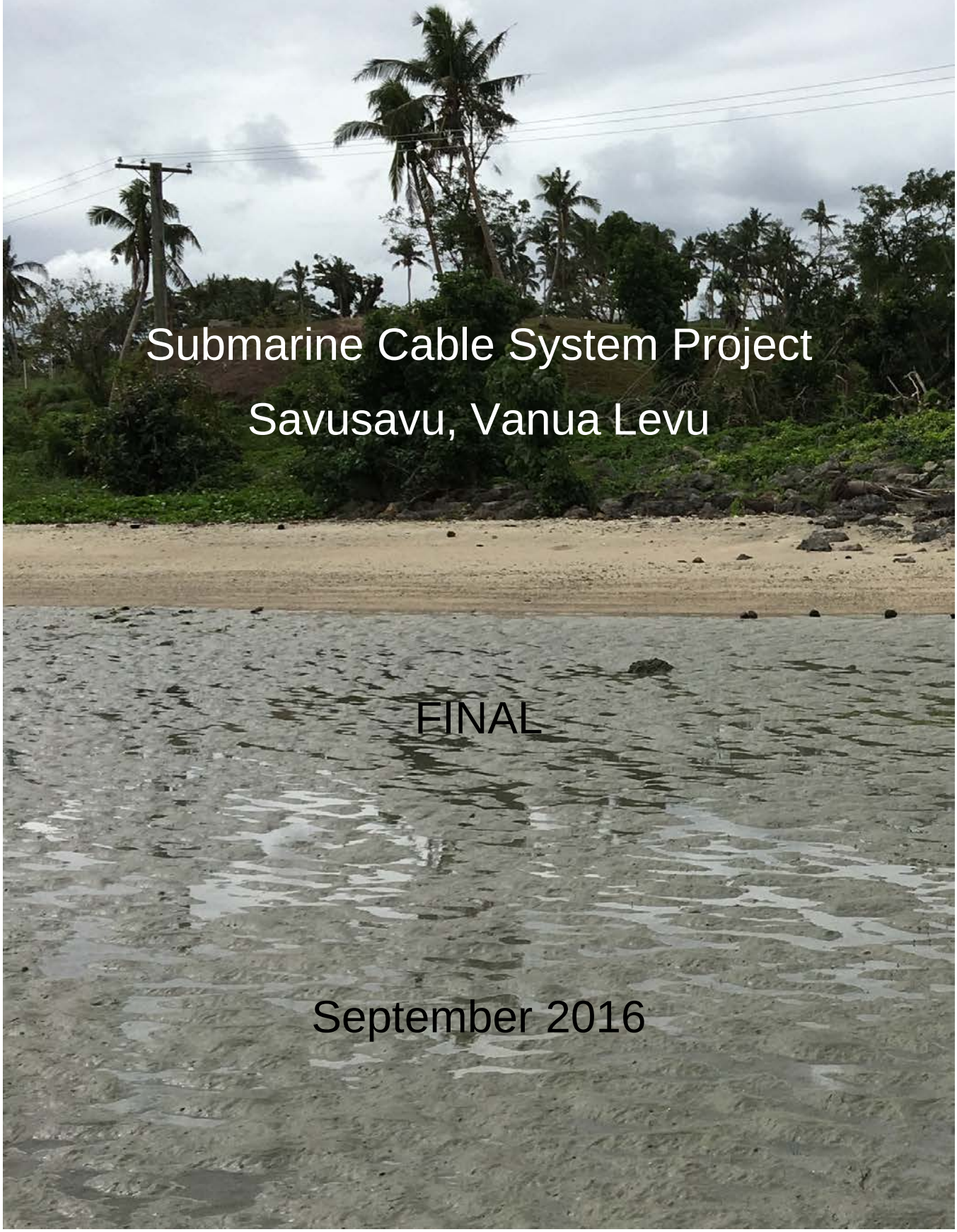
SFG2501

Environmental & Social Impact Assessment

Submarine Cable System Project

Savusavu, Vanua Levu



FINAL

September 2016

EXCEUTIVE SUMMARY

The Government of Fiji plans to invest in a submarine cable system to connect Vanua Levu at Savusavu, with the proposed Fiji (Viti Levu)-Samoa cable. An Initial Environmental Examination (IEE) for the Fiji-Samoa Connectivity Project has been undertaken which assessed the environmental and social issues that may arise from an SCS development and provided mitigation and management plans prepared in accordance with Fiji legislation and WB safeguard policies.

This Environmental and Social Impact Assessment (ESIA) identifies issues associated with the Vanua Levu extension to the proposed Fiji (Viti Levu)-Samoa cable and focuses on the coastal zone and near-shore marine area at several locations in Savusavu. The potential impacts associated with those in deeper waters have been identified and addressed in the IEE.

