Erosion and sediment control devices are in place, are maintained and working effectively • Water run off management systems operating correctly • Complaints register being updated and complaints reported and responded to in a timely manner. • Majority of workforce are from the islands and the island community are satisfied with the processes.	

APPENDIX D: CURRENT GOVERNMENT TREE COMPENSATION APPROVAL RATES

All prices are in Australian Dollars

Tuvalu Government
Ministry of Natural Resources and Lands
Lands and Survey Department

Government Tree Compensation Approved Rates

No	Tree / Crop	Approved Rates
1	Cocnut trees	
	(well spaced and managed)	
	~ Bearing trees	$50.00
	~ Non-Bearing trees with trunk	$20.00
	~ Seedling without trunk	$10.00
	Cocnut Trees	
	~ Bearing trees	$40.00
	~ Non-Bearing trees	$10.00
	~ Seedling without trunk (new)	$1.00
2	Bananas	
	~ Maximum of 5 shoot per mat	$20.00
	~ Per stem	$12.00
	~ Per shoot	$5.00
3	Breadfruit	
	~ Per bearing tree	$40.00
	~ Non-bearing tree & over 3m height	$20.00
	~ Seedling < 3m height	$5.00
4	Pandanus	
	~ Useful for timber and fruits	$40.00
	~ Useful for leaves, fruits & not big enough to provide valuable pole	$20.00
5	Puka, Kanava, Fetau	
	~ Per tree large enough for a canoe	$40.00
6	Puka, Kanava, Fetau, Fao, Pua, Milo, Gasu & Valovalo	
	~ Per tree with stem 15 cm or > in diameter at height of I meter but	
	not suitable for a canoe construction	$10.00
7	Tausunu	
	~ Above 3 feet	$5.00
	~ Between 1 and 3 feet	$1.00
8	Felo and Tal;e	
	~ Per fruit or flowering bearing tree	$10.00
	~Non-Bearing tree (new)	$3.00
9	Patete, Kumala, & Taamuu	
	~ Per p[lant or mount	$1.00

10	Pulaka		
	~ Per shoot over 4.3 feet	$16.00	
	~ Per shoot up to 3 feet	$8.00	
11	Dalo / Taro	$8.00	
12	Pawpaw		
	~ Bearing tree	$5.00	
	~ Non-bearing tree	$2.00	
13	Laukatafa		
	~ Per plant over 3 feet high	$2.00	
	~ Between 1 and 3 feet	$1.00	
14	Gie		
	~ Per plant > 3 m height	$2.00	
	~ Between 1 foot and 3 feet (new)	$1.00	
15	Pumpkin		
	~ Bearing plant	$2.00	
	~ Non-bearing plant	$1.00	
16	Nonu		
	~ Bearing tree	$2.00	
	~ Non-bearing tree	$1.00	
17	Togo		
	~ Per tree	$3.00	

Appendix E: Department of Environment Scoping Forms

	DEPARTMENT OF ENVIRONMENT **Scoping Form** **EIA Amendment Regulations 2017**	**Office Use Only** DAA ___/__ Date Received __/__/__ Amount Paid $

Send or deliver applications to the Department of Environment, Ministry of Foreign Affairs, Trade, Tourism, Environment & Labor, Government of Tuvalu, Private Mail Bag, Funafuti, TUVALU. For enquiries phone: (688) 20179 or email: env@gov.tv or buchtersn@gmail.com

Notification and Application for Development Approval

Per Section 6C of the Environmental Protection (Environmental Impact Assessment) Amendment Regulations 2017, the Department must undertake a scoping exercise where the screening process assesses a development activity either as a category A or B.

The outcome of EIA scoping is a set of Terms of Reference (TOR) that outline the required content, and provide advice on the format, of an EIA report. The TOR help proponents and consultants to prepare a quality EIA report with sufficient and relevant information, so that a project's environmental consequences can be adequately analyzed and understood.

Important note: This Tuvalu Department of Environment TOR shall be read in conjunction with the TOR of funding agencies and other bodies involved in this project. It does not take precedence over any other TOR and other identified environmental factors to be considered.

