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Nanumaga Detailed Design Report

Tuvalu Coastal Adaptation Project

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1. INTRODUCTION

1.1 General

Consisting of nine islands and atolls spread over 750,000km^2, Tuvalu is the fourth smallest nation in the world in land area with a population of just over 10,000. It is one of the most vulnerable countries in the world to the impacts of climate change and particularly sea-level rise and the possibility of intensifying storm events. Recent cyclones have caused population displacement, significant loss and damage of infrastructure as well as destruction of agricultural resources, contamination of ground water and changes in shoreline systems. Such impacts negatively affect the wellbeing of communities and long-term sustainable development aspirations. In response to this increasing challenge, the Government of Tuvalu (GoT) and the Green Climate Fund (GCF) have jointly committed US$38 million for the Tuvalu Coastal Adaptation Project (TCAP).

Three main islands have been selected for the proposed GCF project: Funafuti, Nanumea and Nanumaga. Nanumaga was selected due to the severity of the damage incurred following the passage of Tropical Cyclone (TC) Pam in 2015. The funding application proposed that TCAP resources finance locally appropriate coastal protection measures along the high value zone (450m) in Nanumaga. The lack of a landing facility suitable for a large dredge or working vessels limits the coastal protection infrastructure that may be constructed on Nanumaga. As such, soft measures including beach nourishment and dune restoration have been recommended. Subsequent feasibility studies including hydrodynamic and coastal processes, an ESIA, and geotechnical investigations led to the selection of Berm Top Barriers (BTB) built from large geotextile containers as the recommended coastal adaptation measure for Nanumaga.

1.2 Project and report objectives

TCAP will build coastal resilience which is an urgent national priority. The project will address the financial and capacity constraints at all levels – from technical to community awareness. TCAP was approved in June 2016 and the project implementation commenced in September 2017. The project will run until September 2023. TCAP has 3 main outputs:

Output 1: Strengthening of institutions, human resources, awareness and knowledge for resilient coastal management.

Output 2: Vulnerability of key coastal infrastructure is reduced against wave induced damages in Funafuti, Nanumea and Nanumaga.

Output 3: A sustainable financing mechanism established for long-term adaptation efforts.

The following body of work progresses Output 2, which has two main task areas or Activities:

- Activity 2.1: Coastal protection design. Site-specific assessments and ESIA undertaken in all islands in a participatory manner.
- Activity 2.2: Coastal protection measures implemented.

The objective of this report is to provide detailed design parameters and present the finalised coastal protection measures on Nanumaga ready for construction (implementation). This report is designed to be read in conjunction with the IFC drawings attached in Appendix A.

1.3 Report background

This report has brought together the findings of several investigations used to inform the design and implementation of the TCAP Nanumaga coastal protection design, these investigations include, but are not limited to:

- TCAP Concept Design Report (UNDP, 2020)
- Nanumaga Environmental and Social Impact Assessment (SPC, 2020a)
- Nanumaga Geotechnical Investigation (SPC, 2020b)
- Exploratory study for the development of ship landing facilities at Niutao and Nanumaga (Deltares, 2017)

These investigations accompany extensive stakeholder consultation, site investigations and interviews with contractors working in the region to inform the detailed design presented herein.

1.4 Report outline

The structure of this report can be summarised as follows:

- Section 2 presents the design life, a brief description of the site as well as the basis of design
- Section 3 presents a description of the Nanumaga coastal protection design and associated aspects including the boat harbour design.
- Section 4 presents an overview of the project's proposed implementation
- Section 5 provides a summary of the key findings of the Detailed Design and recommendations.

2. BASIS OF DESIGN

2.1 Design Life

The Australian Standard Guidelines for the design of maritime structures (AS 4997-2005) specifically excludes the design of "coastal engineering structures such as rock armoured walls, groynes, etc." The Berm Top Barrier design presented in the Concept Design Report adopts buried geosynthetic mega containers (GMC) for the core of the structure. Geotextile containers were originally expected to have a service life of at least 25 years in their earlier design iterations. Improvements in geosynthetics have been reported to have design lives exceeding 40 years (Bettington, 2018). This has been adopted as the design life of the BTB structure.

2.2 Design event

A 100-year Average Recurrence Interval (ARI) value has been adopted for the stability of any structures. The recurrence of the return event for overtopping design of the BTB is a one-year ARI based on safe average overtopping volumes for pedestrian access behind the structure crest after EurOtop (2018).

2.3 Site

Nanumaga is a table reef with a single reef island (Tanyama,1952). The island is oval shaped, replicating the shape of the reef platform. It is approximately 3.1km long in the north-south axis and 1.5km wide in east-West axis. Nanumaga island evolved in the same way as Funafuti atoll, with Nanumaga's much smaller lagoon infilling to reach a maximum state, with only a remnant low-lying area in its centre (**Figure 1**).

Nanumaga is located approximately 400km to the North West of Funafuti. The island has a an unprotected, 100m long, 10m wide boat channel cut into the reeftop midway along the western coast of the island which extends to the sandy shoreline. The boat channel is the only port of any kind in the island.

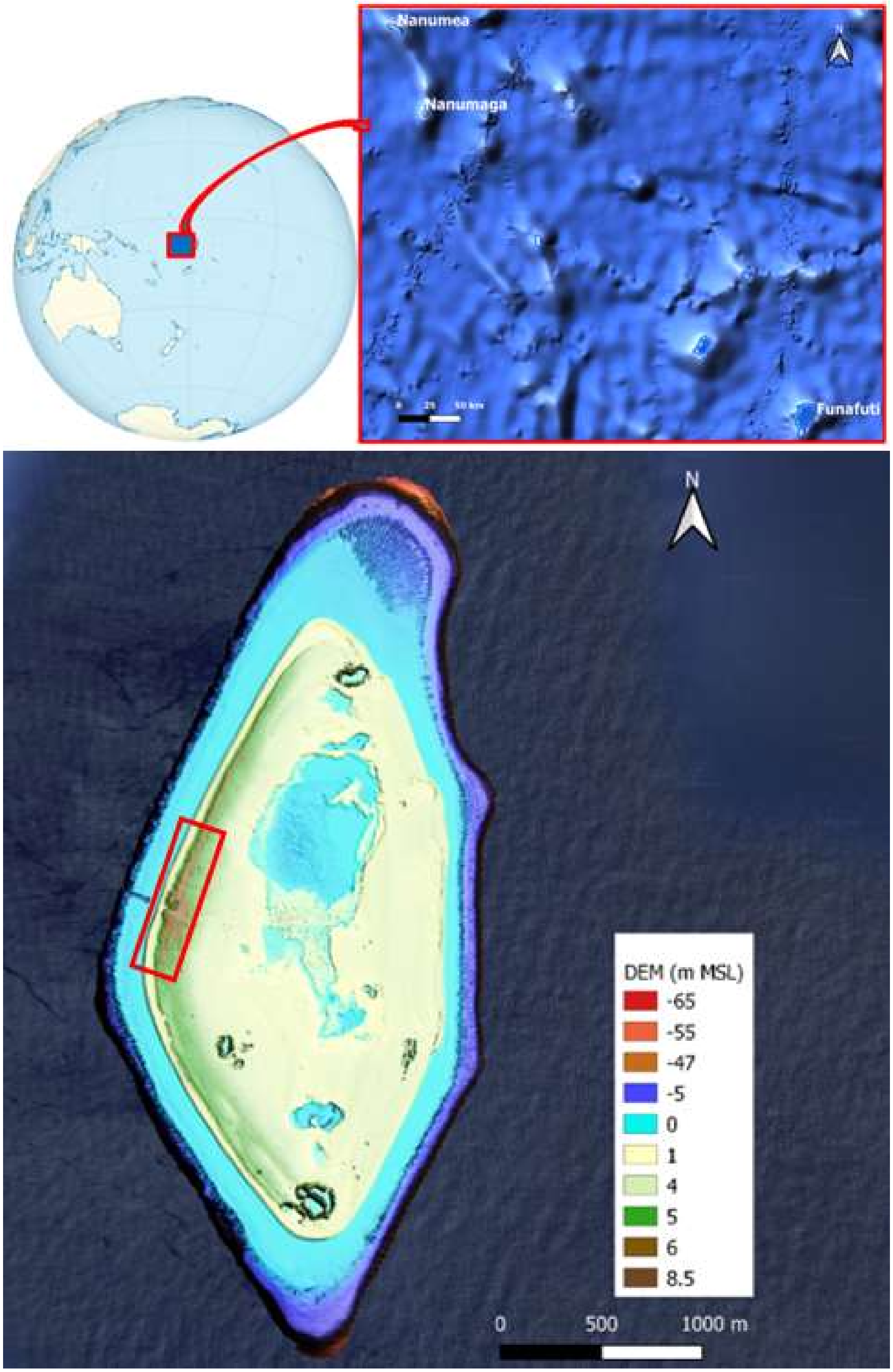


Figure 1: Tuvalu setting (top) and Nanumaga digital elevation model (bottom) with TCAP site marked by red polygon. Please note heights have been approximated with respect to Mean Sea Level (MSL). (source: Fugro, 2019).

2.3.1 Bathymetry and topography

A marine Light Detection and Ranging (LiDAR) survey was undertaken of all Tuvalu's nine islands was commissioned by TCAP in August 2019. The resultant dataset provided a high resolution topographic and bathymetric digital earth model (DEM) to a depth of approximately 40m, the bathymetry and topography at the project site on Nanumaga's western coast is provided in Figure 2.

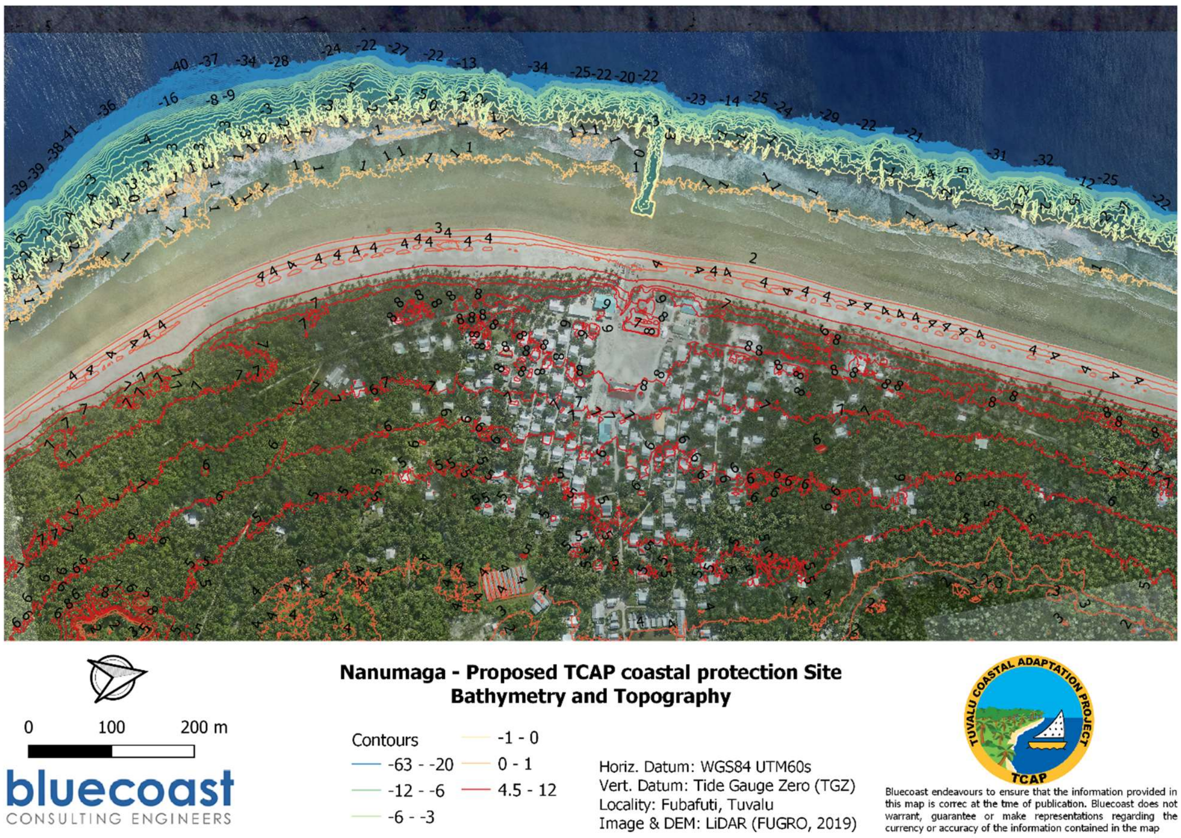
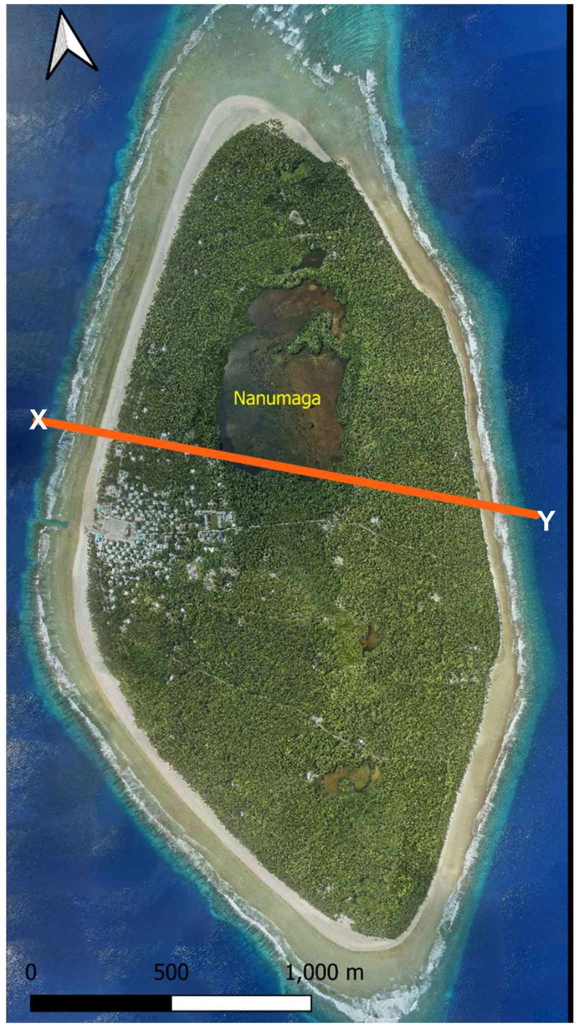


Figure 2: Topographic and bathymetric contour map of proposed TCAP coastal protection site on Nanumaga's western coast taken from FUGRO Marine LiDAR survey, August 2019.

2.3.2 Geomorphology

Geotechnical surveys have shown the island is composed of loose foraminifera rich sands with occasional loose coral gravel layers. Excavations of a large pit near the eastern shoreline found that loose foraminifera-rich sand continued to a depth below the level of the present-day fringing reef, suggesting the reef island was formed by calcareous sediment infilling a pre-existing lagoon of the small atoll.

A 6-8m (above TGZ) storm berm is the major geomorphological feature along the western shore of the island and is the highest natural feature, Figure 3. Boreholes taken from the storm berm were seen to contain light sandy soils, with unaltered sand on the active beach. The light sandy soils are described as foraminifera-rich sand with occasional coral gravel fragments. The light sandy soils are distinguished from the unaltered sands due to the presence of organic content (roots, leaves and branches) in various stages of decomposition, which have stained the calcareous sand to a variety of different shades of grey depending on the organic content.



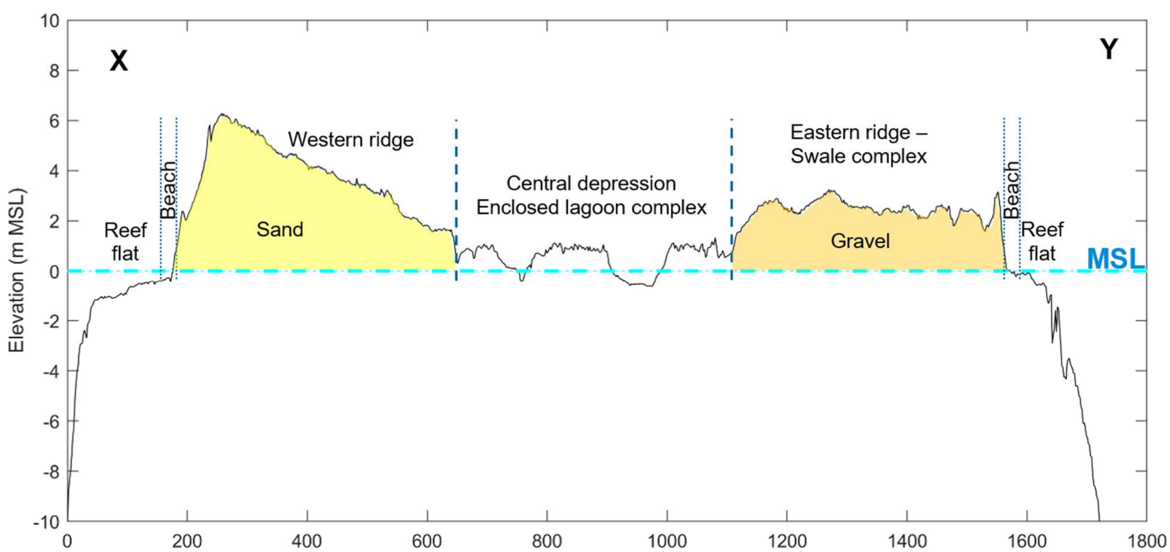


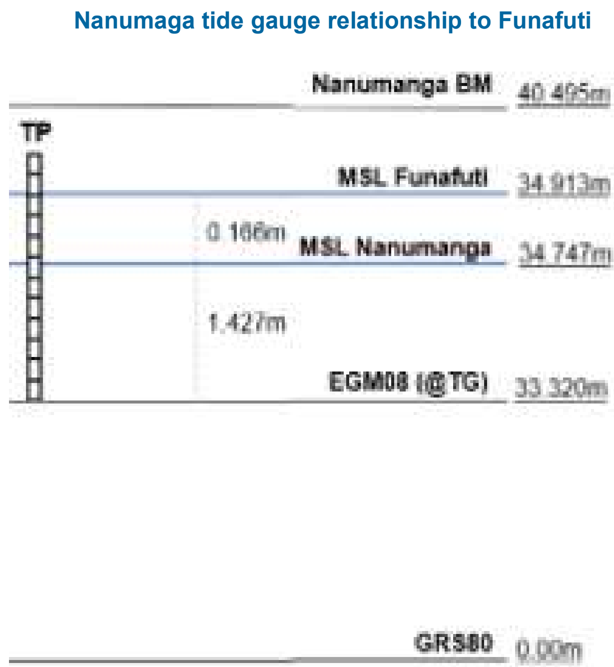
Figure 3: Map of Nanumaga landform units after SPC, 2020a (Source: McLean et al,1991).

2.4 Design inputs

2.4.1 Water levels

No long-term water level measurements have been undertaken at Nanumaga Island at the time of this report. Tidal planes for Nanumaga are presented in Figure 4 from tide tables produced by the Climate and Oceans Support Program in the Pacific (CoSPac, 2020) with levels reduced to Tide Gauge Zero (TGZ) at Funafuti following the levelling program undertaken by FUGRO for TCAP in 2019.

Figure 4: Tidal plane at Nanumaga with respect to Tide Gauge Zero (TGZ) at Funafuti Port. (source: CoSPac, 2020)



Tidal Plane	Recorded Height (m TGZ)
Highest Astronomical Tide (HAT)	3.22
Mean High Water Springs (MHWS)	2.73
Mean High Water Neap (MHWN)	2.21
Mean Sea Level (MSL)	1.88
Mean Low Water Neap (MLWN)	1.57
Mean Low Water Neap (MLWS)	1.047
Lowest Astronomical Tide (LAT)	0.687
Tide Gauge Zero (TGZ)	**0.00**

Table 1: Calculated design water levels for Nanumaga coast al protection works

Design parameter	Water level
2100 Sea Level Rise[1]	0.75m
Wave setup[2]	0.95m
HAT Nanumea	3.22m TGZ
IBEmax[3]	0.28m
Design Water Level	**5.2m TGZ**

[1] IPCC 2019 upper limit of RCP8.5 range
[2] Calculated as 10% of depth-limited wave heigh at project site (Section 2.4.3)
[3] maximum recorded value of Inverse Barometric Effect (IBE)

2.4.2 Waves

There is no long-term recorded wave data for Nanumaga. Wave climate information for Nanumaga presented in Figure 5 and Table 2**Figure 6** has been determined based on a long-term regional model hindcast. The site is dominated by swell (wave period, Tp>8sec) with locally generated seas (Tp< 8 seconds) only occurring on average 2% of the time. Average Significant Wave Height (Hs) is 1.7m. The dry season (May-Oct) is dominated by waves from the eastern and southerly sectors (E to SW). The island's orientation will provide some protection to the project site from the dominant easterly waves and wind during this period.

The wet season (Nov-Apr) sees less frequent waves generated from the southerly sector, with a greater frequency in waves arriving from the north (NE to NW). The largest waves can be seen to occur from the west and the north west, these occur primarily in the wet season and are attributed to the passage of tropical cyclones in the vicinity of Nanumaga. It should be noted that cyclones passing as far away as 1100km from Nanumaga have the propensity to send waves of over 5m to Nanumaga's reef crest, further details of cyclonic effects on Nanumaga can be found the Concept Design Report (UNDP, 2020).

The 100year annual recurrence interval (ARI) significant wave height and peak wave period for the western coast of Nanumaga is presented in Table 3.

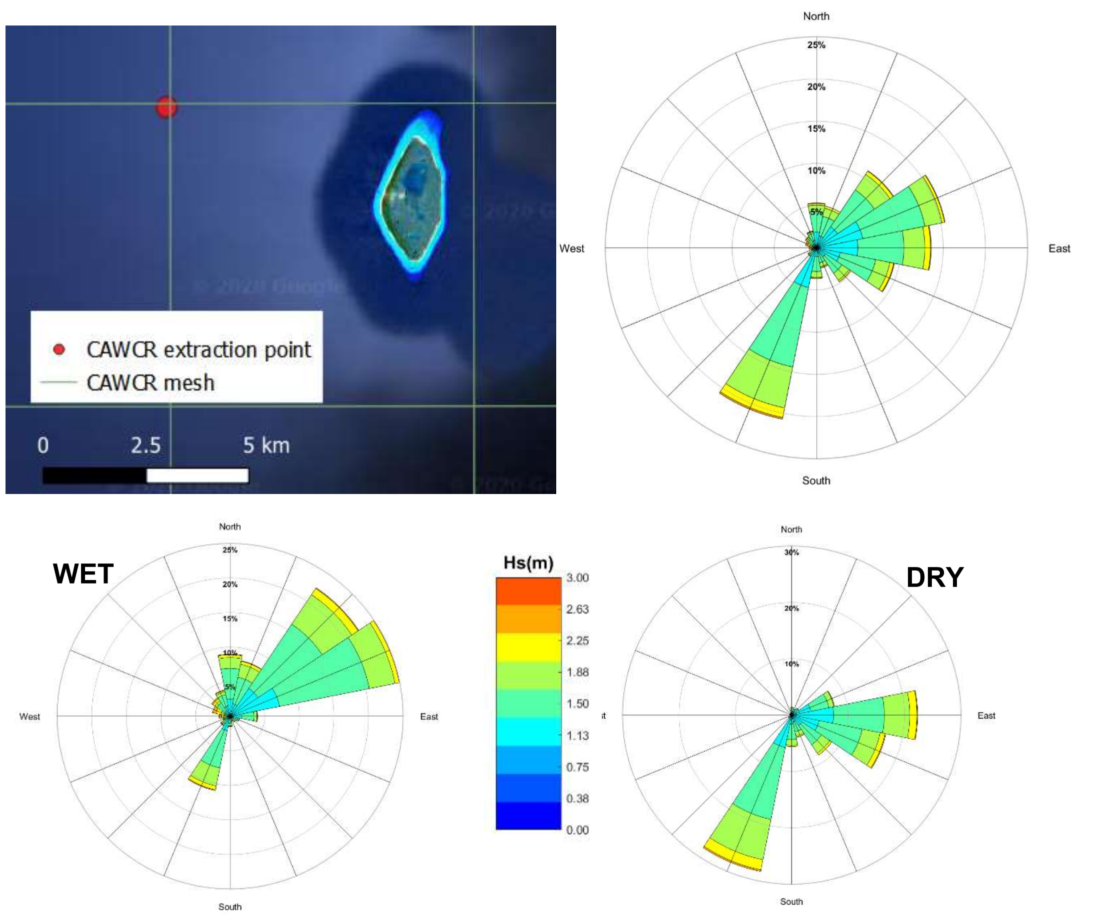


Figure 5: (clockwise from top left): CAWCR grid resolution around Nanumaga and model extraction point, long-term and seasonal wave roses for the deep water CAWCR model extraction point offshore for the wave hindcast information 1979-2019

Table 2: Long term and seasonal statistics calculated for the CAWCR model extraction points in deep water offshore of Nanumaga for the wave hindcast information 1979-2019

Parameter	Statistic	Long term average (40yrs)	Wet season (Nov- Apr)	Dry season (May – Oct)
Hs (m) Significant Wave Height	Average	1.7	1.7	1.7
	20%ile	1.4	1.4	1.4
	90%ile	2.1	2.2	2.1
	Max	6.7	6.7	3.5
Tp (s) Peak Wave Period	Average	11.4	11.5	11.3
	20%ile	9.1	9.5	8.8
	90%ile	15.6	14.9	15.9
	% of Time Sea (Tp<8s)	2%	2%	3%
	% of Time Swell (Tp>8s)	98%	98%	97%
Dp (°N) Peak Wave Direction	Weighted Average	129	13	155
	Standard Deviation	64	60	51

Table 3: Design (ARI 100 year) significant wave heights and peak wave periods offshore and on the shoreline of the western coast of Nanumaga

Location	ARI 100-year wave
Offshore Nanumaga (>50m depth)	Hs = 7m, Tp = 12sec
Nanumaga shoreline	Hs = 2.3m, Tp = 12sec

2.4.3 Currents

At the time of writing there has been no water current measurements in the vicinity of Nanumaga. Offshore (deep water) currents are expected to be minimal (<1m/s) and are mostly associated with oceanic circulation or with surface wind-driven currents.

Nearshore currents are driven by wave processes across the reef flats. When waves arrive perpendicular to the reef crest, wave breaking and wave setup over the reef drives currents towards the path of least resistance, small reef gunnels, around the island tips or towards the small boat channel. When waves arrive at an oblique angle to the reef crests and island shorelines, longshore currents are set up along the west coast of Nanumaga. During south to south-west swells, net northward longshore currents would be expected. This is expected to also drive a net northerly longshore transport of sand along the shoreline when wave heights are large enough. During the wet season when intermittent storms result in westerly or northerly wave events, these longshore processes are expected to reverse with currents and sediments flowing toward the islands southern tip at a reduced rate.

2.4.4 Wind regime

The wind climate at Nanumaga was assessed using data extracted from a regional hindcast model from the Centre for Australian Weather and Climate Research (CAWCR). The wind roses in Figure 6 and wind climate statistics in Table 4 show prevailing winds are dominated by easterly trades of moderate strength. The range of wind directions is relatively larger during the wet season, with stronger wind speeds originating from the north and west.

Table 4: Wind climate statistics for Nanumaga.

Parameter	Statistic	Long term averages (41-years) - CAWCR		
		All seasons	Wet (Nov-Apr)	Dry (May-Oct)
Wind speed [m/s]	Mean	5.1	5.0	5.2
	20%ile	3.3	3.1	3.6
	50%ile	5.0	4.8	5.3
	75%ile	6.4	6.3	6.6
	90%ile	7.8	7.9	7.8
	99%ile	10.9	12.1	9.7
	99.5%ile	12.1	13.3	10.1
	Max	26.2	26.2	13.0
Wind direction	Weighted mean [°N]	101	129	85
	Standard deviation [°]	51	59	33

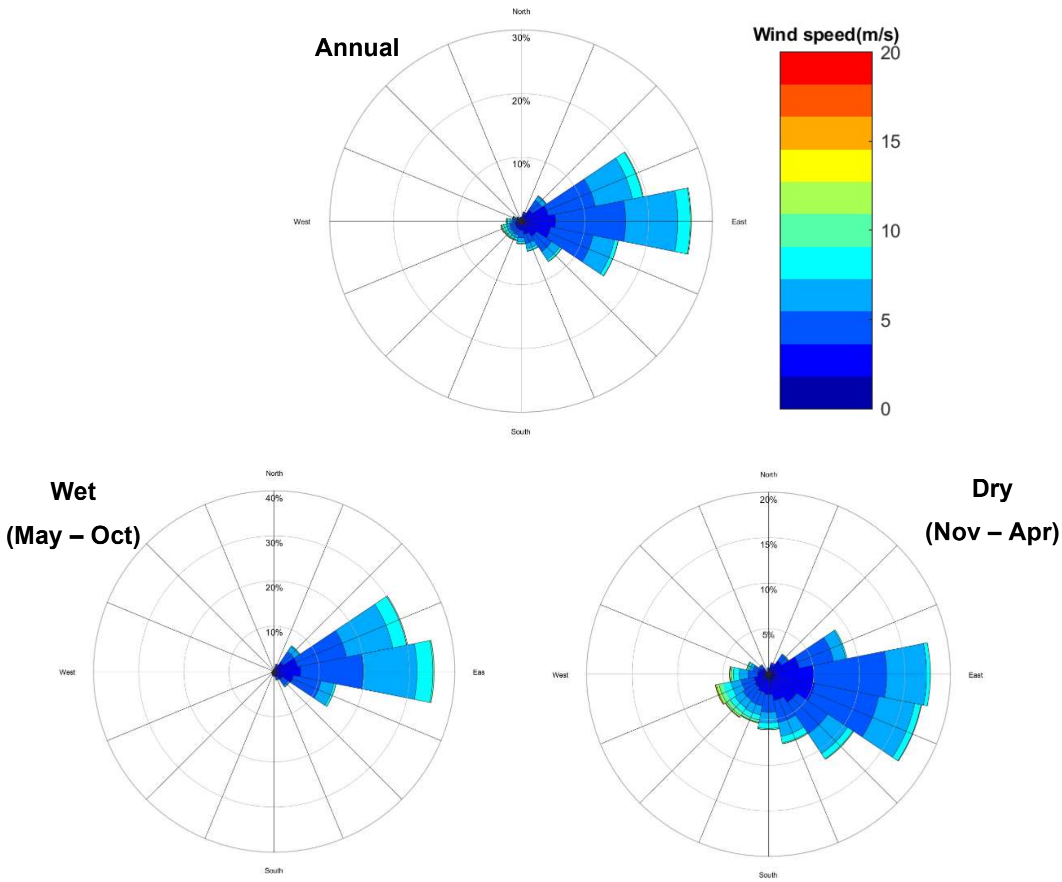


Figure 6: Annual, wet season and dry season wind roses for Nanumaga.

3. COASTAL PROTECTION DESIGN

3.1 Overview

Full details on the design process and iterations of the Nanumaga coastal protection can be found in the Concept Design Report (UNDP, 2021a) and is summarised in the following section. Appendix A: and **Error! Reference source not found.** provide the IFC detailed design drawings and bill of quantities. Table 5 provides an overview of the key parameters of the Nanumaga Coastal Protection design.

Table 5: Overview of TCAP design parameters for Nanumaga Coastal Protection works

Design parameter	Design value
Berm Top Barrier Length	665m
Berm Top Barrier Height	8.5-10m TGZ at crest of BTB
Berm Top Barrier volume	9,500m^3
Boat ramp design	Stacked 2.5m^3 geotextile synthetic containers topped by 75m^2 of cellular concrete blocks

Figure 7: Site plan of the TCAP Nanumaga coastal protection design

3.2 Structure details

Berm Top barriers (BTB) are to be constructed of buried Geotextile Mega Containers (GMC) laid end to end. The GMC are to be 'keyed in' to the surface of the storm berm on Nanumaga's west coast by excavating the topsoil layer by around 500mm. A layer of geotextile material is to be placed in the excavation footprint and pinned to the ground. The GMC is to be positioned and hydraulically filled from locally sourced (TYPE B) sediment. The whole structure is buried under replaced and locally sourced (TYPE A) sand at an angle of natural repose (30-35°) and revegetated with native vegetation and larger (palm or coconut) palms on the horizontal extremities of the works.

Atop the replaced fill of the BTBs, a 1m wide footpath will be constructed, consisting of geotextile and wooden planks filled with coral rubble or larger (Type A) fill. A typical section of the BTB is shown in Figure 8.

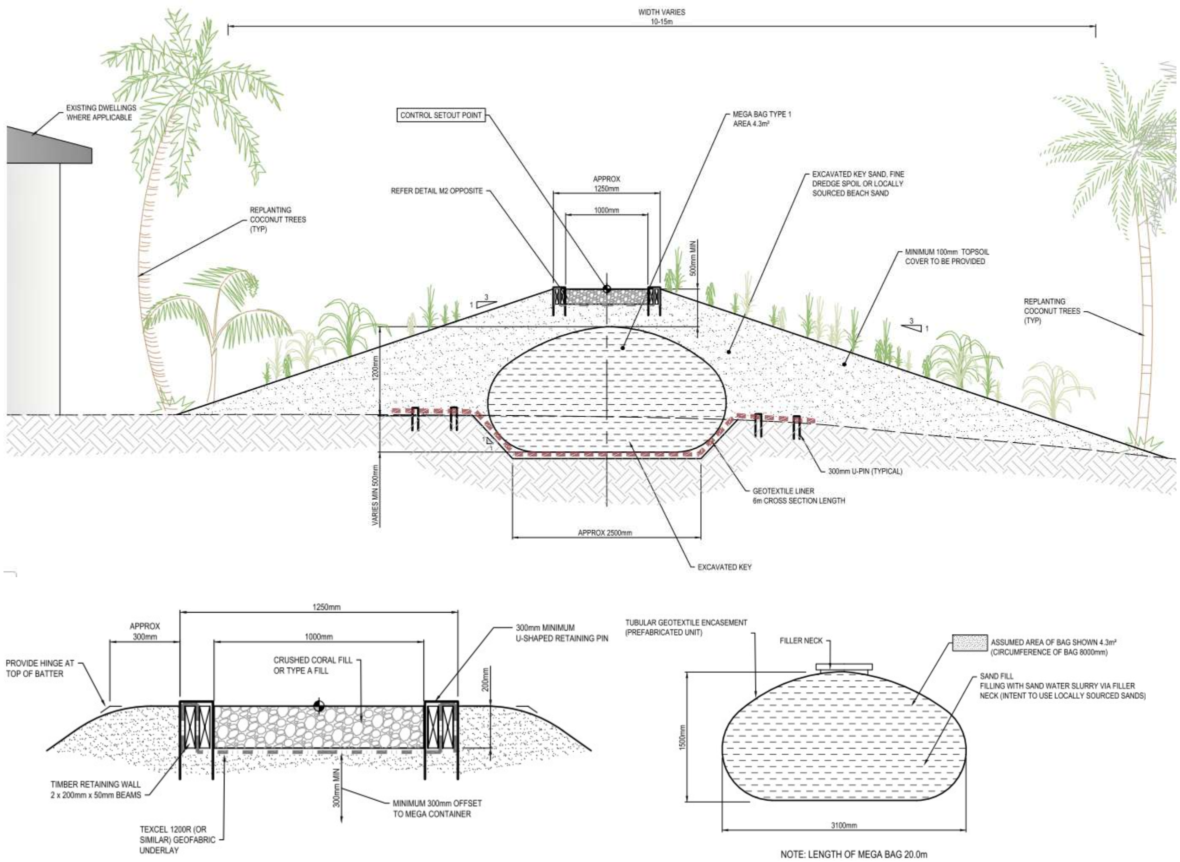


Figure 8: Typical section of Berm Top Barrier (top) and footpath and GMC detail (below)

Table 6: Geosynthetic container design sizes

Type	Height (mm)	Length (mm)	Width (mm)
GMC	1,500 – 2,100	20,000	1,500 – 4,800

3.2.1 Alignment and crest levels

Generally, the alignment of the BTB has been designed to follow the natural alignment of the storm berm on Nanumaga's west coast. The alignment can be seen to meander along its length (Figure 7), this is to provide sufficient barrier from private and public infrastructure and roadways. The final alignment is expected to change during construction due to new infrastructure having been built since original design, however the objective of the design is to increase the level of the highest landform of the island (storm berm) by an additional 1500mm. The height of the finished BTB will be between 8.5-10m TGZ.

The BTBs are to be located at the crest of the natural storm berm, not in the usual active shoreline zone. The geosynthetic bags are intended to remain buried and will be vegetated to become a reasonably seamless raised part of the natural berm system. This means that should wave attack wash away the vegetated outer layer the geosynthetic bag will remain as an immovable line of defence. Thus, the BTB will augment natural berm height and if subject to damaging wave conditions will persist. Even in the highly unlikely event that a BTB inner geosynthetic bag was punctured, it contains beach sand. This will simply become additional volume to the natural berm.

3.2.2 Durability and maintenance

There is potential that the BTB may be overtopped during extreme wave and water level events in excess of the design event. It is recommended that the BTB be inspected after any significant overtopping event or if the GMC units is exposed. In these instances, maintenance is to be undertaken to repair any tears or holes in the GMC unit and to fill any areas where erosion has occurred.

The geotextile used for the construction of the units will be designed to be vandal and UV-resistant, TEXCEL 1200R or similar. Full geotextile specifications are provided in the IFC drawings (Appendix A). Even though this design intendeds to bury the geotextile containers they are designed to withstand exposure to wave action, sunlight, high volumes of pedestrian traffic and recreational fishing, etc; however, there is potential for the bags to be damaged by impacts from large debris during very large events. Should units become exposed or damaged, the Government of Tuvalu Public Works department (PWD) will be trained in the repair of the units.

3.3 Drainage

The BTB has been designed to reduce inundation and overtopping events from the ocean. During rainfall events, drainage patters will be altered very little from their current arrangement, as the BTB will be placed atop the highest existing landform (storm berm). During construction, it is imperative that the excavation footprint is built such that water discharged through the hydraulic filling process of the GMC units runs to the ocean and not the village.

3.4 Borrow areas

The borrow area for the estimated 9,500m^3 of fill required for the Nanumaga Coastal Protection works was identified on the north eastern tip of Nanumaga by the TCAP team in 2017 with further investigation and geotechnical testing undertaken by SPC in 2020 (SPC, 2020b). The TC Pam deposit was conservatively estimated at approximately 120,000m^3 of sediment in November 2017 following the passage of TC Pam, Figure 9. It is recommended that a reassessment of the geomorphology of the deposit is undertaken prior to extraction taking place. When extraction takes place, care should be taken to minimise the risks of increased coastal erosion associated with the extraction, for example sand should not be extracted from the active beach of the storm deposit.

Full details of sediment quality and PSD are available in SPC (2020b). Fill requirements for the Nanumaga Coastal Protection works are presented in **Table 7**.

Figure 9: top: Borrow area for TCAP coastal protection works at the northern point of Nanumanga, April 2020 (Source: Department of Lands and Survey, Tuvalu). Bottom left: An identified 120,000m^3 (approx.) of sediment deposited following TC Pam. right: seaward edge of the deposit looking south 90m from the established vegetation line (Source: TCAP, 2017).

Table 7: Sediment size requirements for the Nanumaga Coastal Protection works

Fill Type	Properties	Use
TYPE A	≥90% passing 75mm sieve	Fill over GMC units
	300mm maximum particle size	Larger size particles and coral to be separated for use in footpath
TYPE B	100% passing 26.5mm sieve	GSC, GMC unit fill

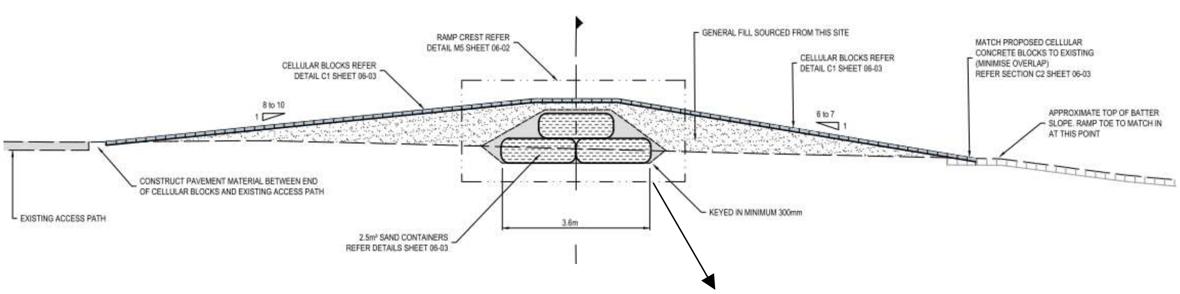
3.5 Boat ramp

The central section of Nanumaga Village provides access to the ocean by a recently constructed cellular concrete (Flexmat™ or similar) boat ramp. The eastern extent of this ramp terminates just west of the Store and the footings of the old church site, see Figure 10. The TCAP Coastal protection works will extend the boat ramp over the berm and into the village.

The present accessway has over many years of use caused a depression in the height of the naturaly storm berm (around 1.0 – 1.5m) and combined with the influence of the boat channel is known to be a major source of marine water over topping volums during large events. By raising the landward end of the road TCAP can reduce overtopping risk and volumes.

The berm height will be raised by pyramid stacking GSC units (2+1), laying geotextile and fill atop the GSC units and then instaling the cellular concrete ramp mat as per manufactire specifications marrting into the existng ramp. A coss-section of the proposed ramp is provided in Figure 11.

Figure 10: recently constructed Flexmat ™ cellular concrete boat ramp on Nanumaga.



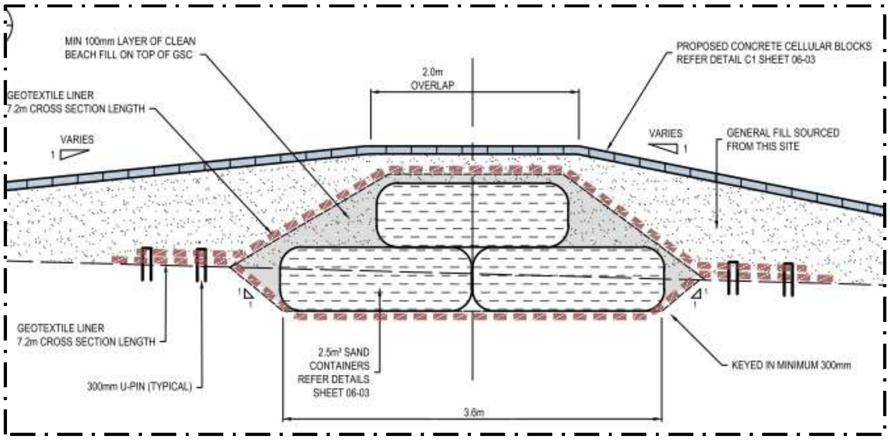


Figure 11: longitudinal section of proposed boat ramp extension

4. PROJECT IMPLEMENTATION

4.1 General

The United Nations Development Programme (UNDP), Pacific Office in Fiji act as the Project Management Unit (PMU) for TCAP, implementing the project in partnership with the GoT. Assistance throughout the implementation phase has also been provided by the Pacific Community (SPC) has also been engaged by UNDP to conduct the ESIA, coastal vulnerability and geotechnical components.

The following section describes non-design related aspects of the project implementation.

4.2 Project governance and oversight

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. 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.

TCAP will strengthen institutional and community capacity for sustaining and replicating project results. It is envisaged that the project will help to strengthen governmental capacity for coastal management and its legacy will be a Coastal Management Strategy for Tuvalu with internal agency capacity for its implementation.

4.3 Procurement strategy

Due to the works complexities stemming from the remote location of the project sites, the unique atoll environments and the nature of the construction works in Tuvalu, UNDP have proposed a 3-stage *Interactive Dialogue* Procurement Strategy. The construction works will be tendered as a complete package of works encompassing Funafuti, Nanumea and Nanumaga. The procurement stages are briefly described below:

- Pre-qualification (PREQ): The PREQ procedure is aimed at identifying qualified applicants for the next stage of the procurement process based upon their expertise, financial and technical capacity, and experience in construction in remote undeveloped atoll islands.

- Request for Proposal (RFP): A formal RFP will be issued to pre-qualified tenderers to provide both a formal technical and financial response to the tender. A pre-bid conference will be undertaken prior to the submission of the tenderer's RFP response.
- Interactive Dialogue (ID):The interactive dialogue allows UNDP and tenderers to discuss the scope and complexities around the project and for tenderers to understand better the RFP requirements. ID offers significant and clear benefits; enabling risk and assumptions to be thoroughly tested, innovative solutions to evolve and the foundations established for ensuring a successful contractual outcome of the tender. After completion of the ID sessions, the offerors are expected to submit their proposals within the stipulated deadline. The evaluation of the proposals including the contract award will follow the standard UNDP RFP process.

4.4 Contract delivery

The works contract will be delivered through UNDP's standard construction contract. Terms of the contract and any proposed departures by the tenderers will be discussed during the ID phase of procurement in the presence of the UNDP Legal and Procurement Teams as well as the PMU. Contractual discussions and verifications through the ID phase will minimise the risk of contractual disputes during construction as the ID sessions provide an opportunity for both parties to explore contingencies and project risks prior to signing and commencement of works.

4.5 Construction Environmental and Social Management Plan (C-ESMP)

The planned works on Nanumaga 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, impact to structures, impaired beach access or views) 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 the Environmental and Social impact Assessment Nanumaga and Nanumea undertaken by The Pacific Community – Geosciences, Energy and Maritime Division (SPC, 2020a). The key potential project impacts and risks have been identified as the following:

- Increased water turbidity from dredging works
- Changing access to, and use of, coastal marine environment
- Increased risk of traffic accidents
- Solid waste management
- Use of heavy machinery on the beach leading to increased sedimentation
- Fuel or other hazardous spills
- Noise and dust disturbance

This ESIA contains the recommended mitigation measures for Nanumaga for pre-construction, construction, and operational phases to avoid, reduce, or mitigate all identified impacts. The Contractor for the TCAP works will be required to produce a Contractor's Environmental and

Social Management Plan (C-ESMP). The C-ESMP will be the Contractor's governing document for the implementation of this ESIA's recommendations during works. The C-ESMP will be reviewed and approved by the TCAP Project Management Unit and disclosed prior to commencement of civil works. A summary of the key environmental and social indicators is provided in the table below.

Table 8: Environmental and Social Indicators and parameter considered under each indicator during the impact assessment (Source: SPC: 2020a)

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

Environmental and Social Indicator	Factors to be considered
	• Employment
Community Health and Safety	• Gender based violence • Worker safety

5. SUMMARY AND RECOMMENDATIONS

5.1 Summary

This report is the culmination of the design process for the Nanumaga Coastal Protection works as part of the TCAP. It finalises the design narrative undertaken in the Concept Design Report (UNDP, 2020) and draws on extensive stakeholder consultation, site investigations and interviews with contractors working in the region. The basis of design, structure parameters and the project implementation framework is presented herein. A safety in design (SiD) investigation which presents a design and construction risk assessment is provided in appendix C for reference.

The Nanumaga Coastal Protection works can be summarised as follows:

- 665m of Berm Top Barrier (BTB) constructed on the western coast of Nanumaga. Constructed from buried geotextile mega containers (GMC) approximately 20m long, the BTB will raise the height of the storm berm by around 1500mm. The GMC will be filled and buried under 9,500m^3 of sediment sourced from the northern tip of Nanumaga located around 500m from the village centre. The BTB will be planted with local vegetation and a small rubble footpath will be built on the crest of the BTB alignment.
- A cellular concrete boat ramp will extend the recently constructed boat ramp from Nanumaga boat harbour to the Village centre. The ramp will be placed atop stacked geosynthetic containers (GSC) and will raise the berm in this location.

5.2 Recommendations

The following recommendations are included as the TCAP moves through the implementation stage:

- Any uncertainties or omissions within this Detailed Design Report and associated IFC drawings should be conveyed by the tenderers to UNDP during the ID phase of the procurement strategy
- The submitted C-ESMP should address as a minimum the risks presented in Table 8 and those detailed in the ESIA (SPC, 2021a).
- A post-construction monitoring and maintenance strategy should be established with clear tasks, roles, training and budget allocated to GoT.
- Wherever possible a UNDP representative engineer should be present during the construction phase to ensure the coastal protection works are constructed as to the specifications presented.