- **Section 1 – Project details**
Project name: Tuvalu Coastal Adaptation Project (TCAP) **Nanumaga** Project proponent (developer): TCAP
- **Preliminary Assessment:**
This section applies if the development is deemed to require a Preliminary EIA Assessment under Section 5 of the EIA Screening Template. This list forms the Terms of Reference to guide the Preliminary EIA Assessment as requested by the Department.
TOR for Preliminary EIA
- Description of the development proposal
- Justification for the development proposal
- Location map, site plan, detailed drawing of proposed project
- Description of the area to be affected (including description of existing land use, vegetation types, species habitats, cultural areas, etc. Detailed mapping to be included as appropriate)
- Summary of consultation undertaken (see DOE consultation checklist)

- Assessment of foreseeable environmental impacts, with particular focus on the following:
  - Coastal/Beach Environment:
  • BTB Placement
  • Strom deposit extraction
  • Sedimentation

- Local Managed Marine Area - Vegetation Communities - Endangered and Threatened Species *Note: As discussed above, this list includes the environmental factors deemed important by the Tuvalu Dept of Environment. It is not an exclusive list and shall be read in conjunction with the TOR of funding agencies and other bodies involved in this project.* - Describe alternatives considered and measures proposed to mitigate or avoid identified adverse impacts
- Assessment of foreseeable social impacts, including: employment opportunities; housing; utilities, public health and safety; cultural heritage and resources of cultural, archaeological or historical value; and gender inequalities including women employment. - Describe alternatives considered and measures proposed to mitigate or avoid identified adverse impacts.
- Environmental Management Plan Table showing potential environmental impacts and what mitigation measures proposed to be employed to minimize environmental effects

	DEPARTMENT OF ENVIRONMENT **Scoping Form** **EIA Amendment Regulations 2017**	**Office Use Only** DAA ___/__ Date Received __/__/__ Amount Paid $

Send or deliver applications to the Department of Environment, Ministry of Foreign Affairs, Trade, Tourism, Environment & Labor, Government of Tuvalu, Private Mail Bag, Funafuti, TUVALU. For enquiries phone: (688) 20179 or email: env@gov.tv or buchtersn@gmail.com

Notification and Application for Development Approval

Per Section 6C of the Environmental Protection (Environmental Impact Assessment) Amendment Regulations 2017, the Department must undertake a scoping exercise where the screening process assesses a development activity either as a category A or B.

The outcome of EIA scoping is a set of Terms of Reference (TOR) that outline the required content, and provide advice on the format, of an EIA report. The TOR help proponents and consultants to prepare a quality EIA report with sufficient and relevant information, so that a project's environmental consequences can be adequately analyzed and understood.

Important note: This Tuvalu Department of Environment TOR shall be read in conjunction with the TOR of funding agencies and other bodies involved in this project. It does not take precedence over any other TOR and other identified environmental factors to be considered.

- **Section 1 – Project details**
Project name: Tuvalu Coastal Adaptation Project (TCAP) **Nanumea Island** Project proponent (developer): TCAP
- **Preliminary Assessment:**
This section applies if the development is deemed to require a Preliminary EIA Assessment under Section 5 of the EIA Screening Template. This list forms the Terms of Reference to guide the Preliminary EIA Assessment as requested by the Department.
TOR for Preliminary EIA
- Description of the development proposal
- Justification for the development proposal
- Location map, site plan, detailed drawing of proposed project
- Description of the area to be affected (including description of existing land use, vegetation types, species habitats, cultural areas, etc. Detailed mapping to be included as appropriate)
- Summary of consultation undertaken (see DOE consultation checklist)

- Assessment of foreseeable environmental impacts, with particular focus on the following:
  - Coastal/Beach Environment:
  • BTB Placement
  • Storm deposit extraction
  • Sedimentation of lagoon
  - Vegetation communities
  - Endangered and threatened Species
  - Invasive Species (Koe Leafworm)
  - UXO Identification on Project Footprint
 	
Note: As discussed above, this list includes the environmental factors deemed important by the Tuvalu Dept of Environment. It is not an exclusive list and shall be read in conjunction with the TOR of funding agencies and other bodies involved in this project.
 	
- Describe alternatives considered and measures proposed to mitigate or avoid identified adverse impacts

- Assessment of foreseeable social impacts, including: Employment opportunities; housing; utilities, public health and safety; cultural heritage and resources of cultural, archaeological or historical value; and gender inequalities including women employment. - Describe alternatives considered and measures proposed to mitigate or avoid identified adverse impacts.
- Environmental Management Plan Table showing potential environmental impacts and what mitigation measures proposed to be employed to minimize environmental effects


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TUVALU COASTAL ADAPTATION PROJECT
TCAP


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