6. REFERENCES

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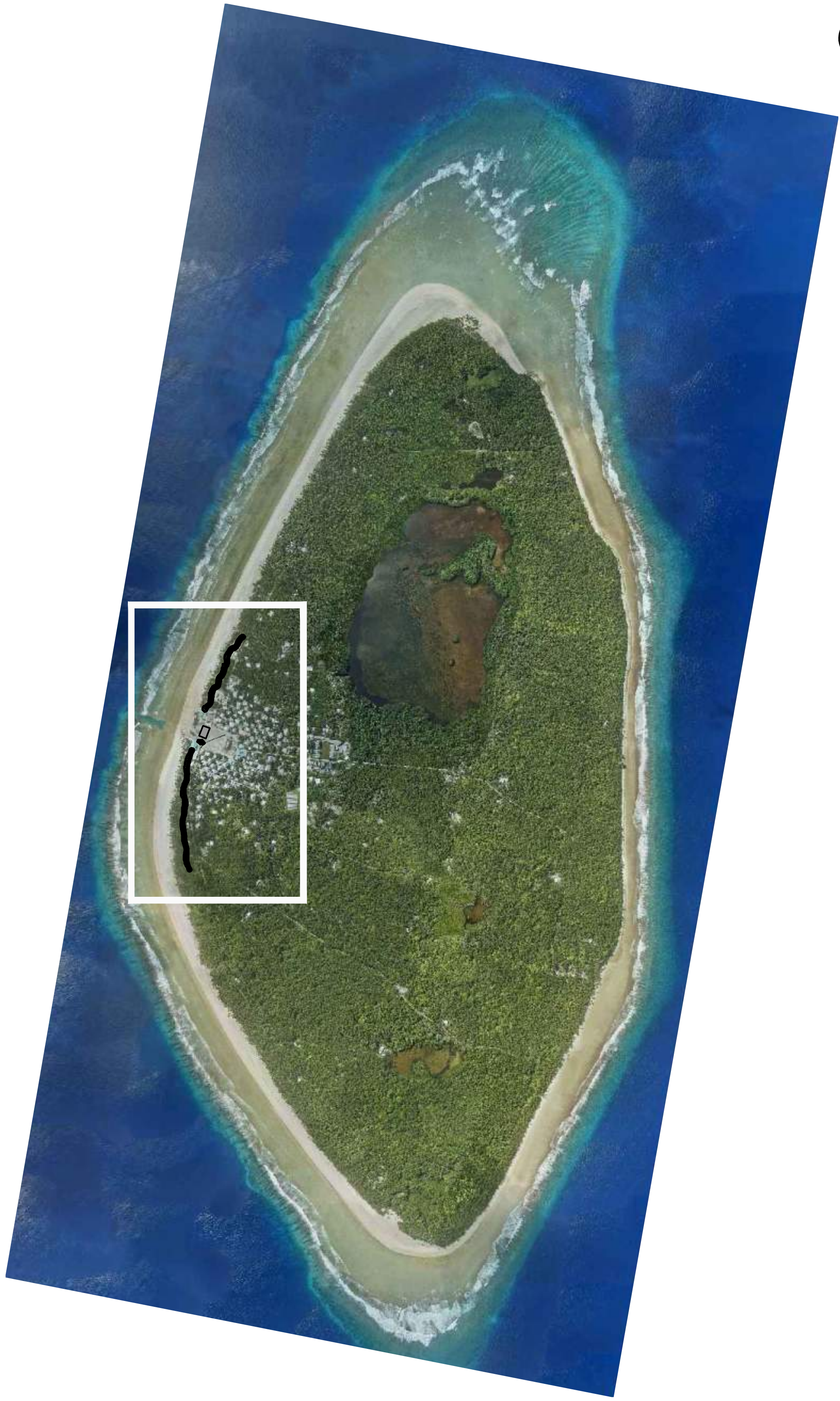
Appendix A: Nanumaga Coastal Protection IFC Drawings

TUVALU COASTAL ADAPTATION PROJECT (TCAP)

NANUMAGA

NANUMAGA DRAWING LIST

JOB No	PLAN No	Rev	DESCRIPTION
P19012			
P19012-AG-CV-	00-01	A	COVER SHEET, LOCALITY AND DRAWING LIST
	01-01	A	SITE PLAN
	02-01	A	GENERAL NOTES
	03-01	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 1
	03-02	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 2
	03-03	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 3
	03-04	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 4
	03-05	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 5
	03-06	A	GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 6
	04-01	A	SITE SETOUT PLAN
	05-01	A	EARTHWORK VOLUME MOVEMENT PLAN
	06-01	A	TYPICAL SECTION AND DETAILS SHEET 1
	06-02	A	TYPICAL SECTION AND DETAILS SHEET 2
	06-03	A	TYPICAL SECTION AND DETAILS SHEET 3
	07-01	A	CONTROL GB01 SITE CROSS SECTIONS SHEET 1
	07-01	A	CONTROL GB01 SITE CROSS SECTIONS SHEET 2
	07-01	A	CONTROL GB01 SITE CROSS SECTIONS SHEET 3
	07-01	A	CONTROL GB02 SITE CROSS SECTIONS SHEET 1
	07-01	A	CONTROL GB02 SITE CROSS SECTIONS SHEET 2
	07-01	A	CONTROL GB02 SITE CROSS SECTIONS SHEET 3
	07-01	A	CONTROL GB02 SITE CROSS SECTIONS SHEET 4
	08-01	A	CONTROL GB03 SITE CROSS SECTIONS SHEET 1



LOCALITY PLAN
SCALE 1: 10,000

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 100 200 300 400 500m
SCALE 1:10,000 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
bluecoast CONSULTING ENGINEERS
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www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
COVER SHEET, LOCALITY AND DRAWING LIST

DRG NO.
P19012-AG-CV-00-01

REV.
A

SITE PLAN
SCALE 1: 1,000

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

DESIGNED BY	JL
DRAWN BY	MLC
CHECKED BY	JL
APPROVED	AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
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PROJECT NUMBER
P19012

DRAWING TITLE
SITE PLAN

DRG NO.
P19012-AG-CV-01-01

REV.
A

TECHNICAL SPECIFICATION

GENERAL CONSTRUCTION NOTES

1. THE WORKS SHALL BE PROTECTED AND/OR MANAGED TO ACCOUNT FOR HIGH WATER LEVELS WAVE ACTION AND STORMWATER.
2. THE WORKS SHALL BE COMPLETED IN A MANNER WHICH LIMITS THE EXTENT OF THE WORKS EXPOSED TO POSSIBLE DAMAGE FROM HIGH WATER LEVELS, WAVE ACTION AND STORMWATER AND ENSURE THAT IT DOES NOT ADVERSLEY AFFECT AREAS ADJACENT TO THE WORKS.
3. DEMOLITION AND EXCAVATION SHALL BE UNDERTAKEN IN A CAREFUL MANNER WITH A MINIMUM OF DISTURBANCE AND WITH EVERY POSSIBLE PRECAUTION TAKEN TO PREVENT DAMAGE TO PROPERTY AND INJURY TO PERSONNEL.
4. CARRY OUT ALL WORKS IN ACCORDANCE WITH THE APPROVED PROJECT DOCUMENTATION. RECORD AND HAVE AUTHORISED ANY CHANGES MADE TO THE WORKS UNDER THIS DOCUMENTATION IN ACCORDANCE WITH QUALITY PROCEDURES.
5. ALL DISCREPANCIES SHALL BE REFERRED TO THE UNDP ENGINEER FOR RESOLUTION BEFORE PROCEEDING.
6. DURING THE CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE WORKS INCLUDING ADJACENT STRUCTURES AND ROADS IN A STABLE CONDITION AND ENSURING NO PART IS OVERSTRESSED.
7. ALL DIMENSIONS ARE IN MILLIMETRES AND ALL LEVELS IN METRES RELATIVE TO CHART DATUM (CD).
8. ARRANGE TGZ SETOUT IN LIAISON WITH GOVERNMENT OF TUVALU LANDS AND SURVEY DEPARTMENT. NOTIFY SURVEY CO-ORDINATOR A MINIMUM OF 24 HOURS IN ADVANCE.
9. CATCHMENT BASED ON DIGITAL MODEL (DEM) PROVIDED BY FUGRO (2019).
10. ELEVATED PATHWAY TO BE HIGHEST POINT OF RECLAMATION TO ALLOW OVERLAND FLOWS FROM MAJOR STORM EVENTS TO BE CONVEYED OFF THE RECLAMATION. REFER DESIGN REPORT FOR DETAILS.
11. ALL DIMENSIONS RELATING TO EXISTING WORK, GROUND AND SEABED LEVELS, OR ITEMS SUPPLIED BY OTHERS, SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF ANY FABRICATION AND ERECTION WORKS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THEIR CORRECTNESS.
12. ALL PROPRIETARY ITEMS SHALL BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS/SUPPLIERS INSTRUCTIONS.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR TEMPORARY SITE DRAINAGE AND GENERAL MAINTENANCE OF THE AREA DURING CONSTRUCTION.
14. THE CONTRACTOR SHALL RECORD PHOTOGRAPHIC EVIDENCE OF ALL EXCAVATIONS PRIOR TO ANY BACKFILLING .

EXCAVATION AND FILL WORKS

1. THE UNDP CONSTRUCTION SUPERVISOR SHALL BE ADVISED WHEN DEMOLITION, EXCAVATION AND FILL WORKS ARE TO COMMENCE.
2. THE EXCAVATION ALIGNMENT AND BATTER SHALL BE IN ACCORDANCE WITH THE LEVELS AND SIDE SLOPES SHOWN ON THE DRAWINGS.
3. CARE MUST BE TAKEN WITH EXCAVATION BATTERS TO ENSURE THEY ARE NOT IMPEDEING ROAD AND SITE ACCESS.
4. APPROVAL MUST BE SOUGHT BY THE CONSTRUCTION SUPERVISOR FROM THE KAPULE IN REGARDS TO THE REMOVAL OF TREES, OR COVERING OF LOCAL GARDENS OR INFRASTRUCTURE BY EXCAVATION BATTERS.
5. COVERING OF THE BERM TOP BARRIERS MUST BE IN ACCORDANCE WITH THE ALIGNMENT LEVELS AND SIDE SLOPES OF THOSE SPECIFIED IN THE DRAWINGS. ANY PROPOSED CHANGES TO THE DESIGNS MUST BE PROPOSED TO THE UNDP ENGINEER PRIOR TO CONSTRUCTION.
6. STOCKPILING OF SAND SHALL BE LIMITED TO THE MINIMUM EXTENT PRACTICAL FOR CONTINUITY OF THE WORKS.

FILL MATERIAL

1. ALL FILL MATERIALSHALL BE NON-COHESIVE GRANULAR MATERIAL COMPRISING HARD, DENSE AND DURABLE SPACE PARTICLES WHICH SHALL BE FREE FORM ORGANIC AND CARBONACEOUS MATERIALS.

GRADING OF FILL MATERIAL SHALL COMPLY WITH THE FOLLOWING PROPERTIES:

TYPE A: 300mm MAXIMUM PARTICLE SIZE
≥90% PASSING 75mm SIEVE
TYPE B: 100% PASSING 26.5mm SIEVE

GEOTEXTILE PLACEMENT

1. THE GEOTEXTILE SHALL BE TEXCEL 1200R OR APPROVED EQUIVALENT WHICH COMPLIES WITH THE FOLLOWING MINIMUM REQUIREMENTS:
   - UNIT WEIGHT TO AS3706.1
   - GRABTENSILE STRENGTH TO AS2001.2.3
   - TRAPEZOIDAL SPACES TEAR RESISTANCE ASTM D1117
   - WATER PERMEABILITY (10 CM HEAD)
   - 1000 g/m2
   - 1000N (MIN) IN ANY DIRECTION IN PLANE OF GEOTEXTILE
   - 600N (MIN) IN ANY DIRECTION
   - 30litres/m2/second (MIN)
2. THE PLACEMENT OF GEOTEXTILE FILTER SHALL SATISFY THE CRITERIA BELOW:
   - GROUND PREPARATION: SHARP-EDGED ROCKS, STUMPS AND THE LIKE ARE TO BE REMOVED PRIOR TO LAYING OF THE GEOTEXTILE
   - JOINING FABRIC ELEMENTS: FABRIC ELEMENTS MAY BE JOINED BY EITHER OVERLAPPING OR SEWING. OVERLAP WIDTHS SHALL BE NO LESS THAN 0.5M WITH THE DIRECTION OF OVERLAP TAKING INTO ACCOUNT THE OVERBURDEN MATERIAL SUPPLY DIRECTION. FOR SEWING ASSEMBLY 0.1m OVERLAP IS SUFFICIENT TO ENSURE CONTINUITY OR TO MANUFACTURERS INSTRUCTION.
   - LAYING IN WATER: RAPID IMMERSION REQUIRES BALLASTING OF FABRIC.
   - JOIN GEOTEXTILE AS TO RETAIN ADEQUATE FILTER FUNCTION.

GEOTEXTILE (MEGA) CONTAINERS

1. PLACEMENT OF THE CONTAINERS SHALL ACHIEVE THE FOLLOWING TOLERANCES:
   - A TOLERANCE OF 5º ALONG THE BUND OF INDIVIDUAL CONTAINERS
   - MAXIMUM 50mm HORIZONTAL OFFSET BETWEEN THE ENDS OF ADJACENT GEOSYNTHETIC SAND CONTAINERS.
   - MAXIMUM 50mm HORIZONTAL SEPARATION BETWEEN ADJACENT GEOSYNTHETIC SAND CONTAINERS.
2. CONTAINERS SHALL BE FILLED USING TYPE B FILL MATERIAL.
3. CONTAINERS SHALL BE FILLED AND SEALED IN ACCORDANCE WITH THAT PRESCRIBED BY THE MANUFACTURER AND IN ACCORDANCE WITH THE CONSTRUCTION PROCEDURE.
4. THE FILLING METHODS SHALL BE HYDRAULICALLY ASSISTED AND SHALL ACHIEVE CONTAINER DIMENSIONS WITHIN THE RANGE SPECIFIED BELOW:

TYPE	HEIGHT (mm)	LENGTH (mm)	WIDTH (mm)
CONTAINER	1,500	20,000	3,100

5. THE CONTAINERS SHALL BE PLACED ON A GEOTEXTILE TO PREVENT THE LOSS OF FINES THROUGH THE STRUCTURE, IN ACCORDANCE WITH THE DRAWINGS AND THIS SPECIFICATION.
6. THE CONTAINERS SHOULD BE PLACED USING SPECIALISED FILLING/PLACEMENT EQUIPMENT, IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
7. THE AMOUNT OF HANDLING SHALL BE MINIMISED TO ENSURE THE GEOSYNTHETIC SAND CONTAINER RETAINS ITS FORM AND SHAPE, AND TO REDUCE THE STRAINS PUT ON THE GEOTEXTILE AND SEAMS. THE GEOSYNTHETIC MEGA CONTAINERS SHALL BE PLACED IN SUCH A WAY AS TO MINIMISE EXPOSURE OF THE ON-SITE CLOSURE SEAM.
8. THE CONTAINERS SHALL BE PLACED IN A STRETCHER BOND LAYOUT TO ENSURE EFFECTIVE INTERLOCK AND STABILITY.
9. IF VEHICULAR TRAFFICKING ATOP THE GEOSYNTHETIC SAND CONTAINERS IS REQUIRED DURING PLACEMENT, A MINIMUM SAND COVER OF 500mm IS REQUIRED OVER THE GEOSYNTHETIC SAND CONTAINERS.

REINSTATEMENT, SITE DISESTABLISHMENT AND CLEANUP

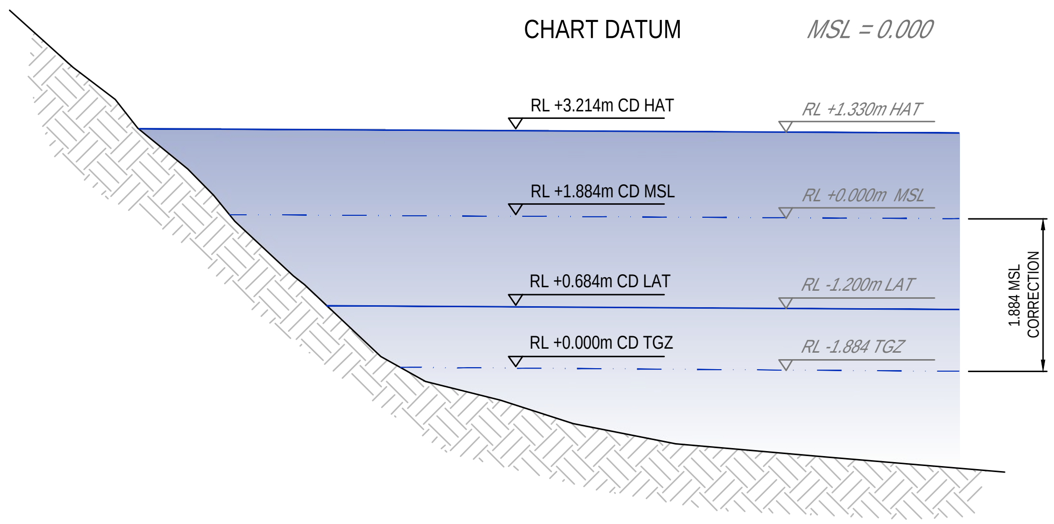
1. EXCEPT TO THE EXTENT THAT THE SITE HAS BEEN REPAIRED AND UPGRADED IN ACCORDANCE WITH THE WORKS, THE SITE SHALL BE REINSTATED TO ITS PRE-CONSTRUCTION CONDITION AND ANY STRUCTURES DAMAGED DURING THE COURSE OF THE WORKS.
2. UPON COMPLETION OF THE WORKS, THE SITE SHALL BE CLEARED OF ALL SURPLUS MATERIALS, PLANT, FENCING, SITE SHED, NOTICE BOARDS AND THE LIKE, TO THE SATISFACTION OF THE UNDP REPRESENTATIVE.
3. UPON COMPLETION OF THE WORKS, REMOVAL AND LAWFUL DISPOSAL OFF SITE OF ALL SURPLUS SPOIL, RUBBISH OR EXCESS MATERIAL, AND FOR THE FINAL CLEANING UP OF ALL AREAS COVERED BY THE CONTRACT SHALL BE LEFT CLEAN AND TIDY UPON COMPLETION.

BOAT RAMP

1. RAMP SURFACE TO BE PRECAST CONCRETE PATTERN BLOCKS ON PERMEABLE GEOTEXTILE MATTING, FLEXMAT™ FM40 OR SIMILAR.
2. ANCHORING OF THE MAT SYSTEM IS TO BE UNDERTAKEN USING STANDARD STEEL ANCHOR PINS SUITABLE FOR FM40 MAT (SEE DWG**XXX** FOR DETAIL). PINS ARE TO BE DRIVEN UNTIL WEDGED BETWEEN THE BLOCKS. A STEEL EXTENSION ROD IS TO BE USED IN FINAL STAGES OF DRIVING TO PREVENT HAMMER IMPACT (CHIPPING) DAMAGE TO THE BLOCK'S EDGES. PIN DRIVING TO STOP AS PIN HEAD IS WEDGED BETWEEN BLOCKS, PREVENTING CONTACT WITH MATTING.
3. EDGES SHOULD BE STABILISED BY COVERING THE TOP SKIRT WITH A CONCRETE SEAL TO THE FIRST ROW OF BLOCKS AND BURY EDGE INTO EMBANKMENT USING LOCALLY SOURCED FILL.

INSTALLATION

4. GENERALLY, MATS ARE TO BE INSTALLED IN ACCORDACE WITH MANUFACTURERS RECOMMENDATIONS.
5. PROTRUDING OBJECTS (BOULDERS, ROOTS ETC) NEED TO BE REMOVED PRIOR TO INSTALLATION.
6. LOCALLY SOURCED BASE MATERIAL TO BE WELL-SMOOTHED BY MEANS OF TRANSVERSE SKIMMER BEAM AND COMPACTED.
7. MATS TO BE INSTALLED BY MOBILE CRANE, FRONT END LOADER OR BACK HOE. DURING MATTRESS SUSPENSION THE LIFTING TUBULARS MUST BE KEPT PERFECTLY HORIZONTAL, TO AVOID PROGRESSIVELY WORSENING MISALIGNMENT (SKEWING) OF SUCCESSIVE MATTRESSES. SAFE WORKING LOAD OF THE CRANE MUST BE AT LEAST TWICE THE WEIGHT OF THE MATS. HOISTING SHOULD BE SMOOTH WITHOUT JERKING AFTER CHECKING THAT PROPER CLOSURE OF THE CLAMPS IS NOT PREVENTED BY DEBRIS OR WRINKLED (UNSTRETCHED) MATTING.
8. SIDE EDGE OF EACH FRINGE MAT SHOULD BE LOWERED ALONGSIDE A PRE-PEGGED WIRE AND SUSPENDED MAT SHOULD BE ALIGNED VERTICALLY WHEN LOWERED ALONGSIDE THE PRECEDING MATTRESS.
9. SPECIAL CARE SHOULD BE TAKEN THAT THE SIDE SKIRT IS FULLY STRETCHED TO ENSURE THAT EFFECTIVE OVERLAP WIDTH IS NOT REDUCED. EDGE STABILIZATION, ANCHORING AND GROOVE FILLING TO BE CARRIED OUT IN STRICT ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.
10. FOLLOWING INSTALLATION, A COMPACTOR (WITH PLYWOOD SEPARATION BOARD) IS TO BE USED OVER MATS TO ACCOMPLISH PROPER BEDDING OF THE BLOCKS ONTO THE SUPPORTING MATERIAL.



Funafuti Tide Gauge Datum Relationships and MSL Correction (Source Fugro and SPC, 2019)

TIDE CHART - DATUMS

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

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SCALE 1:100 AT ORIGINAL SIZE
0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

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PROJECT
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PROJECT NUMBER
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DRG NO.
P19012-AG-CV-02-01

REV.
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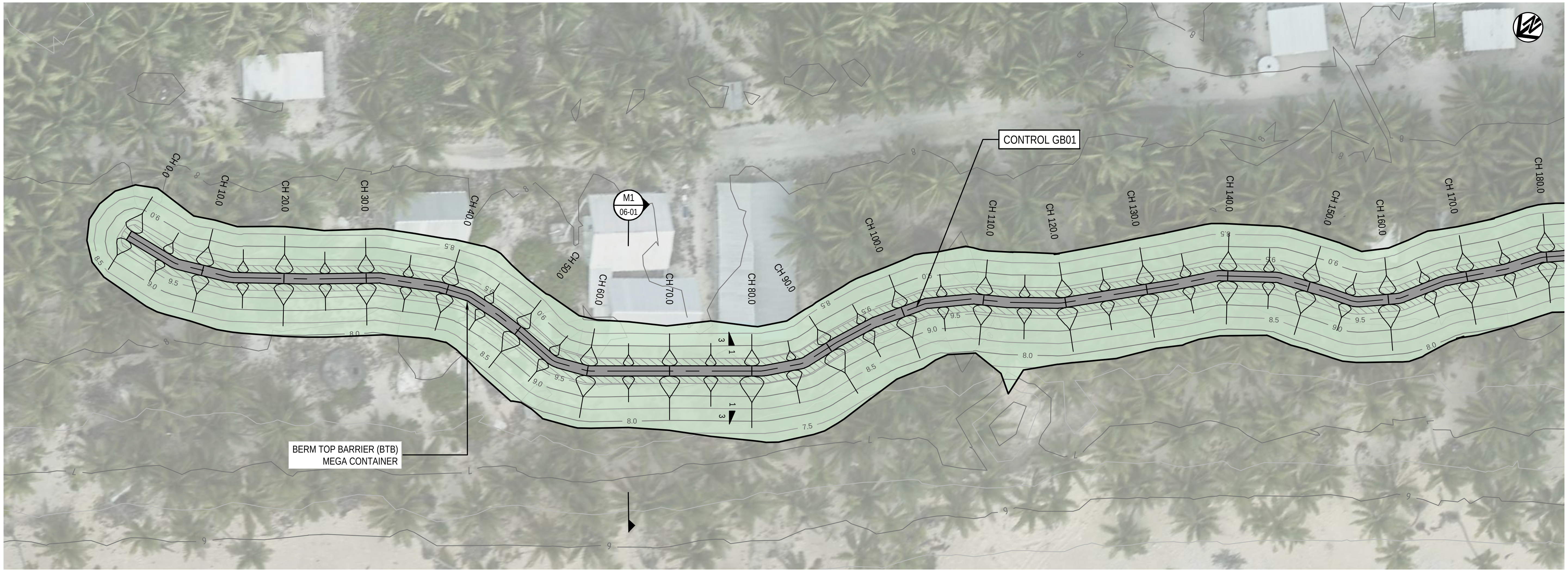

PLAN

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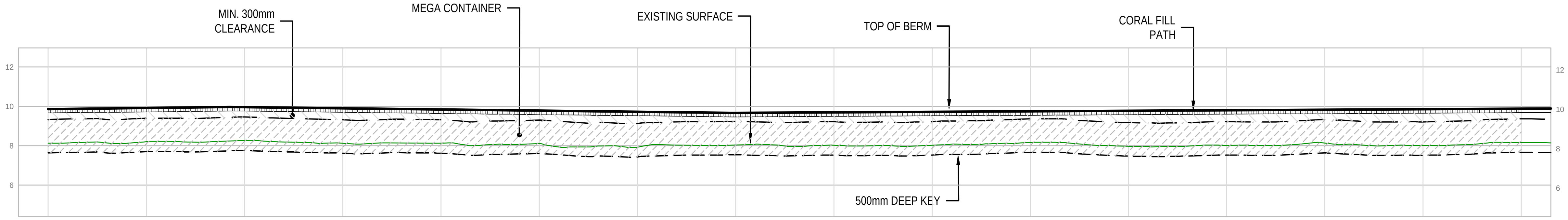

DATUM R.L. 3

CONTROL S.O.P	9.87	9.90	9.91	9.92	9.94	9.94	9.97	9.96	9.94	9.94	9.90	9.89	9.89	9.85	9.85
EXISTING SURFACE	8.14	8.13	8.12	8.21	8.20	8.19	8.25	8.27	8.22	8.21	8.12	8.09	8.09	8.14	8.13
DEPTH TO EXISTING (m)	1.7	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.7	1.7
CHAINAGE	0.00	6.25	7.01	10.00	13.31	13.86	18.48	20.00	22.79	22.88	30.00	31.39	31.80	38.81	39.17

CONTROL S.O.P	9.84	9.83	9.82	9.80	9.80	9.78	9.78	9.78	9.75	9.75	9.73	9.72	9.72	9.67	9.67
EXISTING SURFACE	8.13	8.05	8.01	8.07	8.07	8.11	8.11	8.11	7.94	7.99	7.91	7.93	7.96	8.04	8.04
DEPTH TO EXISTING (m)	1.7	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.6	1.6
CHAINAGE	40.00	42.40	43.12	46.87	47.06	50.00	50.00	50.15	55.17	56.29	59.74	60.00	60.42	69.64	70.00

CONTROL S.O.P	9.70	9.70	9.70	9.71	9.71	9.72	9.73	9.73	9.74	9.74	9.75	9.76	9.76	9.77	9.77
EXISTING SURFACE	8.03	8.00	7.99	8.00	7.98	8.03	8.05	8.06	8.10	8.11	8.17	8.17	8.16	8.00	7.99
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.6	1.8	1.8
CHAINAGE	80.00	81.11	81.58	85.93	86.87	90.00	91.02	91.20	95.97	96.32	100.00	102.58	103.22	108.49	108.98

CONTROL S.O.P	9.78	9.78	9.78	9.80	9.80	9.80	9.83	9.84	9.84	9.85	9.85	9.86	9.87	9.87	9.88
EXISTING SURFACE	7.98	7.95	7.95	8.03	8.03	8.03	8.13	8.06	8.06	8.02	8.02	8.01	8.10	8.13	8.17
DEPTH TO EXISTING (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7
CHAINAGE	110.00	113.00	113.22	119.14	119.57	120.00	130.00	133.20	133.31	138.51	139.10	140.00	145.72	146.37	150.00

LONGITUDINAL SECTION GB01

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

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0 2.5 5 7.5 10 12.5m — SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
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VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:

UNDP — Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT — TCAP

PLANS PREPARED BY:
bluecoast
CONSULTING ENGINEERS
1/1874 Gold Coast Highway
Burleigh Heads
QLD, 4220. Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

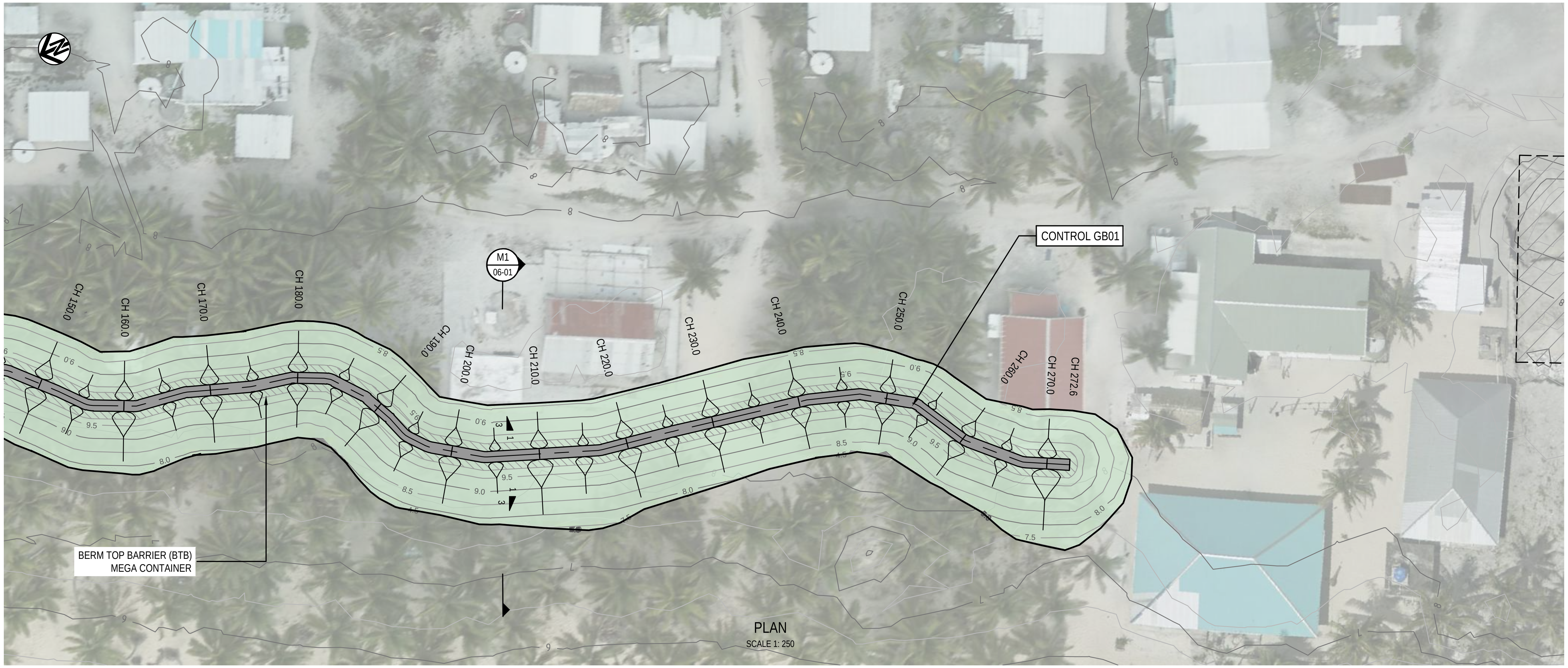
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

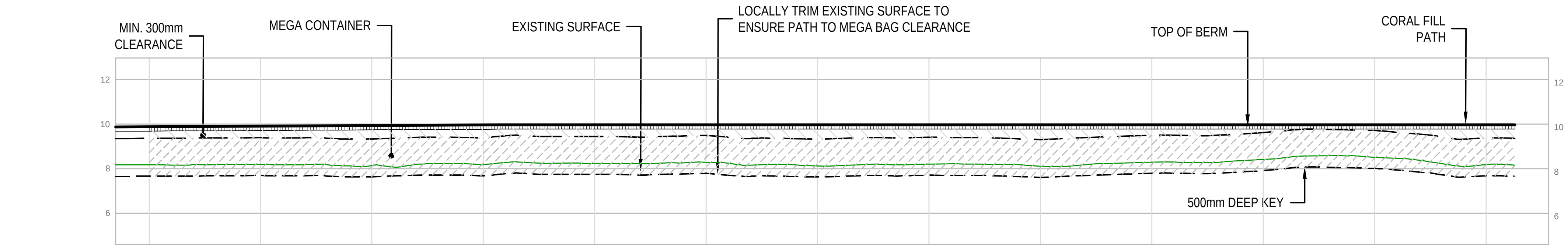
PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 1

DRG NO.
P19012-AG-CV-03-01

REV.
A





DATUM R.L. 3

CONTROL S.O.P	9.88	9.89	9.89	9.90	9.90	9.91	9.91	9.91	9.93	9.93	9.94	9.95	9.95
EXISTING SURFACE	8.17	8.16	8.16	8.17	8.18	8.19	8.17	8.17	8.14	8.13	8.13	8.21	8.21
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.7	1.7
CHAINAGE	150.00	152.10	152.21	155.48	156.53	160.00	161.05	161.78	166.90	167.38	170.00	174.56	174.89

CONTROL S.O.P	9.96	9.96	9.96	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97
EXISTING SURFACE	8.20	8.18	8.17	8.26	8.30	8.27	8.24	8.24	8.24	8.23	8.23	8.21	8.22
DEPTH TO EXISTING (m)	1.8	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.7
CHAINAGE	179.01	179.60	180.00	181.65	182.98	184.11	187.80	188.41	190.00	191.53	191.81	193.95	194.88

CONTROL S.O.P	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97
EXISTING SURFACE	8.26	8.26	8.29	8.14	8.15	8.12	8.18	8.17	8.20	8.19	8.19	8.10	8.29
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.7
CHAINAGE	196.96	197.67	200.00	203.49	204.08	210.00	216.64	217.13	220.00	225.21	225.27	230.00	240.00

CONTROL S.O.P	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97	9.97
EXISTING SURFACE	8.30	8.30	8.32	8.41	8.54	8.57	8.51	8.51	8.49	8.16	8.11	8.18	8.16
DEPTH TO EXISTING (m)	1.7	1.7	1.6	1.6	1.4	1.4	1.5	1.5	1.5	1.8	1.9	1.8	1.8
CHAINAGE	240.92	241.23	246.97	250.00	252.68	253.87	259.96	260.00	260.66	266.88	267.64	270.00	272.59

LONGITUDINAL SECTION GB01

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1.25 2.5 3.75 5 6.25 SCALE 1:125 AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:

UNDP Empowered lives. Resilient nations.

GREEN CLIMATE FUND

TCAP

PLANS PREPARED BY:

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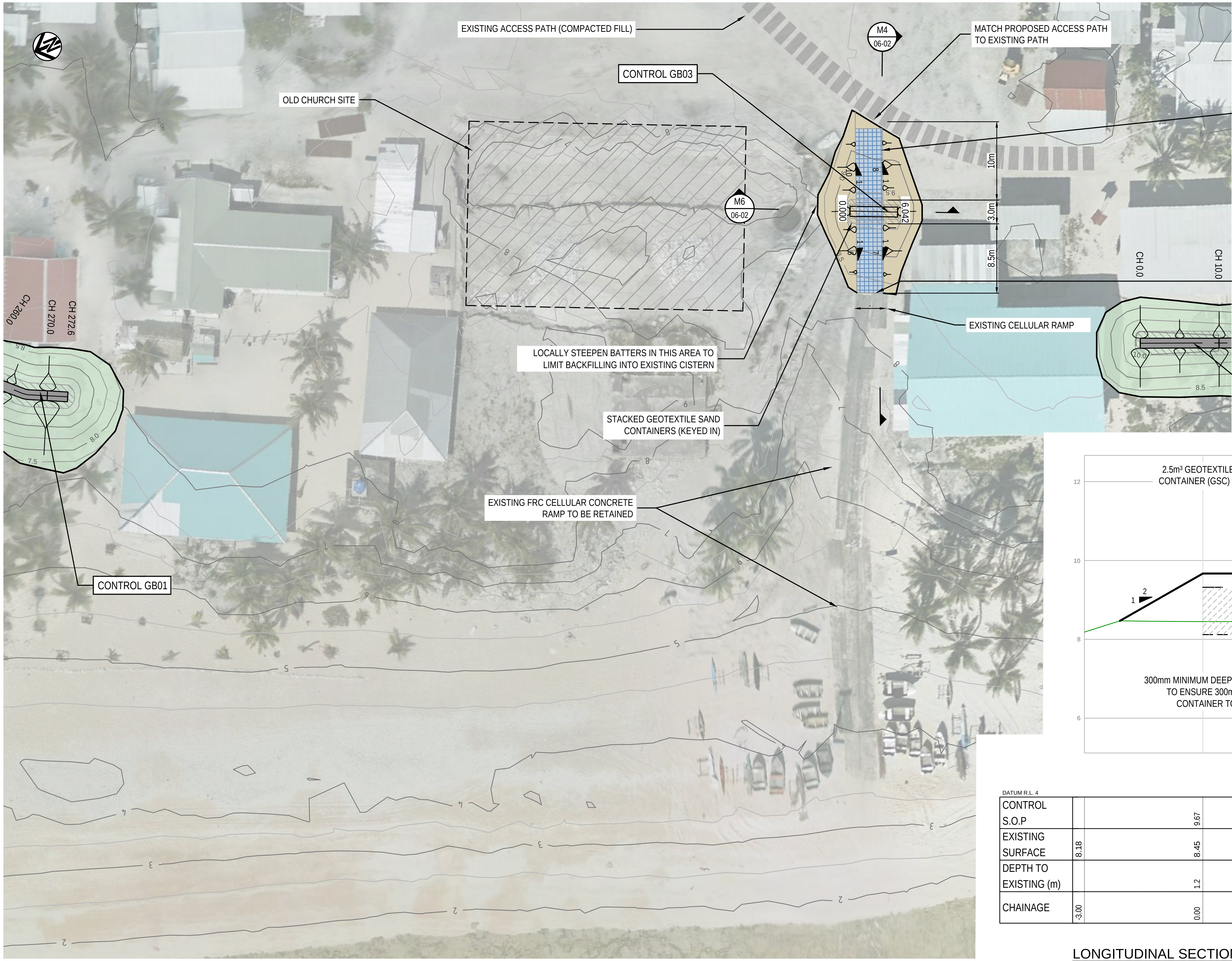
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 2

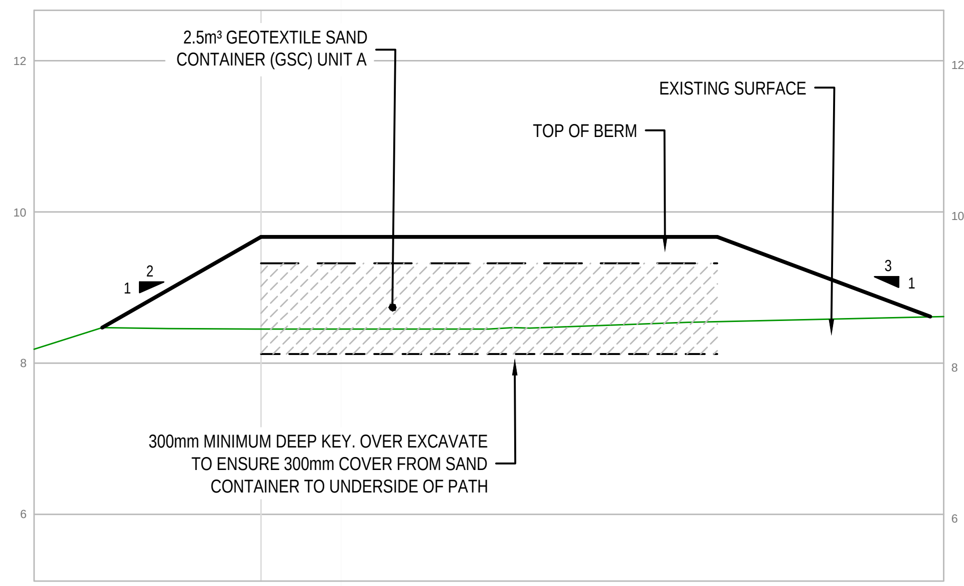
DRG NO.
P19012-AG-CV-03-02

REV.
A



PLAN

SCALE 1: 250



DATUM R.L. 4

CONTROL S.O.P		9.67	9.67	9.67	
EXISTING SURFACE	8.18	8.45	8.52	8.55	8.62
DEPTH TO EXISTING (m)		1.2	1.2	1.1	
CHAINAGE	-3.00	0.00	5.00	6.04	9.04

LONGITUDINAL SECTION GB03

0 0.25 0.5 0.75 1.0 1.25m — SCALE 1:25 AT ORIGINAL SIZE

0 0.5 1.0 1.5 2.0 2.5m — SCALE 1:50 AT ORIGINAL SIZE

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 2.5 5 7.5 10 12.5m — SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

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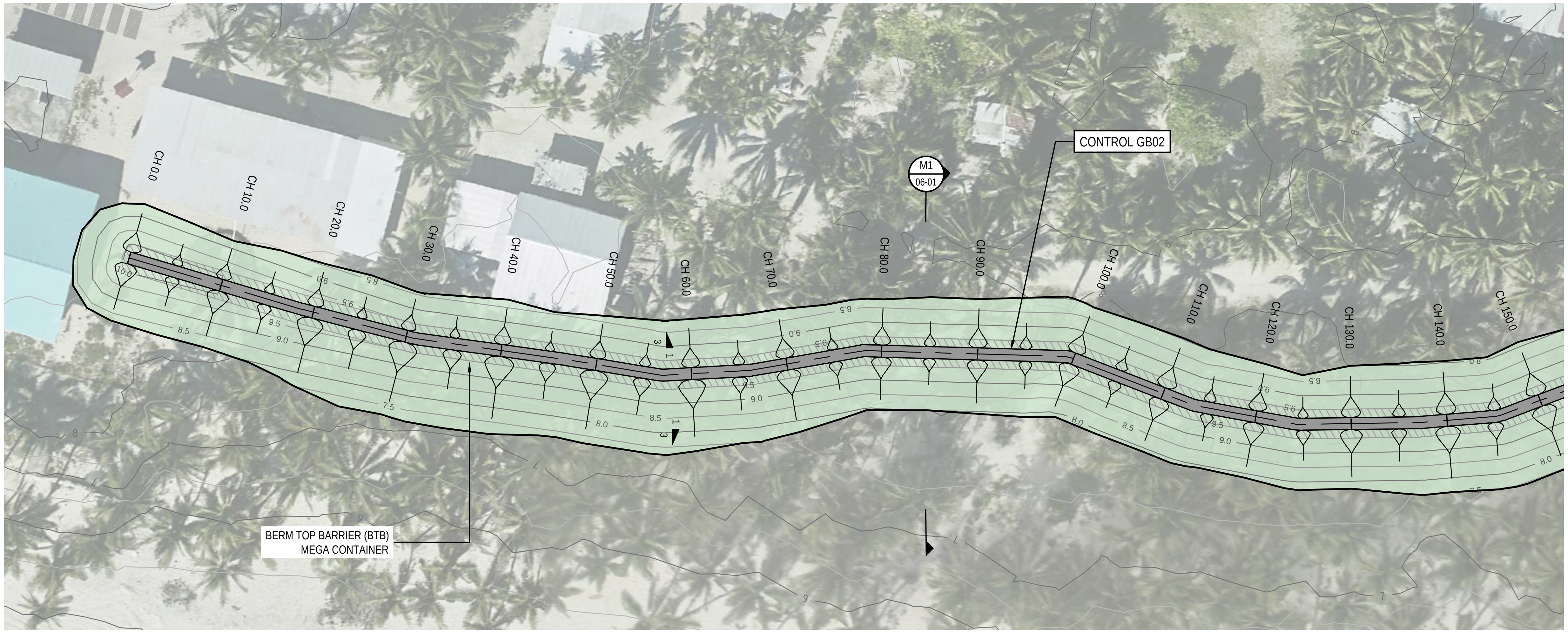
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 3

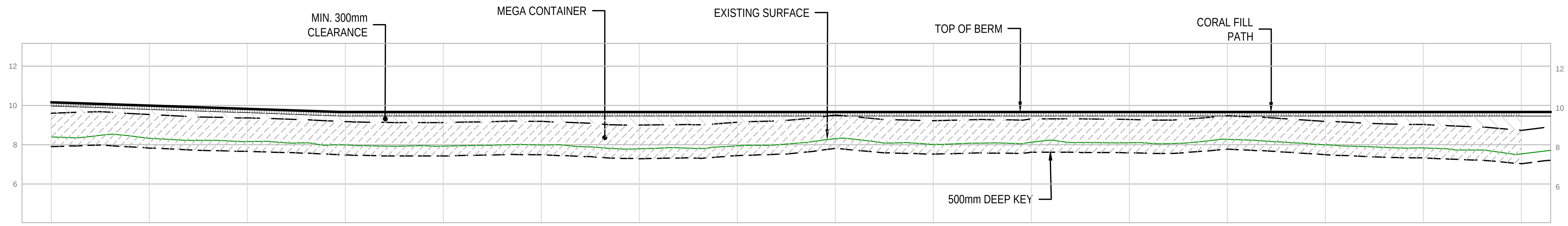
DRG NO.
P19012-AG-CV-03-03

REV.
A



PLAN

SCALE 1: 250



DATUM R.L. 3

CONTROL S.O.P	10.17	10.00	9.85	9.85	9.83	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67
EXISTING SURFACE	8.40	8.33	8.18	8.17	8.16	7.99	7.98	7.97	7.96	7.93	8.01	8.01	7.99
DEPTH TO EXISTING (m)	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
CHAINAGE	0.00	10.00	18.65	18.74	20.00	29.50	30.00	30.82	31.11	40.00	46.89	46.95	50.00

CONTROL S.O.P	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67
EXISTING SURFACE	7.83	7.82	7.79	7.81	7.81	7.95	8.17	8.21	8.31	8.02	8.05	8.11	8.12
DEPTH TO EXISTING (m)	1.8	1.9	1.9	1.9	1.9	1.7	1.5	1.5	1.4	1.6	1.6	1.6	1.5
CHAINAGE	56.66	57.20	60.00	66.01	66.30	70.00	77.87	78.38	80.00	90.00	98.94	99.79	100.00

CONTROL S.O.P	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67
EXISTING SURFACE	8.09	8.05	8.05	8.27	8.18	8.17	7.99	7.85	7.84	7.83	7.73	7.72	7.54
DEPTH TO EXISTING (m)	1.6	1.6	1.6	1.4	1.5	1.5	1.7	1.8	1.8	1.8	1.9	1.9	2.1
CHAINAGE	110.00	113.24	113.70	120.00	124.15	124.64	130.00	137.00	137.16	140.00	145.03	145.73	150.00

LONGITUDINAL SECTION GB02

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1.25 2.5 3.75 5 6.25 — SCALE 1:125 AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m — SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP — Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT — TCAP

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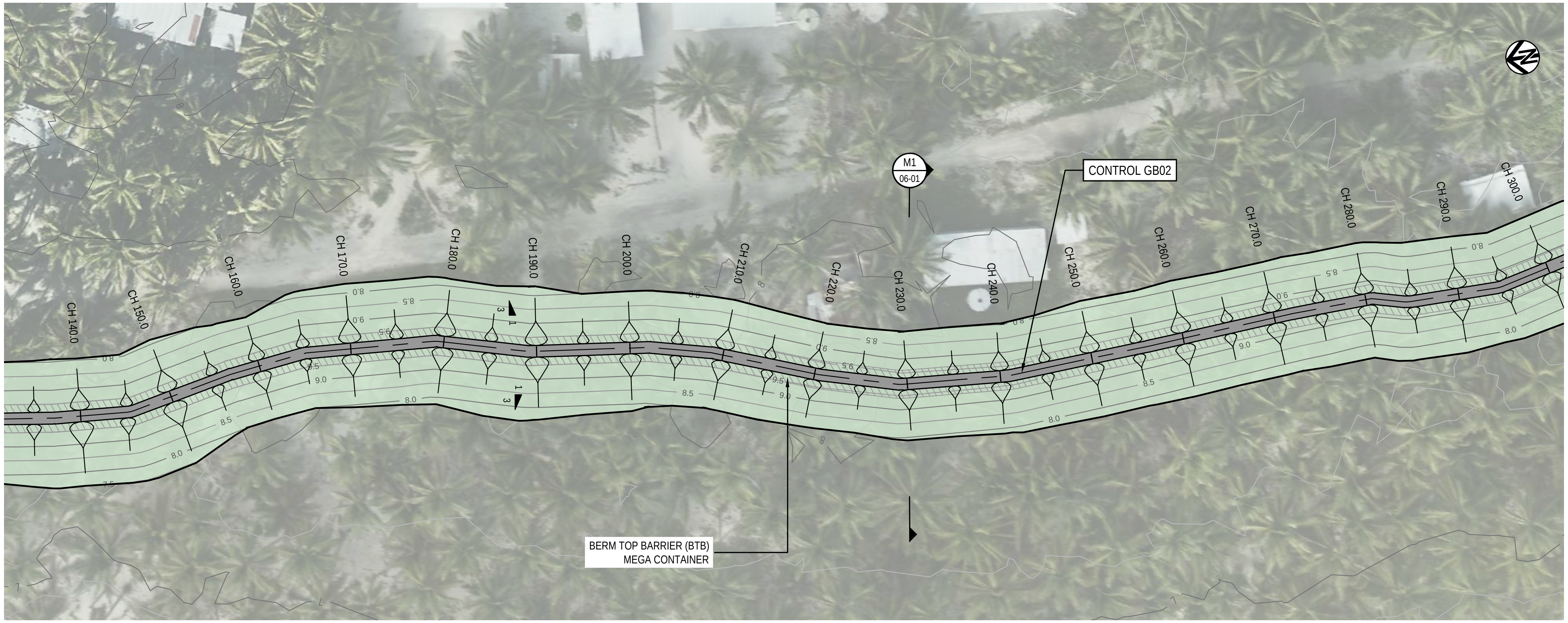
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 4

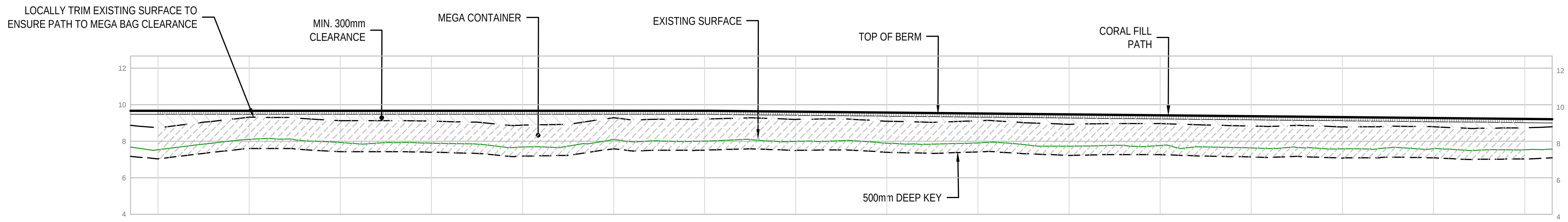
DRG NO.
P19012-AG-CV-03-04

REV.
A



PLAN

SCALE 1: 250



DATUM R.L. 3

CONTROL S.O.P	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67
EXISTING SURFACE	7.54	7.93	7.94	8.11	8.10	8.06	7.93	7.91	7.90	7.90	7.66	7.67	7.68	8.09	7.98
DEPTH TO EXISTING (m)	2.1	1.7	1.7	1.6	1.6	1.6	1.7	1.8	1.8	1.8	2	2	2	1.6	1.7
CHAINAGE	150.00	156.65	156.85	160.00	164.74	165.21	170.00	178.89	179.40	180.00	188.95	189.31	190.00	200.00	201.82

CONTROL S.O.P	9.67	9.67	9.67	9.67	9.67	9.62	9.62	9.62	9.57	9.57	9.57	9.52	9.51	9.51	9.47
EXISTING SURFACE	7.97	8.00	8.00	8.01	8.02	7.99	8.00	8.00	7.93	7.91	7.89	7.91	7.93	7.94	7.73
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.6	1.6	1.6	1.7
CHAINAGE	202.12	208.71	209.00	210.00	210.54	220.00	220.43	220.64	229.00	229.50	230.00	240.00	240.84	241.16	250.00

CONTROL S.O.P	9.44	9.44	9.42	9.37	9.36	9.36	9.32	9.32	9.31	9.30	9.29	9.27	9.25	9.24	9.22
EXISTING SURFACE	7.77	7.77	7.77	7.64	7.61	7.61	7.58	7.59	7.59	7.60	7.63	7.59	7.49	7.51	7.53
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.7	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.7	1.7
CHAINAGE	255.96	255.99	260.00	270.00	271.80	271.88	280.00	280.25	280.98	284.12	284.77	290.00	294.17	294.75	300.00

LONGITUDINAL SECTION GB02

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1.25 2.5 3.75 5 6.25
SCALE 1:125 AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
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GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT
TCAP

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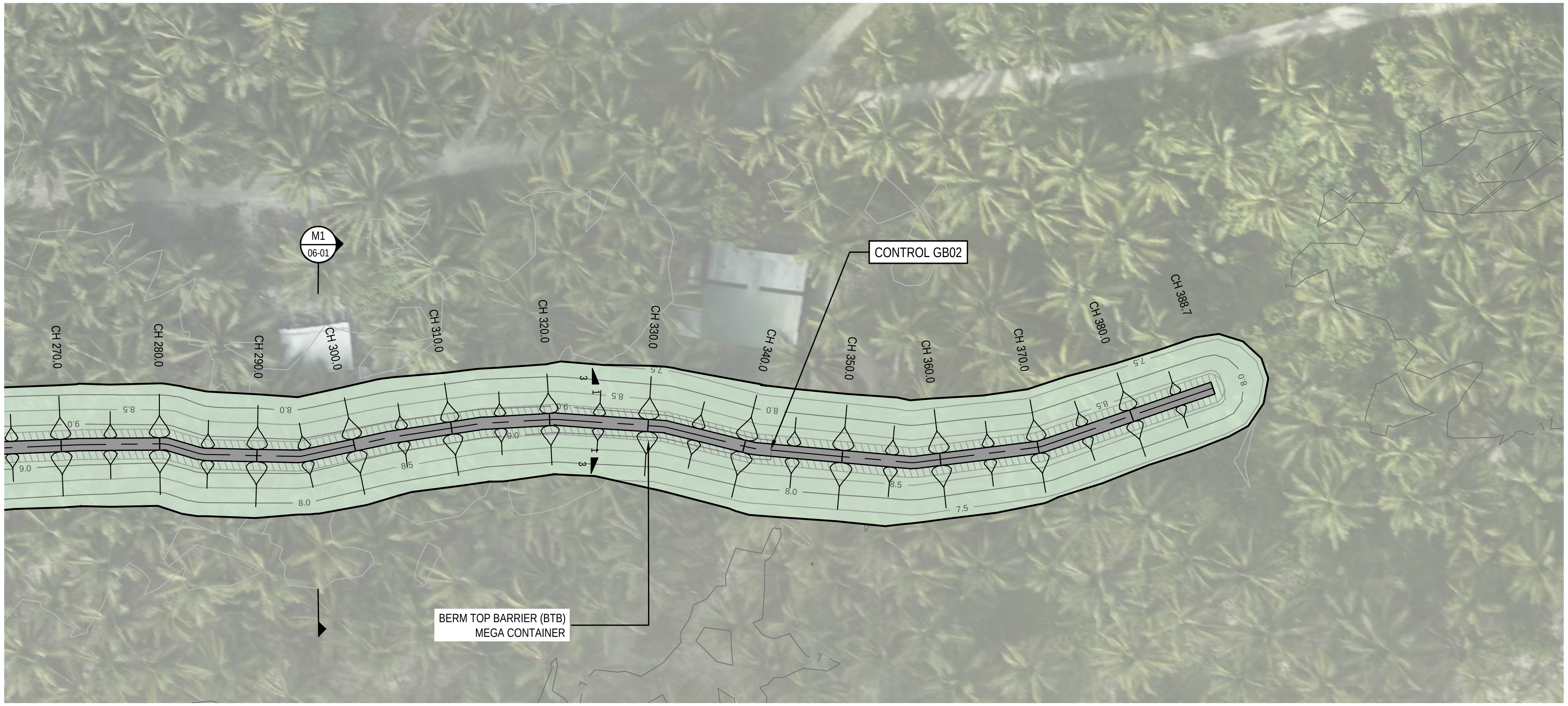
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 4

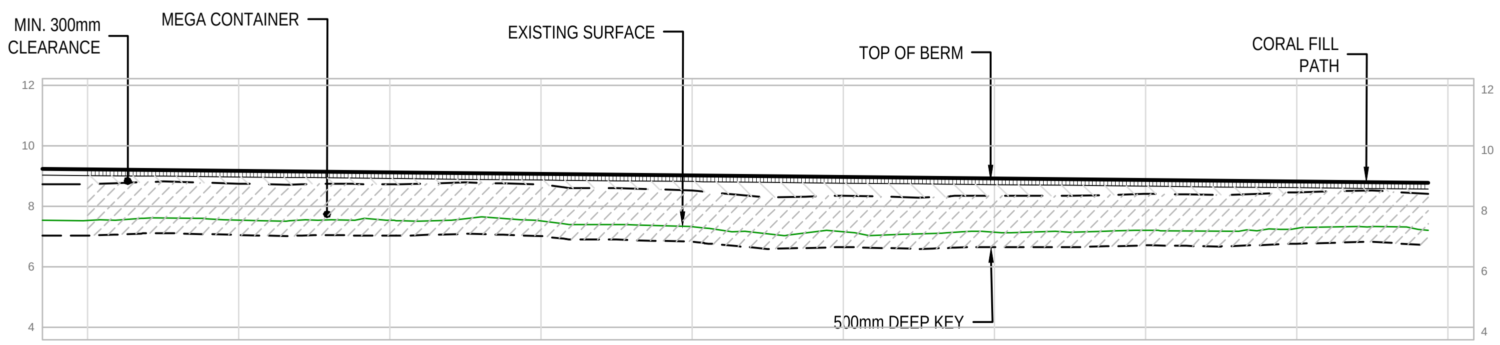
DRG NO.
P19012-AG-CV-03-05

REV.
A



PLAN

SCALE 1: 250



DATUM R.L. 2

CONTROL S.O.P	9.22	9.20	9.20	9.17	9.15	9.15	9.12	9.11	9.11	9.06	9.06	9.06
EXISTING SURFACE	7.53	7.60	7.60	7.54	7.50	7.51	7.53	7.53	7.52	7.52	7.43	7.40
DEPTH TO EXISTING (m)	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6	1.7
CHAINAGE	300.00	303.56	303.71	310.00	313.14	313.37	320.00	320.41	320.72	330.00	331.43	331.86

CONTROL S.O.P	9.01	9.01	9.01	8.96	8.93	8.93	8.91	8.86	8.86	8.86	8.81	8.77
EXISTING SURFACE	7.33	7.28	7.26	7.15	7.12	7.14	7.14	7.20	7.20	7.21	7.26	7.20
DEPTH TO EXISTING (m)	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.6
CHAINAGE	340.00	340.77	341.14	350.00	356.88	357.41	360.00	369.89	370.00	370.40	380.00	388.72

LONGITUDINAL SECTION GB02

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1.25 2.5 3.75 5 6.25 SCALE 1:125 AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m SCALE 1:250 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
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TUVALU COASTAL ADAPTATION PROJECT TCAP

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PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
GENERAL ARRANGEMENT PLAN AND LONGITUDINAL SECTION SHEET 6

DRG NO.
P19012-AG-CV-03-06

REV.
A

NOTE:
1. A NOMINAL 2.5m RADIUS (#) HAS BEEN APPLIED TO ALL HORIZONTAL INTERSECTION POINTS ALONG THE ALIGNMENT

CONTROL GB03

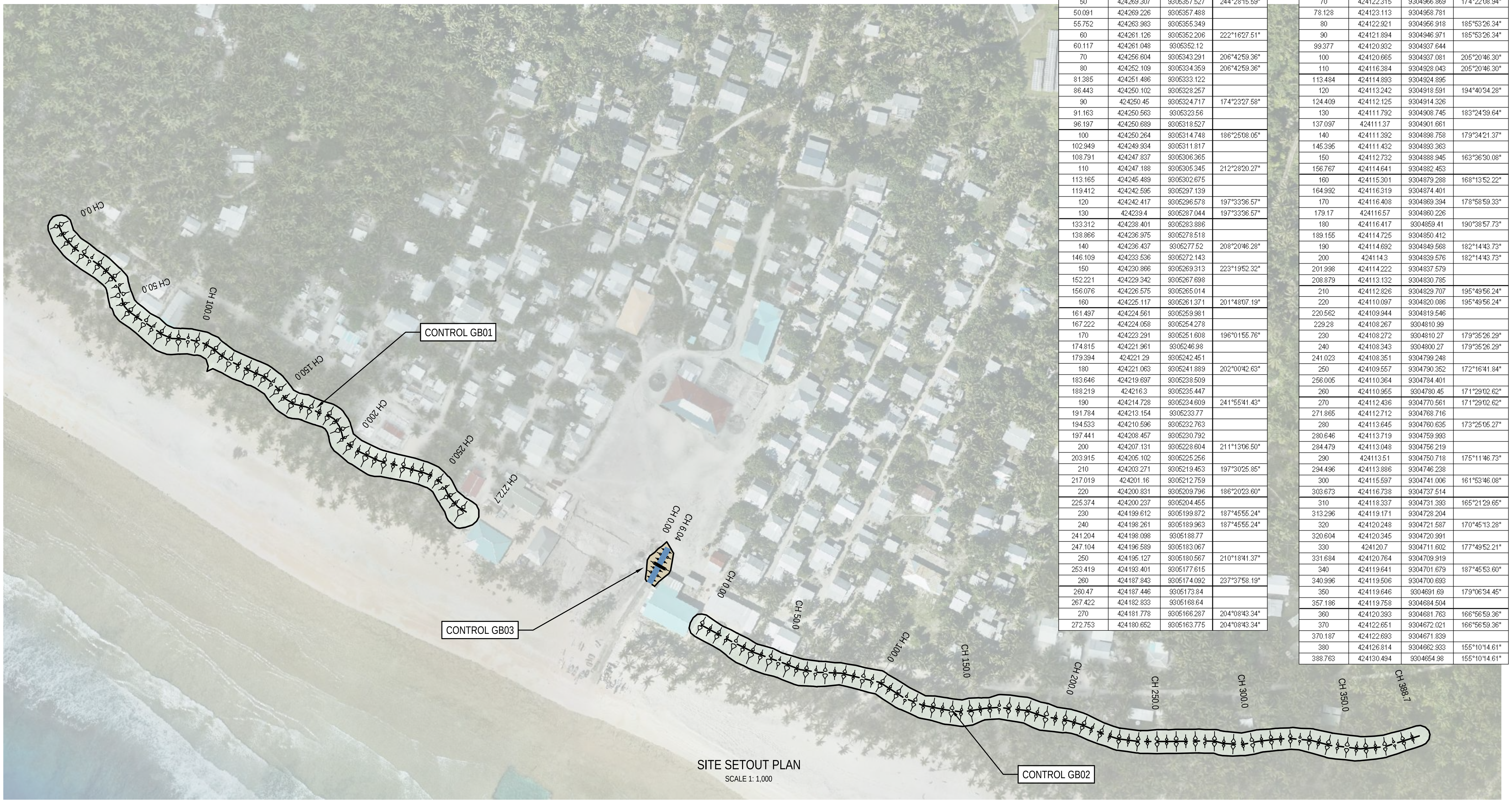
CHAINAGE	EASTING	NORTHING	RL	BEARING
0	424167.195	9305062.73	9.67	202°07'59.68"
6.042	424164.919	9305057.133	9.67	202°07'59.68"

CONTROL GB01

CHAINAGE	EASTING	NORTHING	BEARING
0	424300.847	9305394.561	237°55'05.70"
6.633	424295.227	9305391.038	
10	424293.036	9305388.482	220°36'04.34"
13.592	424290.698	9305385.754	
20	424287.705	9305380.088	207°50'34.46"
22.841	424286.379	9305377.576	
30	424283.259	9305371.132	205°49'44.56"
31.601	424282.562	9305369.692	
39.001	424278.284	9305363.653	
40	424277.595	9305362.93	223°38'49.12"
42.768	424275.684	9305360.927	
46.977	424272.036	9305358.83	
50	424269.307	9305357.527	244°28'15.59"
50.091	424269.226	9305357.488	
55.752	424263.983	9305355.349	
60	424261.126	9305352.206	222°16'27.51"
60.117	424261.048	9305352.12	
70	424256.604	9305343.291	206°42'59.36"
80	424252.109	9305334.359	206°42'59.36"
81.385	424251.486	9305333.122	
86.443	424250.102	9305328.257	
90	424250.45	9305324.717	174°23'27.58"
91.163	424250.563	9305323.56	
96.197	424250.689	9305318.527	
100	424250.264	9305314.748	186°25'08.05"
102.949	424249.934	9305311.817	
108.791	424247.837	9305306.365	
110	424247.188	9305305.345	212°28'20.27"
113.165	424245.489	9305302.675	
119.412	424242.595	9305297.139	
120	424242.417	9305296.578	197°33'36.57"
130	424239.4	9305287.044	197°33'36.57"
133.312	424238.401	9305283.886	
138.866	424236.975	9305278.518	
140	424236.437	9305277.52	208°20'46.28"
146.109	424233.536	9305272.143	
150	424230.866	9305269.313	223°19'52.32"
152.221	424229.342	9305267.698	
156.076	424226.575	9305265.014	
160	424225.117	9305261.371	201°48'07.19"
161.497	424224.561	9305259.981	
167.222	424224.058	9305254.278	
170	424223.291	9305251.608	196°01'55.76"
174.815	424221.961	9305246.98	
179.394	424221.29	9305242.451	
180	424221.063	9305241.889	202°00'42.63"
183.646	424219.697	9305238.509	
188.219	424216.3	9305235.447	
190	424214.728	9305234.609	241°55'41.43"
191.784	424213.154	9305233.77	
194.533	424210.596	9305232.763	
197.441	424208.457	9305230.792	
200	424207.131	9305228.604	211°13'06.50"
203.915	424205.102	9305225.256	
210	424203.271	9305219.453	197°30'25.85"
217.019	424201.16	9305212.759	
220	424200.831	9305209.796	186°20'23.60"
225.374	424200.237	9305204.455	
230	424199.612	9305199.872	187°45'55.24"
240	424198.261	9305189.963	187°45'55.24"
241.204	424198.098	9305188.77	
247.104	424196.589	9305183.067	
250	424195.127	9305180.567	210°18'41.37"
253.419	424193.401	9305177.615	
260	424187.843	9305174.092	237°37'58.19"
260.47	424187.446	9305173.84	
267.422	424182.833	9305168.64	
270	424181.778	9305166.287	204°08'43.34"
272.753	424180.652	9305163.775	204°08'43.34"

CONTROL GB02

CHAINAGE	EASTING	NORTHING	BEARING
0	424138.389	9305034.345	200°47'31.36"
10	424134.839	9305024.996	200°47'31.36"
18.697	424131.752	9305016.865	
20	424131.333	9305015.632	198°44'40.80"
30	424128.12	9305006.162	198°44'40.80"
30.965	424127.81	9305005.248	
40	424125.91	9304996.415	192°08'12.88"
46.923	424124.455	9304989.647	
50	424123.733	9304986.656	193°34'13.08"
56.932	424122.106	9304979.918	
60	424122.051	9304976.85	181°02'30.87"
66.16	424121.939	9304970.691	
70	424122.315	9304966.869	174°22'08.94"
78.128	424123.113	9304958.781	
80	424122.921	9304956.918	185°53'26.34"
90	424121.894	9304946.971	185°53'26.34"
99.377	424120.932	9304937.644	
100	424120.665	9304937.081	205°20'46.30"
110	424116.384	9304928.043	205°20'46.30"
113.484	424114.893	9304924.895	
120	424113.242	9304918.591	194°40'34.28"
124.409	424112.125	9304914.326	
130	424111.792	9304908.745	183°24'39.64"
137.097	424111.37	9304901.661	
140	424111.392	9304898.758	179°34'21.37"
145.395	424111.432	9304893.363	
150	424112.732	9304888.945	163°36'30.08"
156.767	424114.641	9304882.453	
160	424115.301	9304879.288	168°13'52.22"
164.992	424116.319	9304874.401	
170	424116.408	9304869.394	178°58'59.33"
179.17	424116.57	9304860.226	
180	424116.417	9304859.41	190°38'57.73"
189.155	424114.725	9304850.412	
190	424114.692	9304849.568	182°14'43.73"
200	424114.3	9304839.576	182°14'43.73"
201.998	424114.222	9304837.579	
208.879	424113.132	9304830.785	
210	424112.826	9304829.707	195°49'56.24"
220	424110.097	9304820.086	195°49'56.24"
220.562	424109.944	9304819.546	
229.28	424108.267	9304810.99	
230	424108.272	9304810.27	179°35'26.29"
240	424108.343	9304800.27	179°35'26.29"
241.023	424108.351	9304799.248	
250	424109.557	9304790.352	172°16'41.84"
256.005	424110.364	9304784.401	
260	424110.955	9304780.45	171°29'02.62"
270	424112.436	9304770.561	171°29'02.62"
271.865	424112.712	9304768.716	
280	424113.645	9304760.635	173°25'05.27"
280.646	424113.719	9304759.993	
284.479	424113.048	9304756.219	
290	424113.51	9304750.718	175°11'46.73"
294.496	424113.886	9304746.238	
300	424115.597	9304741.006	161°53'46.08"
303.673	424116.738	9304737.514	
310	424118.337	9304731.393	165°21'29.65"
313.296	424119.171	9304728.204	
320	424120.248	9304721.587	170°45'13.28"
320.604	424120.345	9304720.991	
330	424120.7	9304711.602	177°49'52.21"
331.684	424120.764	9304709.919	
340	424119.641	9304701.679	187°45'53.60"
340.996	424119.506	9304700.693	
350	424119.646	9304691.69	179°06'34.45"
357.186	424119.758	9304684.504	
360	424120.393	9304681.763	166°56'59.36"
370	424122.651	9304672.021	166°56'59.36"
370.187	424122.693	9304671.839	
380	424126.814	9304662.933	155°10'14.61"
388.763	424130.494	9304654.98	155°10'14.61"



SITE SETOUT PLAN
SCALE 1: 1,000

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
bluecoast CONSULTING ENGINEERS
1/1874 Gold Coast Highway
Burleigh Heads
QLD, 4220. Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
SITE SETOUT PLAN

DRG NO.
P19012-AG-CV-04-01

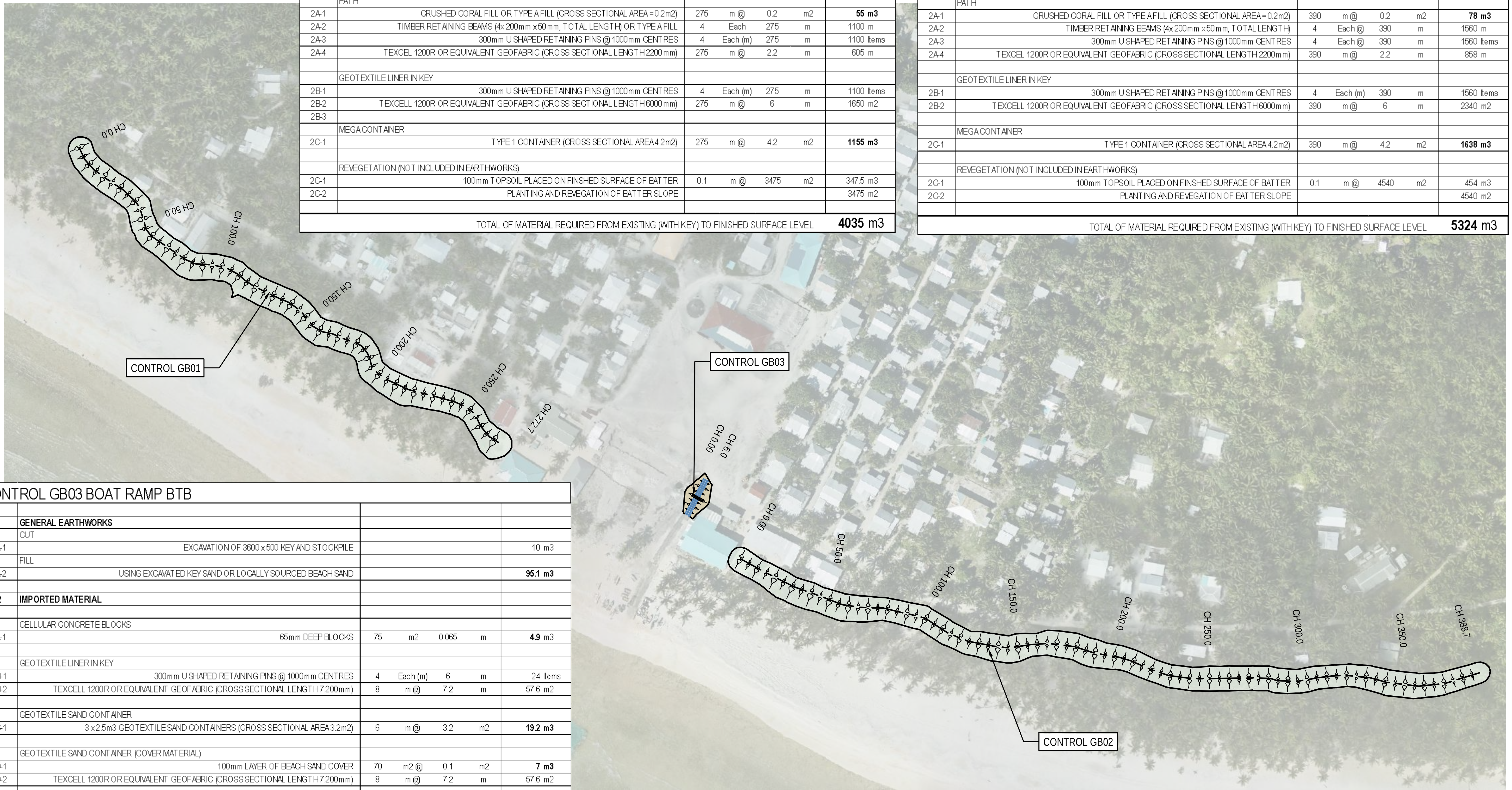
REV.
A

CONTROL GB01 NORTHERN BTB

1	**GENERAL EARTHWORKS**					
	CUT					
1A-1	EXCAVATION OF 2500 x 500 KEY AND STOCKPILE					370 m3
	FILL					
1A-2	USING EXCAVATED KEY SAND OR LOCALLY SOURCED BEACH SAND					**2825 m3**
2	**IMPORTED MATERIAL**					
	PATH					
2A-1	CRUSHED CORAL FILL OR TYPE A FILL (CROSS SECTIONAL AREA = 0.2m2)	275	m @	0.2	m2	**55 m3**
2A-2	TIMBER RETAINING BEAMS (4x 200mm x 50mm, TOTAL LENGTH) OR TYPE A FILL	4	Each	275	m	1100 m
2A-3	300mm U SHAPED RETAINING PINS @ 1000mm CENTRES	4	Each (m)	275	m	1100 Items
2A-4	TEXCEL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 2200mm)	275	m @	2.2	m	605 m
	GEOTEXTILE LINER IN KEY					
2B-1	300mm U SHAPED RETAINING PINS @ 1000mm CENTRES	4	Each (m)	275	m	1100 Items
2B-2	TEXCELL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 6000mm)	275	m @	6	m	1650 m2
2B-3						
	MEGA CONTAINER					
2C-1	TYPE 1 CONTAINER (CROSS SECTIONAL AREA 4.2m2)	275	m @	4.2	m2	**1155 m3**
	REVEGETATION (NOT INCLUDED IN EARTHWORKS)					
2C-1	100mm TOPSOIL PLACED ON FINSHED SURFACE OF BATTER	0.1	m @	3475	m2	347.5 m3
2C-2	PLANTING AND REVEGATION OF BATTER SLOPE					3475 m2
	TOTAL OF MATERIAL REQUIRED FROM EXISTING (WITH KEY) TO FINISHED SURFACE LEVEL					**4035** m3

CONTROL GB02 SOUTHERN BTB

1	**GENERAL EARTHWORKS**					
	CUT					
1A-1	EXCAVATION OF 2500 x 500 KEY AND STOCKPILE					525 m3
	FILL					
1A-2	USING EXCAVATED KEY SAND OR LOCALLY SOURCED BEACH SAND					**3608 m3**
2	**IMPORTED MATERIAL**					
	PATH					
2A-1	CRUSHED CORAL FILL OR TYPE A FILL (CROSS SECTIONAL AREA = 0.2m2)	390	m @	0.2	m2	**78 m3**
2A-2	TIMBER RETAINING BEAMS (4x 200mm x 50mm, TOTAL LENGTH)	4	Each @	390	m	1560 m
2A-3	300mm U SHAPED RETAINING PINS @ 1000mm CENTRES	4	Each @	390	m	1560 Items
2A-4	TEXCEL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 2200mm)	390	m @	2.2	m	858 m
	GEOTEXTILE LINER IN KEY					
2B-1	300mm U SHAPED RETAINING PINS @ 1000mm CENTRES	4	Each (m)	390	m	1560 Items
2B-2	TEXCELL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 6000mm)	390	m @	6	m	2340 m2
	MEGA CONTAINER					
2C-1	TYPE 1 CONTAINER (CROSS SECTIONAL AREA 4.2m2)	390	m @	4.2	m2	**1638 m3**
	REVEGETATION (NOT INCLUDED IN EARTHWORKS)					
2C-1	100mm TOPSOIL PLACED ON FINSHED SURFACE OF BATTER	0.1	m @	4540	m2	454 m3
2C-2	PLANTING AND REVEGATION OF BATTER SLOPE					4540 m2
	TOTAL OF MATERIAL REQUIRED FROM EXISTING (WITH KEY) TO FINISHED SURFACE LEVEL					**5324** m3



CONTROL GB03 BOAT RAMP BTB

1	**GENERAL EARTHWORKS**					
	CUT					
1A-1	EXCAVATION OF 3600 x 500 KEY AND STOCKPILE					10 m3
	FILL					
1A-2	USING EXCAVATED KEY SAND OR LOCALLY SOURCED BEACH SAND					**95.1 m3**
2	**IMPORTED MATERIAL**					
	CELLULAR CONCRETE BLOCKS					
2A-1	65mm DEEP BLOCKS	75	m2	0.065	m	**4.9** m3
	GEOTEXTILE LINER IN KEY					
2B-1	300mm U SHAPED RETAINING PINS @ 1000mm CENTRES	4	Each (m)	6	m	24 Items
2B-2	TEXCELL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 7.200mm)	8	m @	7.2	m	57.6 m2
	GEOTEXTILE SAND CONTAINER					
2C-1	3 x 2.5m3 GEOTEXTILE SAND CONTAINERS (CROSS SECTIONAL AREA 3.2m2)	6	m @	3.2	m2	**19.2 m3**
	GEOTEXTILE SAND CONTAINER (COVER MATERIAL)					
2D-1	100mm LAYER OF BEACH SAND COVER	70	m2 @	0.1	m2	**7 m3**
2D-2	TEXCELL 1200R OR EQUIVALENT GEOFABRIC (CROSS SECTIONAL LENGTH 7.200mm)	8	m @	7.2	m	57.6 m2
	REVEGETATION (NOT INCLUDED IN EARTHWORKS)					
2E-1	100mm TOPSOIL PLACED ON FINSHED SURFACE OF BATTER	0.1	m @	157	m2	15.7 m3
2E-2	PLANTING AND REVEGATION OF BATTER SLOPE					157 m2
	TOTAL OF MATERIAL REQUIRED FROM EXISTING (WITH KEY) TO FINISHED SURFACE LEVEL					**126.2** m3

SITE VOLUMES PLAN

SCALE 1: 1,000

NOTE:

1. ALL VOLUMES ARE IN-SITU CUBIC METRES
2. NO ALLOWANCE HAS BEEN MADE FOR STRIPPED SURFACE.

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
bluecoast CONSULTING ENGINEERS
1/1874 Gold Coast Highway
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www.bluecoastconsulting.com.au

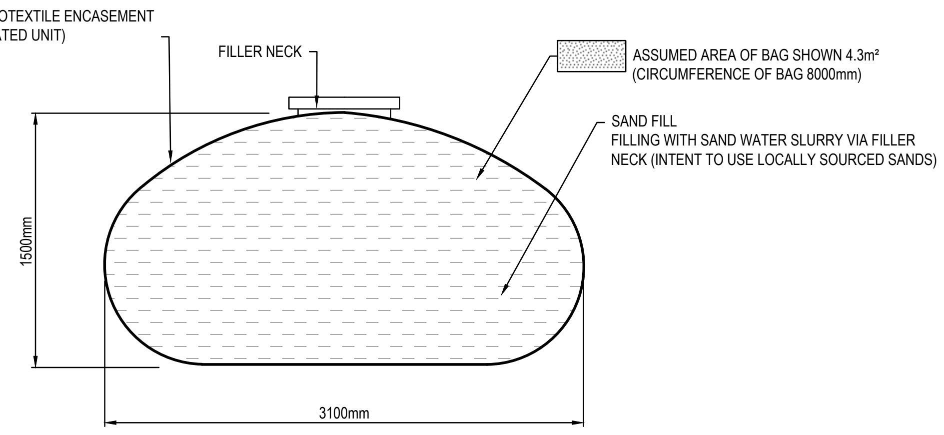
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
EARTHWORK VOLUME MOVEMENT PLAN

DRG NO. P19012-AG-CV-05-01

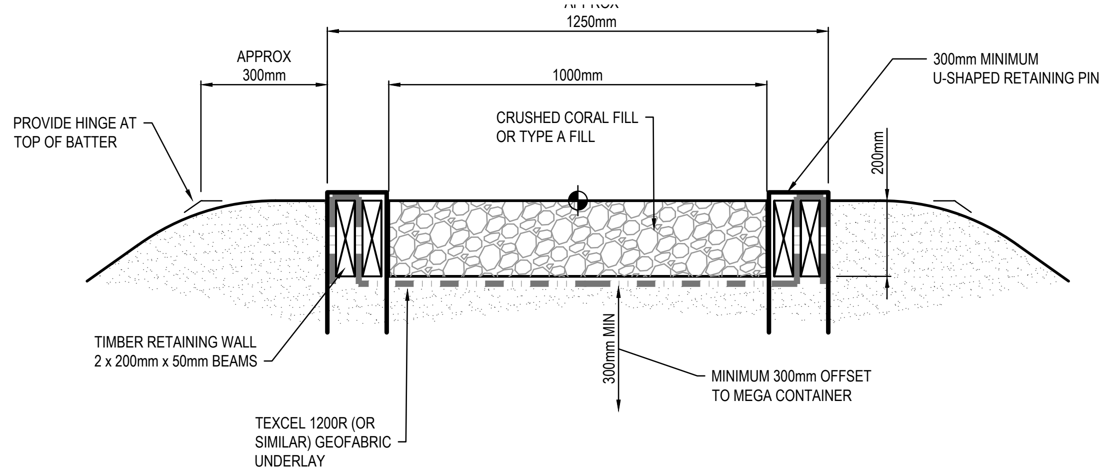
REV. A



NOTE: LENGTH OF MEGA BAG 20.0m

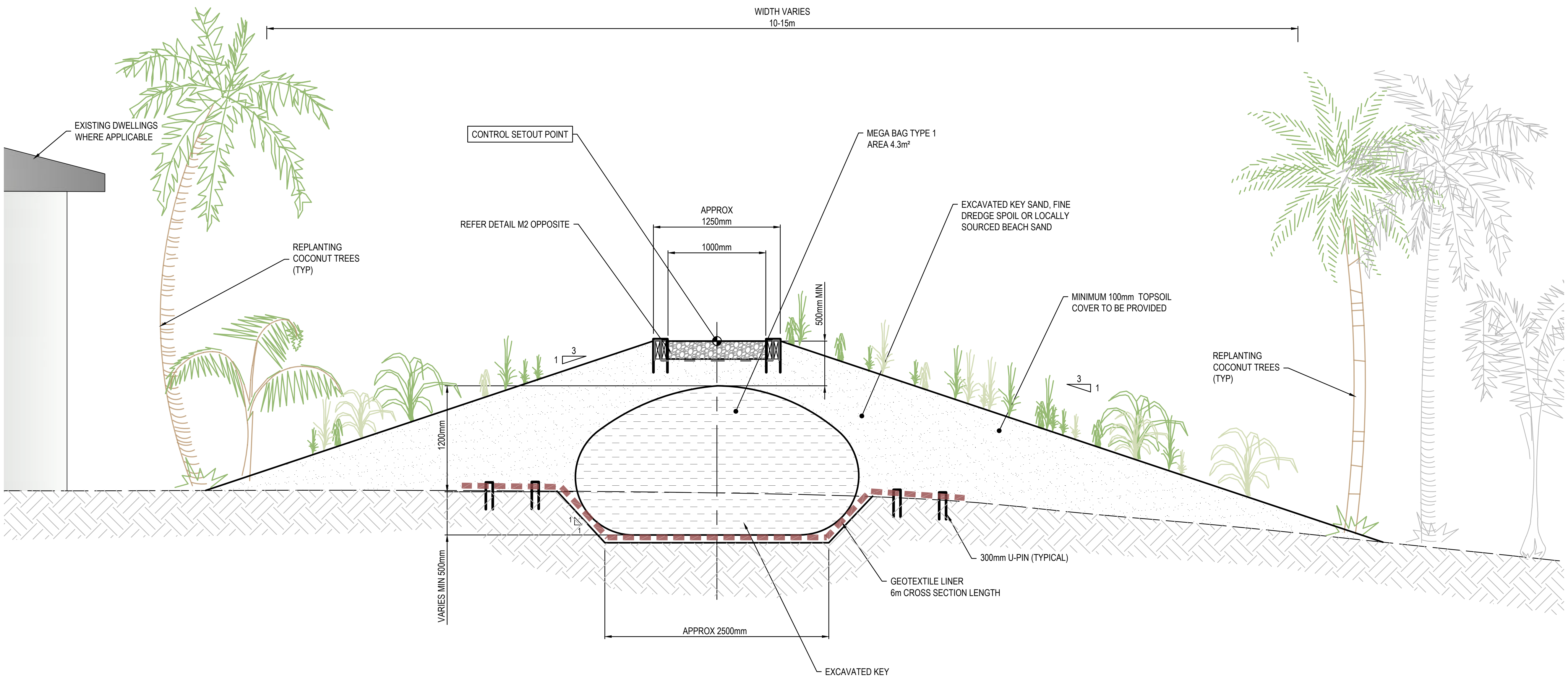
OPTION 2 - SAND (MEGA BAG) CONTAINER (TYPE T1) M3 -

SCALE 1:20



CRUSHED CORAL FOOTPATH M2 -

SCALE 1:10



BERM TOP BARRIER (BTB) GEOTEXTILE MEGA CONTAINER M1 -

SCALE 1:25

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY	JL
DRAWN BY	MLC
CHECKED BY	JL
APPROVED	AW

REFERENCES
SURVEY PROVIDED BY
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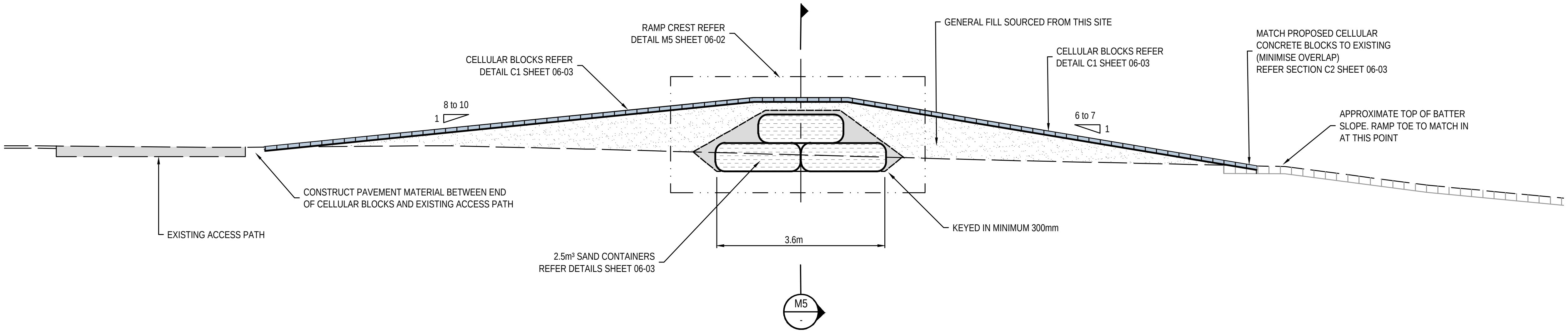
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
TYPICAL SECTION AND DETAILS SHEET 1

DRG NO
P19012-AG-CV-06-01

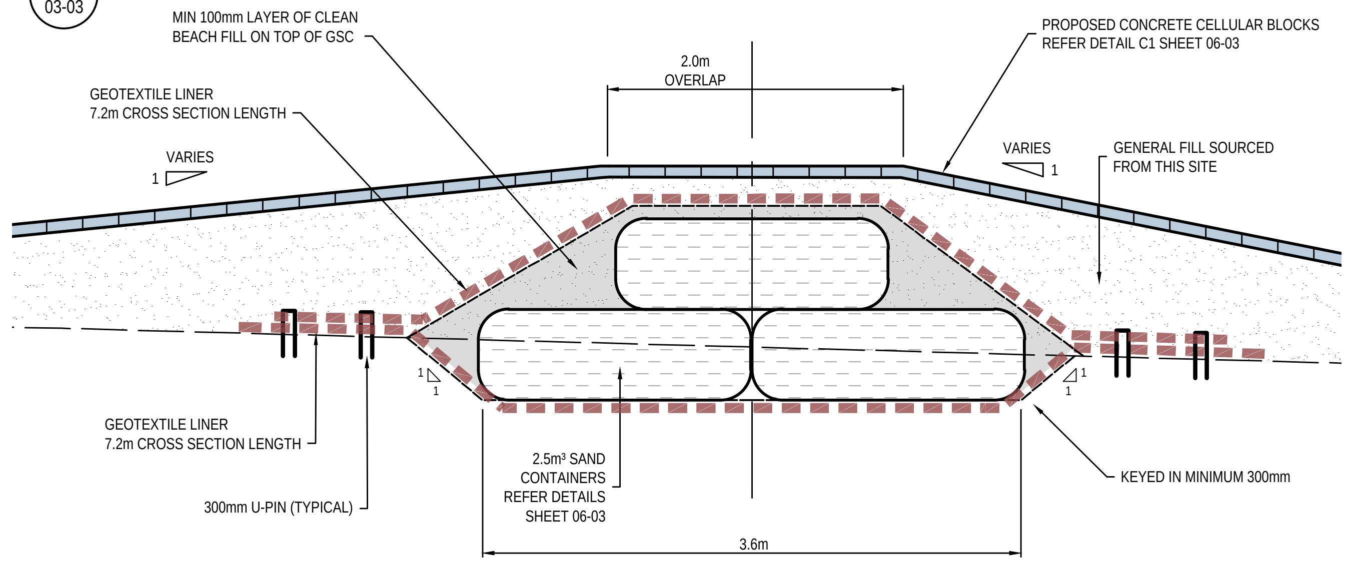
REV
A



VILLAGE CENTRE - TYPICL LOANGITUDINAL SECTION CELLULAR RAMP

M4 03-03

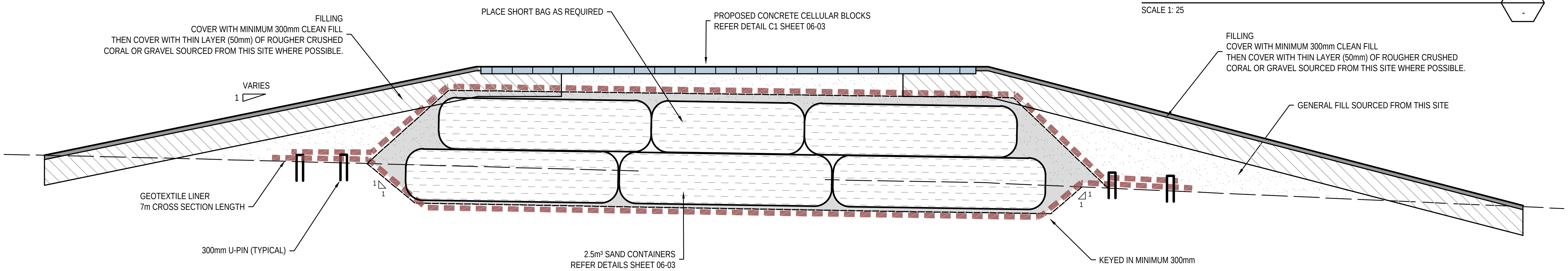
SCALE 1: 50



VILLAGE CENTRE - RAMP CREST DETAIL

M5 -

SCALE 1: 25



VILLAGE CENTRE - SECTION CELLULAR RAMP

M6 03-03

SCALE 1: 25

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 0.25 0.5 0.75 1.0 1.25m — SCALE 1:25 AT ORIGINAL SIZE

0 0.5 1.0 1.5 2.0 2.5m — SCALE 1:50 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

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GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT — TCAP

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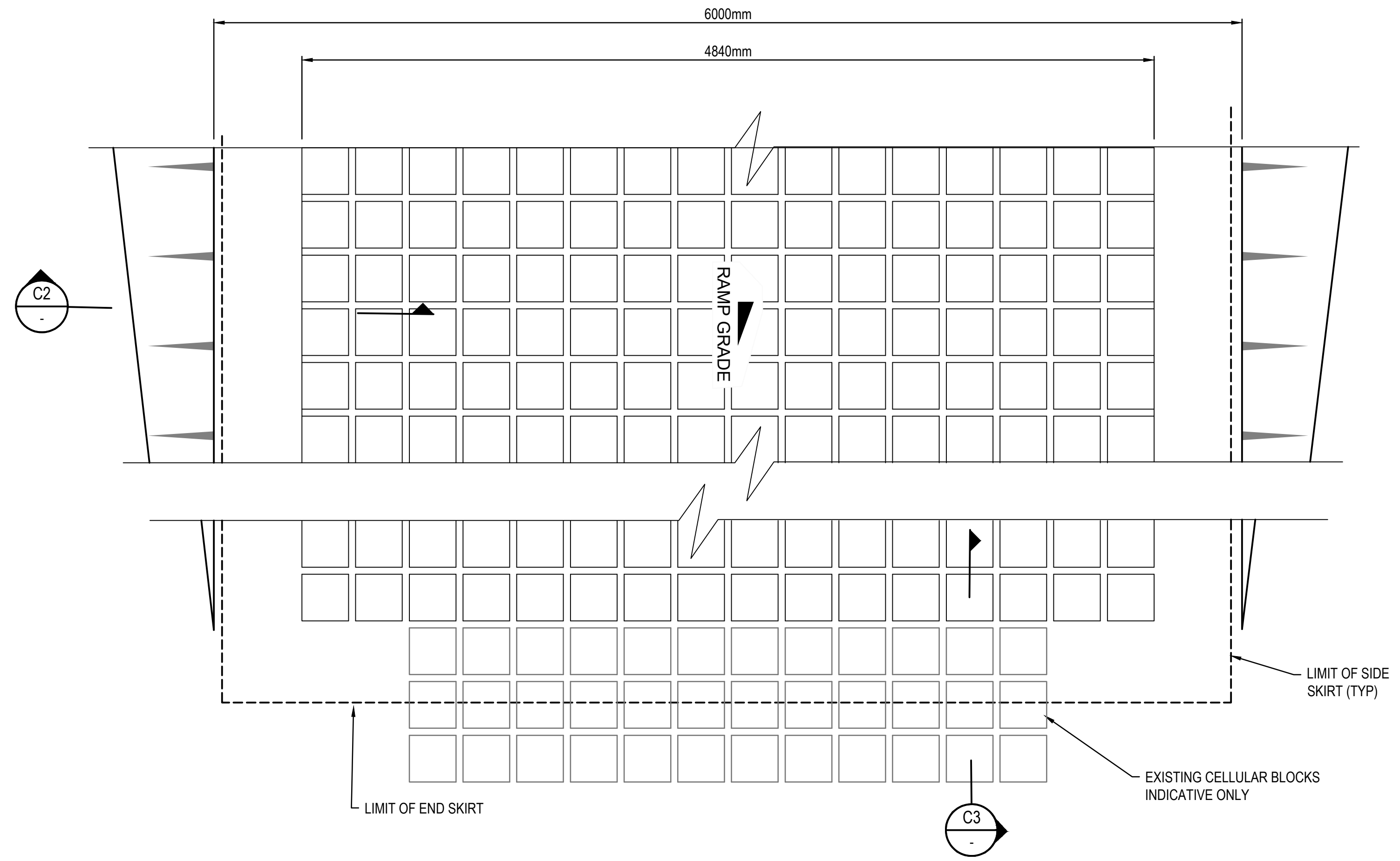
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
TYPICAL SECTION AND DETAILS SHEET 2

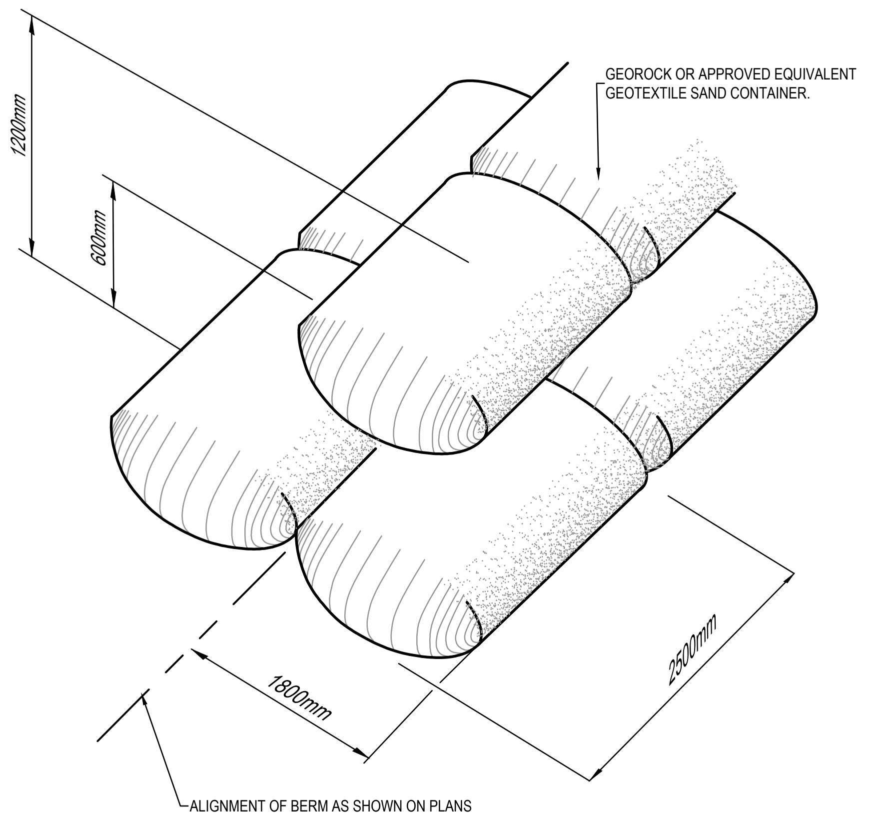
DRG NO.
P19012-AG-06-02

REV.
A



CELLULAR BLOCK PLAN LAYOUT

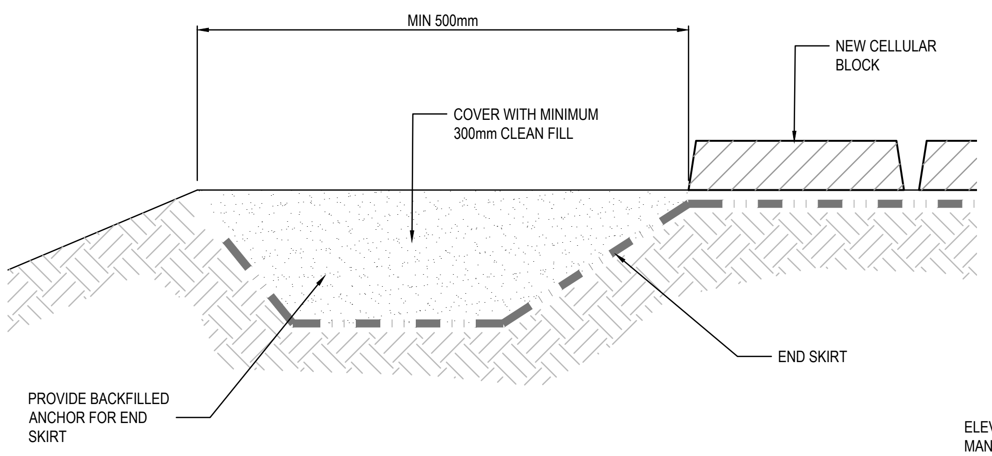
SCALE 1:20



GEOTEXTILE SAND CONTAINER PLACEMENT

M8 / -

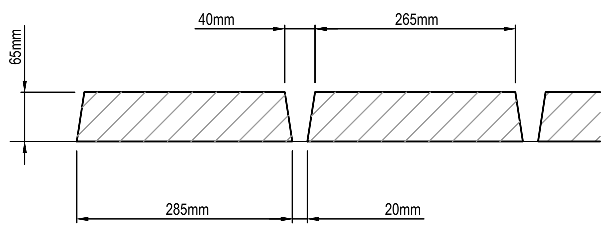
NOTE TO SCALE



CELLULAR RAMP SECTION - EDGE DETAIL

C2 / -

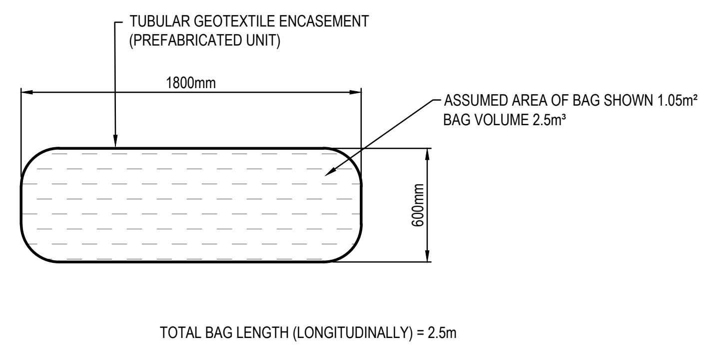
SCALE 1: 5



CELLULAR RAMP - BLOCK DETAIL

C1 / -

SCALE 1: 5



GEOTEXTILE SAND CONTAINER DETAIL

M7 / -

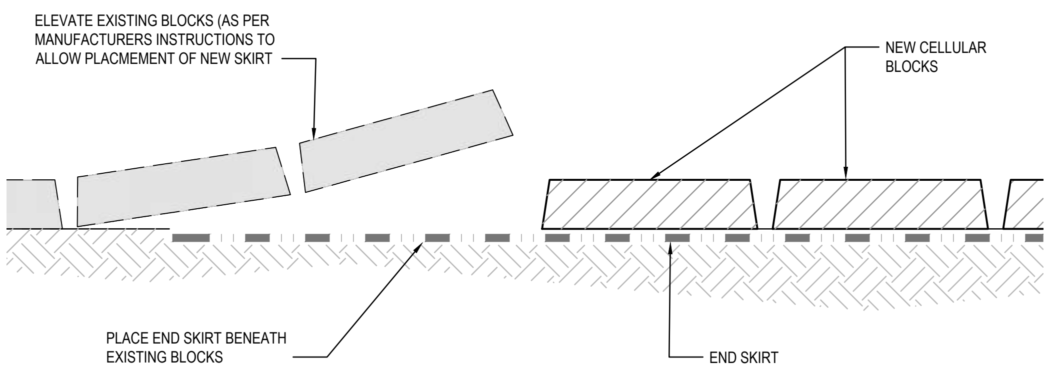
SCALE 1:20

CELLULAR MATTRESS DETAILS

FLEXMAT FM40 (OR APPROVED EQUIVALENT)

- LANDWARD SLOPE: 1V:8H, 10.0m LONG x 5.90m WIDE
- CREST: 3.0m LONG x 5.90m WIDE
- SEAWARD SLOPE: 1V:6H, 8.5m LONG x 5.90m WIDE
- TRANSVERSE ROW OF (SHORT) PINS: 1 PIN EVERY 3rd BLOCK AT EACH END OF EACH SECTION.
- LONGITUDINAL ROW OF (SHORT) PINS (EACH SIDE OF MAT): 4 PINS FOR SEAWARD AND LANDWARD SLOPE SECTIONS, 2 PINS FOR RAMP CREST.

GENERALLY THE SUPPLY AND INSTALLATION OF THE 'FLEXMAT' SHALL BE AS PER THE MANUFACTURERS (MARECON) "INFORMATION DOCUMENT FOR ONSHORE AND COASTAL APPLICATIONS'. REFER ALSO TO NOTES SHEET 02-01.



CELLULAR RAMP SECTION - MATCH TO EXISTING BLOCKS

C3 / -

SCALE 1: 5

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

SCALE 1:20 AT ORIGINAL SIZE (0 0.2 0.4 0.6 0.8 1.0m)

SCALE 1:5 AT ORIGINAL SIZE (0 0.05 0.1 0.15 0.2 0.25m)

DESIGNED BY: JL
DRAWN BY: MLC
CHECKED BY: JL
APPROVED: AW

REFERENCES

SURVEY PROVIDED BY

HORIZONTAL DATUM: UTM-WGS84 / UTSM60S EPSG32760

VERTICAL DATUM: CHART DATUM (CD) TGZ

PLANS PREPARED FOR: UNDP — Empowered lives. Resilient nations. GREEN CLIMATE FUND

PLANS PREPARED BY: bluecoast CONSULTING ENGINEERS

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+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT: TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER: P19012

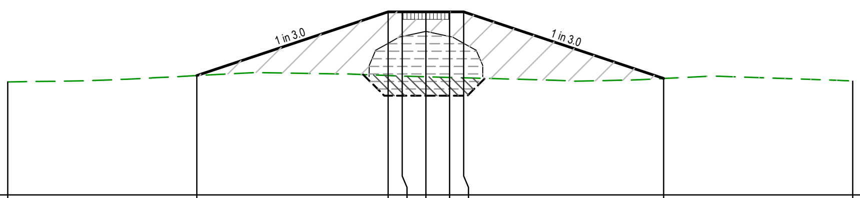
DRAWING TITLE: TYPICAL SECTION AND DETAILS SHEET 3

DRG NO: P19012-AG-06-03

REV: A

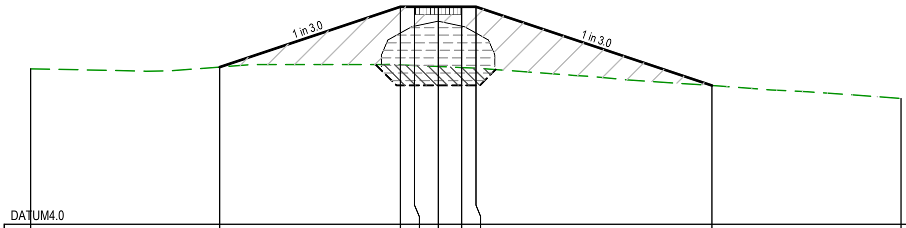
LEGEND

- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



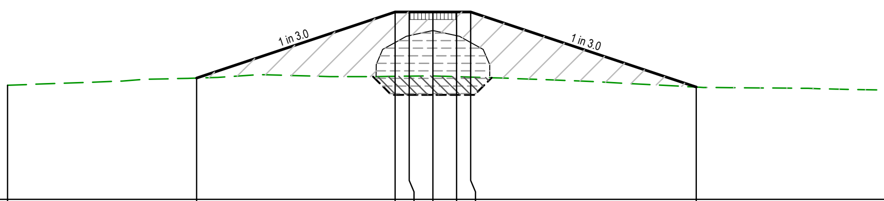
CHANNEL FD01		8.16	9.84	9.84	9.84	9.84	9.84	8.08	
EXISTING SURFACE	7.99	8.16	8.16	8.14	8.13	8.11	8.10	8.08	8.01
OFFSET (-LHS/+RHS)	-11.06	-6.06	-1.00	-0.62	0.00	0.62	1.00	6.29	11.29

CH 40



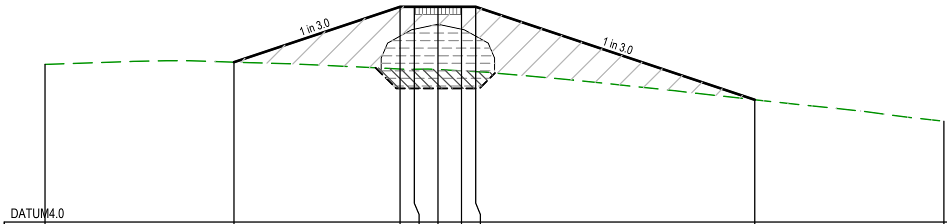
	8.16	9.75	9.75	9.75	9.75	9.75	7.67	
8.11	8.16	8.21	8.20	8.17	8.14	8.13	7.67	7.33
-10.78	-5.78	-1.00	-0.63	0.00	0.63	1.00	7.24	12.24

CH 100



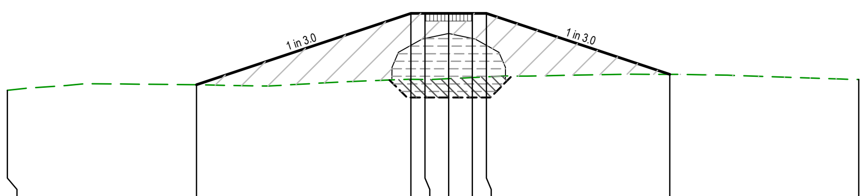
CHANNEL FD01		8.21	9.96	9.96	9.96	9.96	9.96	7.97	
EXISTING SURFACE	8.02	8.21	8.26	8.26	8.27	8.25	8.24	7.97	7.89
OFFSET (-LHS/+RHS)	-11.25	-6.25	-1.00	-0.62	0.00	0.62	1.00	6.96	11.96

CH 20



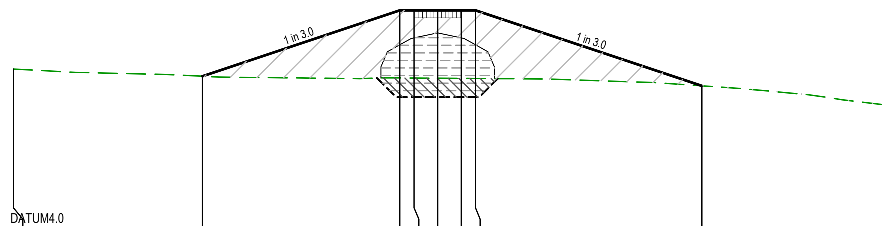
	8.23	9.70	9.70	9.70	9.70	9.70	7.23	
8.17	8.23	8.05	8.04	8.03	8.00	7.98	7.23	6.67
-10.40	-5.40	-1.00	-0.63	0.00	0.63	1.00	8.39	13.39

CH 80



CHANNEL FD01		7.98	9.87	9.87	9.87	9.87	9.87	8.25	
EXISTING SURFACE	7.83	7.98	8.12	8.12	8.14	8.17	8.19	8.25	8.12
OFFSET (-LHS/+RHS)	-11.67	-6.67	-1.00	-0.62	0.00	0.62	1.00	5.85	10.85

CH 0



	7.98	9.72	9.72	9.72	9.72	9.72	7.73	
8.17	7.98	7.94	7.93	7.93	7.92	7.92	7.73	7.20
-11.23	-6.23	-1.00	-0.62	0.00	0.62	1.00	6.99	11.99

CH 60

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY	JL
DRAWN BY	MLC
CHECKED BY	JL
APPROVED	AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
bluecoast CONSULTING ENGINEERS
1/1874 Gold Coast Highway
Burleigh Heads
QLD, 4220. Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

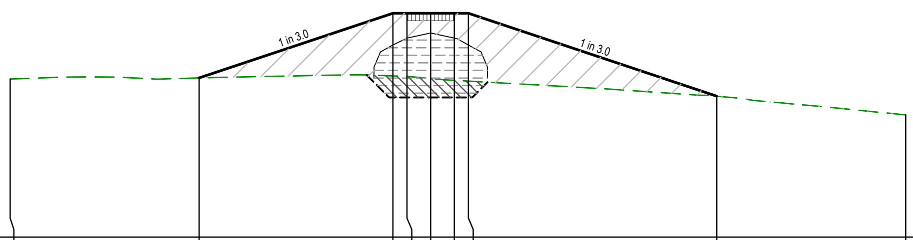
DRAWING TITLE
CONTROL GB01
SITE CROSS SECTIONS
SHEET 1

DRG NO
P19012-AG-CV-07-01

REV
A

LEGEND

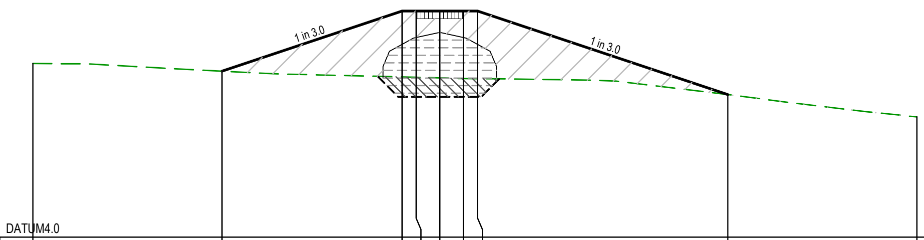
- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



DATUM4.0

CHANNEL FD01		8.20	9.91	9.91	9.91	9.91	9.91	7.72	
EXISTING SURFACE	8.17	8.20	8.26	8.24	8.19	8.14	8.12	7.72	7.23
OFFSET (-LHS/+RHS)	-11.13	-6.13	-1.00	-0.63	0.00	0.63	1.00	7.57	12.57

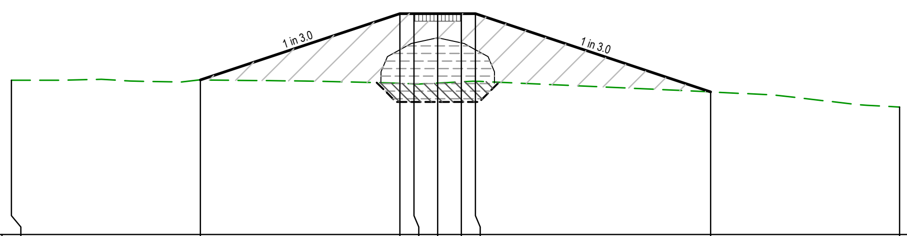
CH 160



DATUM4.0

		8.38	9.97	9.97	9.97	9.97	9.97	7.76	
	8.58	8.38	8.23	8.22	8.20	8.18	8.18	7.76	7.17
	-10.76	-5.76	-1.00	-0.62	0.00	0.62	1.00	7.62	12.62

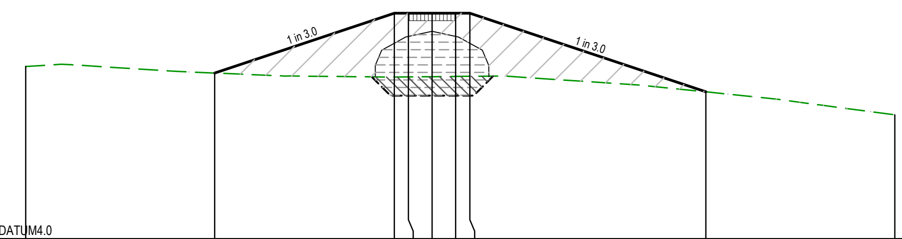
CH 220



DATUM4.0

CHANNEL FD01		8.10	9.86	9.86	9.86	9.86	9.86	7.78	
EXISTING SURFACE	8.09	8.10	8.01	7.99	8.01	8.05	8.06	7.78	7.38
OFFSET (-LHS/+RHS)	-11.28	-6.28	-1.00	-0.63	0.00	0.63	1.00	7.22	12.22

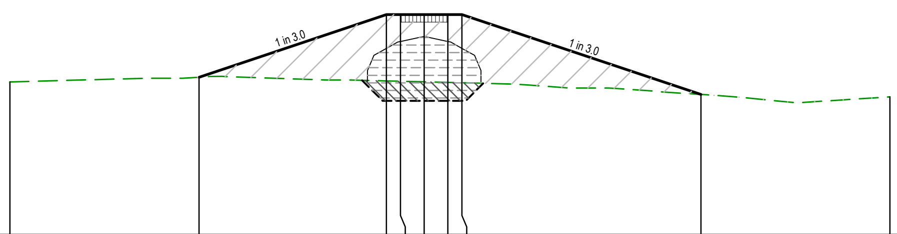
CH 140



DATUM4.0

		8.38	9.97	9.97	9.97	9.97	9.97	7.89	
	8.56	8.38	8.28	8.28	8.29	8.29	8.30	7.89	7.28
	-10.75	-5.75	-1.00	-0.63	0.00	0.63	1.00	7.24	12.24

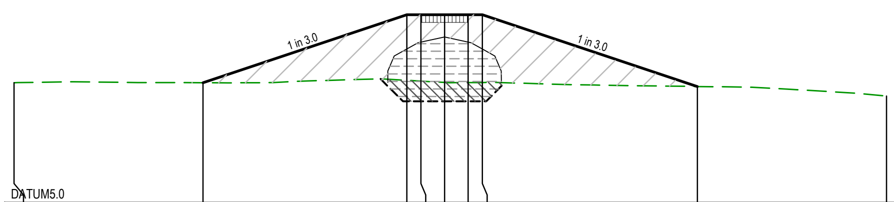
CH 200



DATUM4.0

CHANNEL FD01		8.15	9.80	9.80	9.80	9.80	9.80	7.70	
EXISTING SURFACE	8.03	8.15	8.05	8.04	8.03	8.01	8.00	7.70	7.63
OFFSET (-LHS/+RHS)	-10.96	-5.96	-1.00	-0.63	0.00	0.63	1.00	7.32	12.32

CH 120



DATUM5.0

		8.17	9.96	9.96	9.96	9.96	9.96	8.07	
	8.17	8.17	8.23	8.21	8.17	8.17	8.17	8.07	7.81
	-11.39	-6.39	-1.00	-0.63	0.00	0.63	1.00	6.69	11.69

CH 180

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY	JL
DRAWN BY	MLC
CHECKED BY	JL
APPROVED	AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
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GREEN CLIMATE FUND
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PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

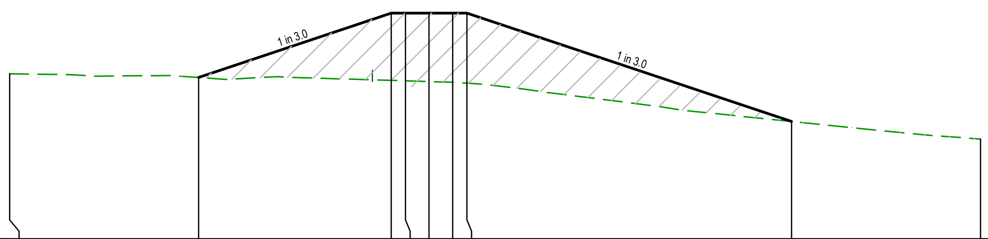
DRAWING TITLE
CONTROL GB01
SITE CROSS SECTIONS
SHEET 2

DRG NO.
P19012-AG-CV-07-02

REV
A

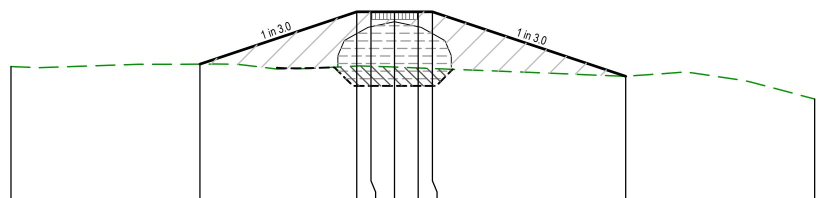
LEGEND

- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



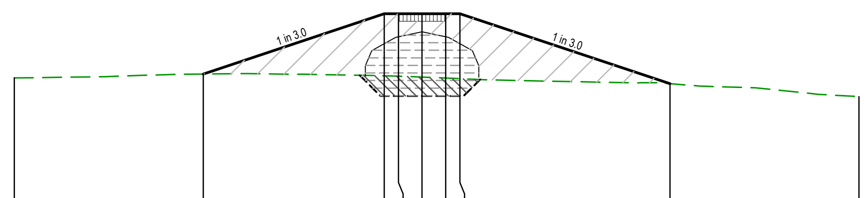
CHANNEL FD01		8.27	9.97	9.97	9.97	9.97	9.97	7.10	
EXISTING SURFACE	8.37	8.27	8.19	8.18	8.16	8.14	8.12	7.10	6.64
OFFSET (-LHS/+RHS)	-11.10	-6.10	-1.00	-0.63	0.00	0.63	1.00	9.59	14.59

CH 273



CHANNEL FD01		8.58	9.97	9.97	9.97	9.97	9.97	8.26	
EXISTING SURFACE	8.52	8.58	8.53	8.53	8.51	8.48	8.47	8.26	7.66
OFFSET (-LHS/+RHS)	-10.15	-5.15	-1.00	-0.62	0.00	0.62	1.00	6.12	11.12

CH 260



CHANNEL FD01		8.37	9.97	9.97	9.97	9.97	9.97	8.11	
EXISTING SURFACE	8.27	8.37	8.32	8.31	8.29	8.26	8.25	8.11	7.77
OFFSET (-LHS/+RHS)	-10.79	-5.79	-1.00	-0.63	0.00	0.63	1.00	6.56	11.56

CH 240

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

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GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
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Burleigh Heads
QLD, 4220, Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

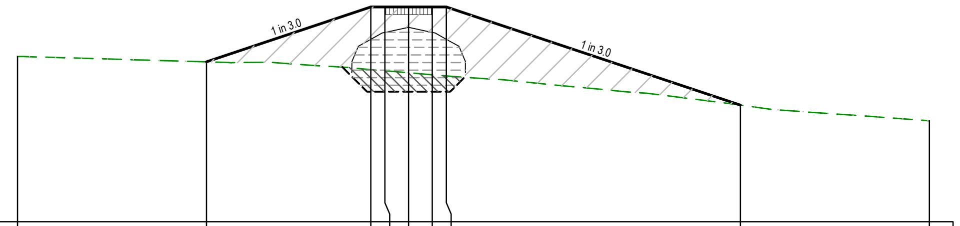
DRAWING TITLE
CONTROL GB01
SITE CROSS SECTIONS
SHEET 3

DRG NO
P19012-AG-CV-07-03

REV
A

LEGEND

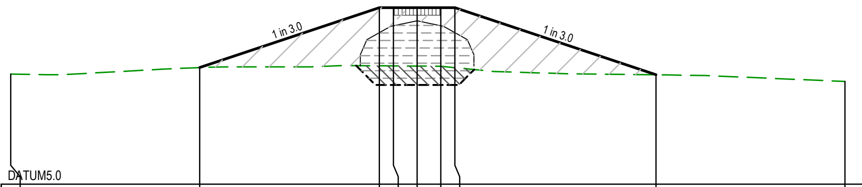
- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



DATUM4.0

CHANNEL FD01		8.22	9.67	9.67	9.67	9.67	9.67	7.07	
EXISTING SURFACE	8.36	8.22	8.01	7.98	7.93	7.88	7.85	7.07	6.66
OFFSET (-LHS/+RHS)	-10.35	-5.35	-1.00	-0.62	0.00	0.62	1.00	8.78	13.78

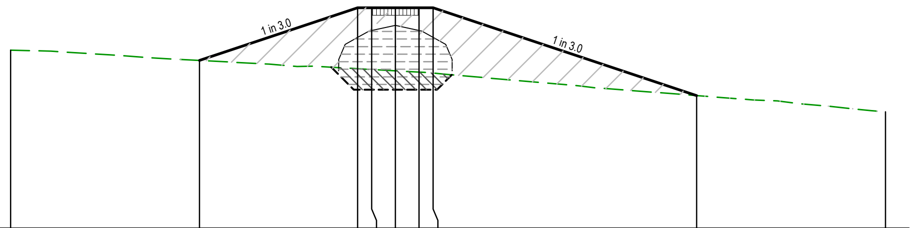
CH 40



DATUM5.0

		8.08	9.67	9.67	9.67	9.67	9.67	7.89	
	7.91	8.08	8.13	8.13	8.12	8.12	8.08	7.89	7.72
	-10.75	-5.75	-1.00	-0.63	0.00	0.63	1.00	6.32	11.32

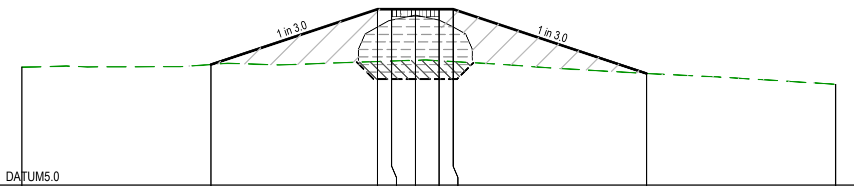
CH 100



DATUM4.0

CHANNEL FD01		8.43	9.83	9.83	9.83	9.83	9.83	7.50	
EXISTING SURFACE	8.71	8.43	8.22	8.20	8.16	8.12	8.10	7.50	7.07
OFFSET (-LHS/+RHS)	-10.19	-5.19	-1.00	-0.63	0.00	0.63	1.00	7.97	12.97

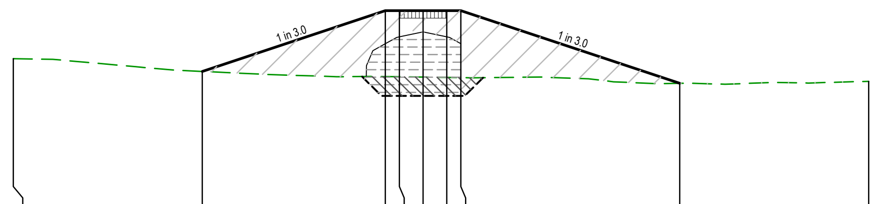
CH 20



DATUM5.0

		8.20	9.67	9.67	9.67	9.67	9.67	7.96	
	8.13	8.20	8.28	8.29	8.31	8.30	8.28	7.96	7.67
	-10.40	-5.40	-1.00	-0.63	0.00	0.63	1.00	6.11	11.11

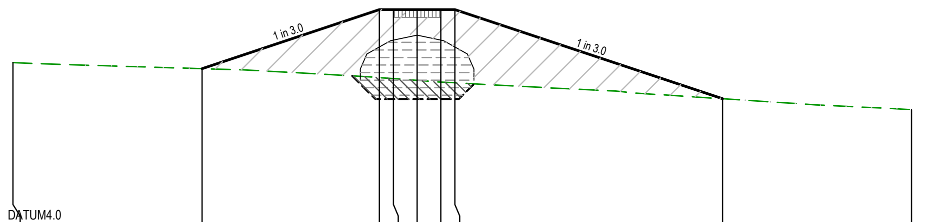
CH 80



DATUM5.0

CHANNEL FD01		8.55	10.17	10.17	10.17	10.17	10.17	8.24	
EXISTING SURFACE	8.89	8.55	8.42	8.41	8.40	8.39	8.39	8.24	8.29
OFFSET (-LHS/+RHS)	-10.84	-5.84	-1.00	-0.62	0.00	0.62	1.00	6.79	11.79

CH 0



DATUM4.0

		8.10	9.67	9.67	9.67	9.67	9.67	7.31	
	8.26	8.10	7.87	7.84	7.79	7.75	7.73	7.31	7.02
	-10.69	-5.69	-1.00	-0.63	0.00	0.63	1.00	8.08	13.08

CH 60

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m SCALE 1:100 AT ORIGINAL SIZE
0 0.25 0.5 0.75 1.0 1.25m SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
bluecoast CONSULTING ENGINEERS
1/1874 Gold Coast Highway
Burleigh Heads
QLD, 4220, Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

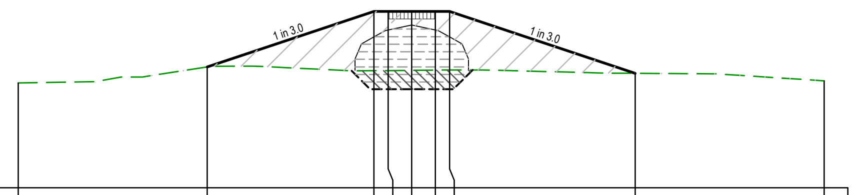
DRAWING TITLE
CONTROL GB02
SITE CROSS SECTIONS
SHEET 1

DRG NO
P19012-AG-CV-07-04

REV
A

LEGEND

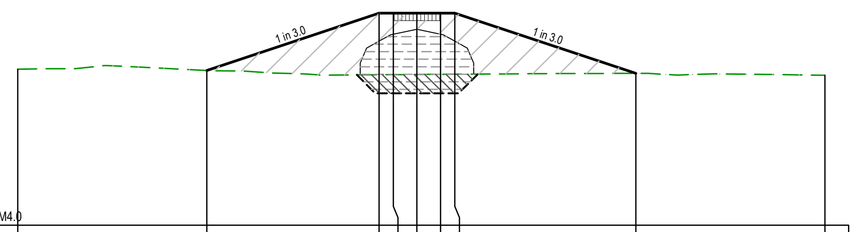
- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



DATUM5.0

CHANNEL FD01		8.20	9.67	9.67	9.67	9.67	9.67	8.03	
EXISTING SURFACE	7.78	8.20	8.10	8.10	8.11	8.11	8.12	8.03	7.83
OFFSET (-LHS/+RHS)	-10.41	-5.41	-1.00	-0.63	0.00	0.63	1.00	5.91	10.91

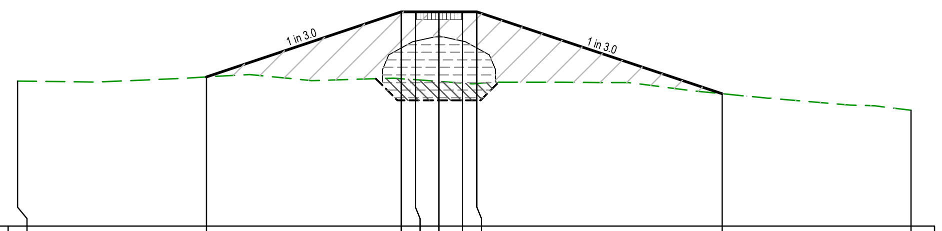
CH 160



DATUM4.0

		8.10	9.62	9.62	9.62	9.62	9.62	8.02	
	8.13	8.10	7.99	7.99	7.99	8.00	8.00	8.02	7.97
	-10.56	-5.56	-1.00	-0.63	0.00	0.63	1.00	5.79	10.79

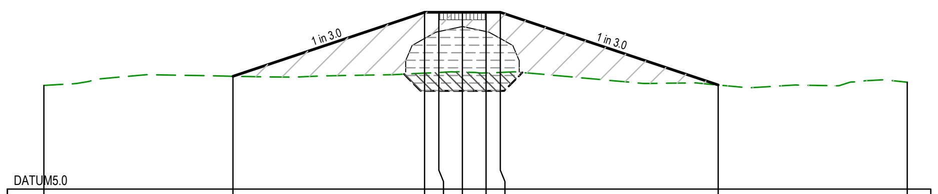
CH 220



DATUM4.0

CHANNEL FD01		7.95	9.67	9.67	9.67	9.67	9.67	7.50	
EXISTING SURFACE	7.84	7.95	7.90	7.88	7.83	7.78	7.77	7.50	7.06
OFFSET (-LHS/+RHS)	-11.16	-6.16	-1.00	-0.62	0.00	0.62	1.00	7.49	12.49

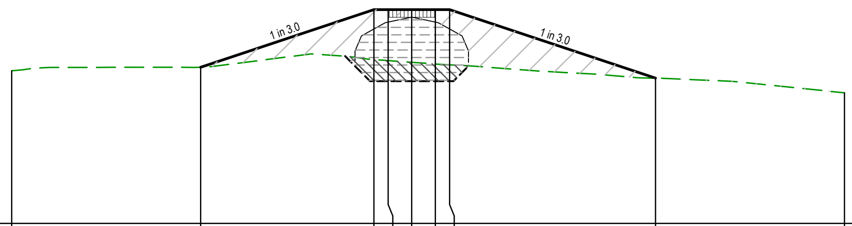
CH 140



DATUM5.0

		7.98	9.67	9.67	9.67	9.67	9.67	7.75	
	7.74	7.98	8.06	8.08	8.09	8.07	8.08	7.75	7.82
	-11.07	-6.07	-1.00	-0.62	0.00	0.62	1.00	6.76	11.76

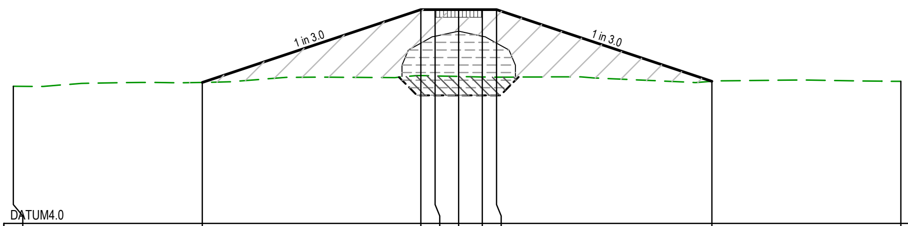
CH 200



DATUM4.0

CHANNEL FD01		8.14	9.67	9.67	9.67	9.67	9.67	7.85	
EXISTING SURFACE	8.05	8.14	8.34	8.32	8.27	8.23	8.21	7.85	7.46
OFFSET (-LHS/+RHS)	-10.59	-5.59	-1.00	-0.62	0.00	0.62	1.00	6.45	11.45

CH 120



DATUM4.0

		7.74	9.67	9.67	9.67	9.67	9.67	7.77	
	7.64	7.74	7.92	7.91	7.90	7.88	7.88	7.77	7.77
	-11.79	-6.79	-1.00	-0.63	0.00	0.63	1.00	6.70	11.70

CH 180

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

SCALE 1:100 AT ORIGINAL SIZE (0 1 2 3 4 5m)

SCALE 1:25 AT ORIGINAL SIZE (0 0.25 0.5 0.75 1.0 1.25m)

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

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GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

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QLD, 4220, Australia
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www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

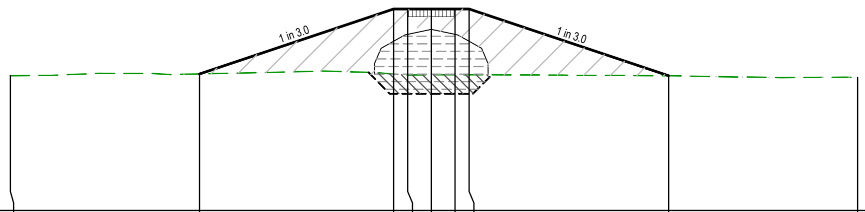
DRAWING TITLE
CONTROL GB02
SITE CROSS SECTIONS
SHEET 2

DRG NO
P19012-AG-CV-07-05

REV
A

LEGEND

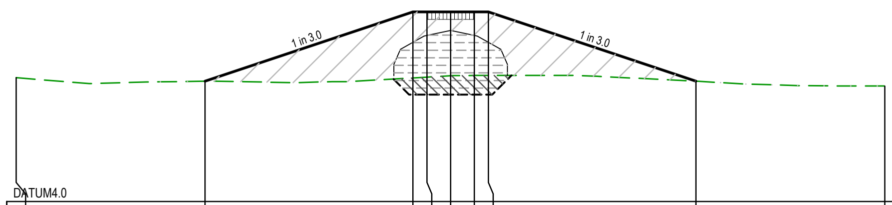
- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



DATUM4.0

CHANNEL FD01		7.61	9.32	9.32	9.32	9.32	9.32	7.56	
EXISTING SURFACE	7.56	7.61	7.60	7.58	7.58	7.58	7.58	7.56	7.51
OFFSET (-LHS/+RHS)	-11.14	-6.14	-1.00	-0.62	0.00	0.62	1.00	6.28	11.28

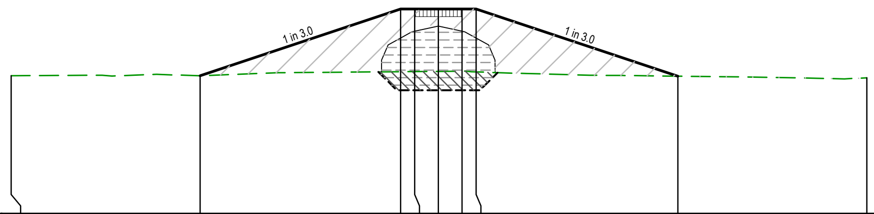
CH 280



DATUM4.0

CHANNEL FD01		7.18	9.01	9.01	9.01	9.01	9.01	7.18	
EXISTING SURFACE	7.27	7.18	7.27	7.29	7.33	7.33	7.33	7.18	7.05
OFFSET (-LHS/+RHS)	-11.50	-6.50	-1.00	-0.62	0.00	0.62	1.00	6.50	11.50

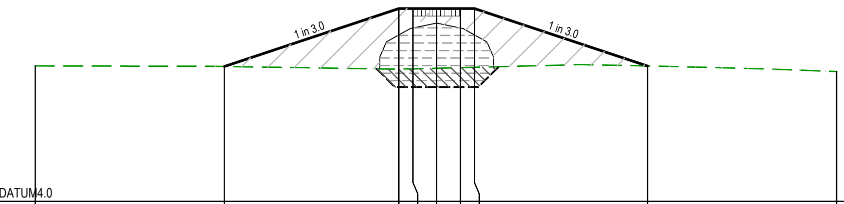
CH 340



DATUM4.0

CHANNEL FD01		7.65	9.42	9.42	9.42	9.42	9.42	7.64	
EXISTING SURFACE	7.65	7.65	7.76	7.76	7.77	7.77	7.75	7.64	7.59
OFFSET (-LHS/+RHS)	-11.30	-6.30	-1.00	-0.63	0.00	0.63	1.00	6.34	11.34

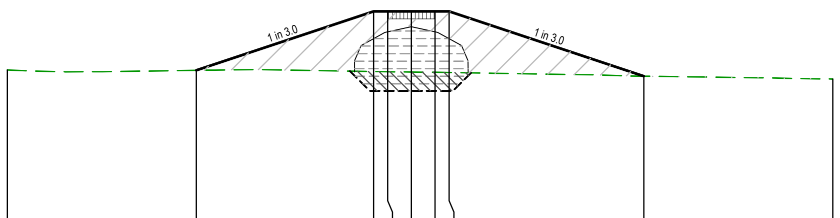
CH 260



DATUM4.0

CHANNEL FD01		7.58	9.12	9.12	9.12	9.12	9.12	7.59	
EXISTING SURFACE	7.59	7.58	7.51	7.51	7.53	7.55	7.55	7.59	7.44
OFFSET (-LHS/+RHS)	-10.61	-5.61	-1.00	-0.63	0.00	0.63	1.00	5.58	10.58

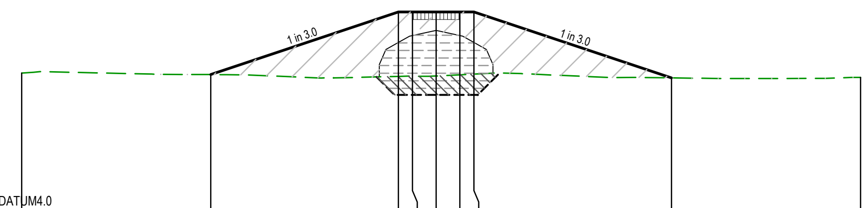
CH 320



DATUM4.0

CHANNEL FD01		7.96	9.52	9.52	9.52	9.52	9.52	7.80	
EXISTING SURFACE	7.96	7.96	7.93	7.92	7.91	7.91	7.90	7.80	7.73
OFFSET (-LHS/+RHS)	-10.69	-5.69	-1.00	-0.63	0.00	0.63	1.00	6.15	11.15

CH 240



DATUM4.0

CHANNEL FD01		7.56	9.22	9.22	9.22	9.22	9.22	7.48	
EXISTING SURFACE	7.60	7.56	7.51	7.52	7.53	7.56	7.58	7.48	7.49
OFFSET (-LHS/+RHS)	-10.96	-5.96	-1.00	-0.63	0.00	0.63	1.00	6.22	11.22

CH 300

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m SCALE 1:100 AT ORIGINAL SIZE
0 0.25 0.5 0.75 1.0 1.25m SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

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PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

PLANS PREPARED BY:
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1/1874 Gold Coast Highway
Burleigh Heads
QLD, 4220, Australia
+61 (0) 412 393 703
www.bluecoastconsulting.com.au

PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

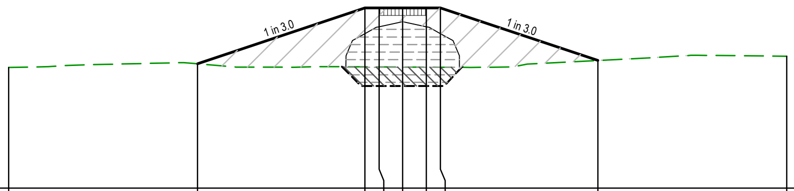
DRAWING TITLE
CONTROL GB02
SITE CROSS SECTIONS
SHEET 3

DRG NO
P19012-AG-CV-07-06

REV
A

LEGEND

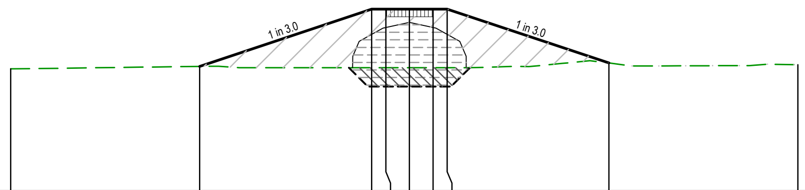
- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- MEGA CONTAINER
- EXCAVATION FOR KEY



DATUM4.0

CHANNEL FD01		7.29	8.77	8.77	8.77	8.77	8.77	7.38	
EXISTING SURFACE	7.19	7.29	7.21	7.21	7.20	7.20	7.20	7.38	7.49
OFFSET (-LHS/+RHS)	-10.43	-5.43	-1.00	-0.62	0.00	0.62	1.00	5.17	10.17

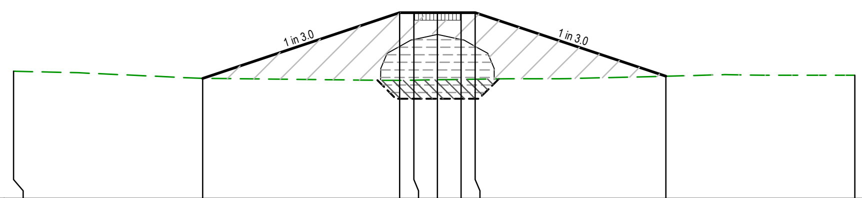
CH 389



DATUM4.0

CHANNEL FD01		7.30	8.81	8.81	8.81	8.81	8.81	7.39	
EXISTING SURFACE	7.23	7.30	7.26	7.26	7.26	7.26	7.26	7.39	7.34
OFFSET (-LHS/+RHS)	-10.55	-5.55	-1.00	-0.62	0.00	0.62	1.00	5.28	10.28

CH 380



DATUM4.0

CHANNEL FD01		7.18	8.91	8.91	8.91	8.91	8.91	7.23	
EXISTING SURFACE	7.36	7.18	7.12	7.13	7.14	7.15	7.15	7.23	7.26
OFFSET (-LHS/+RHS)	-11.21	-6.21	-1.00	-0.63	0.00	0.63	1.00	6.04	11.04

CH 360

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m SCALE 1:100 AT ORIGINAL SIZE
0 0.25 0.5 0.75 1.0 1.25m SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY JL
DRAWN BY MLC
CHECKED BY JL
APPROVED AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
UNDP Empowered lives. Resilient nations.
GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

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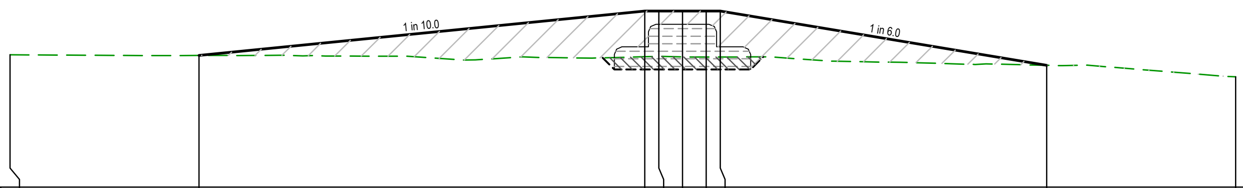
PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
CONTROL GB02
SITE CROSS SECTIONS
SHEET 4

DRG NO
P19012-AG-CV-07-07

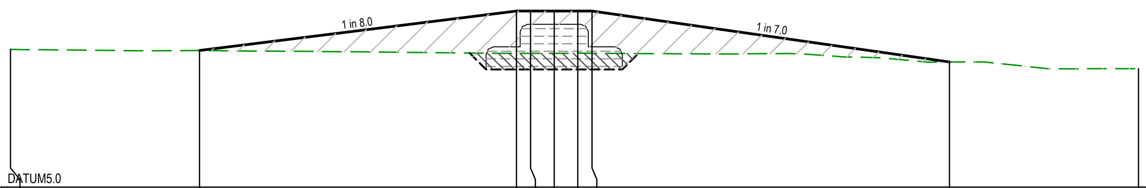
REV
A



DATUM5.0

CHANNEL FD01		8.49	9.67	9.67	9.67	9.67	9.67	8.23	
EXISTING SURFACE	8.51	8.49	8.46	8.46	8.45	8.45	8.45	8.23	7.92
OFFSET (-LHS/+RHS)	-17.79	-12.79	-1.00	-0.62	0.00	0.62	1.00	9.64	14.64

CH 0



DATUM5.0

		8.62	9.67	9.67	9.67	9.67	9.67	8.32	
	8.65	8.62	8.55	8.55	8.55	8.55	8.55	8.32	8.14
	-14.38	-9.38	-1.00	-0.62	0.00	0.62	1.00	10.45	15.45

CH 6

LEGEND

- EXISTING SURFACE
- DESIGN FSL
- EXCAVATION FOR KEY
- PATHWAY
- FILLING
- SAND CONTAINER
- EXCAVATION FOR KEY

REV	DATE	DESCRIPTION	BY	APP'D	REVIEWED
A	XX	ISSUED FOR	MLC	AW	JL

UNFINISHED DRAWING

0 1 2 3 4 5m
SCALE 1:100 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

DESIGNED BY	JL
DRAWN BY	MLC
CHECKED BY	JL
APPROVED	AW

REFERENCES
SURVEY PROVIDED BY
HORIZONTAL DATUM
UTM-WGS84 / UTSM60S EPSG32760
VERTICAL DATUM
CHART DATUM (CD) TGZ

PLANS PREPARED FOR:
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GREEN CLIMATE FUND
TUVALU COASTAL ADAPTATION PROJECT TCAP

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PROJECT
TUVALU COASTAL ADAPTATION PROJECT (TCAP), NANUMAGA

PROJECT NUMBER
P19012

DRAWING TITLE
CONTROL GB03
SITE CROSS SECTIONS
SHEET 1

DRG NO
P19012-AG-CV-07-08

REV
A