Analysis of potential beach manhole locations, cable corridors and cable landing stations has determined a preferred option (BMH1 – located towards the southern end of Savusavu Airport) which will assist with minimising any potential environmental or social impacts. In this location, the terrestrial ecology is limited and the intertidal marine resources have been impacted by natural activities. In addition, the land is state owned, no additional acquisition of private or iTaukei land is required and there will be no displacement of tenants or other land uses, and no assets or livelihoods will be affected.

Management and monitoring plans are outlined in addition to a grievance redress mechanism.

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1 Introduction

1.1 Background

The Government of Fiji (GoF), plans to invest in a submarine cable system (SCS) to connect Vanua Levu at Savusavu, with the proposed Fiji (Viti Levu)-Samoa cable. This will ensure that Fiji's second largest island has the same standard of Information and Communications Technology (ICT) access as Viti Levu. The GoF has approached the World Bank (WB) for funding support for Savusavu Branch Project (the Project).

An Initial Environmental Examination (IEE)[1] for the Fiji-Samoa Connectivity Project has been undertaken which assessed the environmental and social issues arising from an SCS development and presents mitigation and management plans prepared in accordance with Fiji legislation and WB safeguard policies. This report identifies issues associated with the Vanua Levu extension to the proposed Fiji (Viti Levu)-Samoa cable.

The Ministry of Communications (MoC) will take the lead during project preparation and execution and will be responsible for implementation as the Implementing Entity (IE). The Ministry of Economy are the formal Borrower of Project funds, and take overall responsibility for financial management; however, MoC (through a Project Management Unit (PMU) that will be established and staffed) will be required to prepare payment-related documentation, financial reports, and arrange audits. The MoC will take leadership of works contracting and management toward establishment of the cable and its connection to the networks of the operators in Vanua Levu.

The PMU will work closely with the Samoa Submarine Cable Company and their Technical Coordinator (TC) regarding the management of the cable laying company (CLC) who will be laying the Savusavu branch at the same time as the Fiji (Viti-Levu) – Samoa Cable.

As the project approaches 'Ready for Service' the MoC will negotiate the transfer to private ownership of the cable system so that the cable may be accessed by operators immediately upon its being ready for service.

1.2 Project Documentation

The World Bank has classified the Project as safeguards Category B. As such, the Savusavu Branch Project would have the same classification, requiring an Environmental and Social Impact Assessment (ESIA) and Environmental & Social Management Plan (ESMP).

This ESIA focuses on the coastal zone and near-shore marine area and the location of the proposed terrestrial infrastructure, which forms the project influence area (PIA). The potential impacts associated with those in deeper waters have been identified and addressed in MCIT 2015[1].

The Ministry of Communications has commissioned Argo Environmental Ltd (Argo) to undertake an ESIA and ESMP for the proposed cable installation and associated activities for the Savusavu cable landing point in accordance with the Terms of Reference (TOR) and Addendum (Appendix 1). The Addendum identified a number of potential Savusavu landing sites which required further evaluation. These sites are the subject of this evaluation and are identified in Section 2.3.

[1]MCIT 2015. Initial Environmental Examination. TA-8540 REG, Pacific Information and Communication Technology Investment Planning and Capacity Development Facility - Environmental and Social Safeguards. Samoa Submarine Cable Project. Prepared by the Ministry of Communication and Information Technology (MCIT) for the Asian Development Bank and World Bank. July 2015.

2 Project Description

2.1 Project Rationale

The Project is intended to deliver high-capacity lower cost Internet services to the relatively disadvantaged Northern Division of Fiji, consistent with the Government's policy objectives of accelerating development in those areas.

Following telecoms market liberalization in 2008, access to ICT infrastructure and services has improved across the country. However, access, particularly to internet, is not evenly distributed.

Vanua Levu and neighbouring islands account for about 16 percent of the country's population (about 150,000 people), but only about 10 percent of total telecom traffic (in aggregate). Demand for Internet bandwidth in the Northern Division is forecast to increase from present levels of about 1.5 Gbps to 19 Gbps in the next 10 years and to 170 Gbps within 25 years.

Existing connectivity solutions for Vanua Levu via satellite or microwave links will be insufficient to provide the required bandwidth capacity and quality. High-speed Internet offers wide-ranging economic and social development benefits. In addition, and as evidenced by recent experience in Fiji, an optical fibre cable backbone offers greater resilience than terrestrial backbone (microwave) in the event of cyclones.

The objective of the Project is to reduce the cost and increase the availability of ICT services to support social and economic development on Vanua Levu. The Project is expected to contribute to improved public service delivery (including online government services, health and education and financial services); increased private sector development opportunities, and reduced transaction costs for businesses and individuals; and national and regional integration objectives of improved service delivery, trade and communications between Viti Levu, Vanua Levu and other Pacific island economies.

2.2 Project Components

The proposed subsea cable route for the Fiji-Samoa Connectivity Project is shown in Figure 2.1 and identifies the broad alignment of the Savusavu Branch Project. It is proposed to install the Savusavu link at the same time the Fiji-Samoa cable is installed.

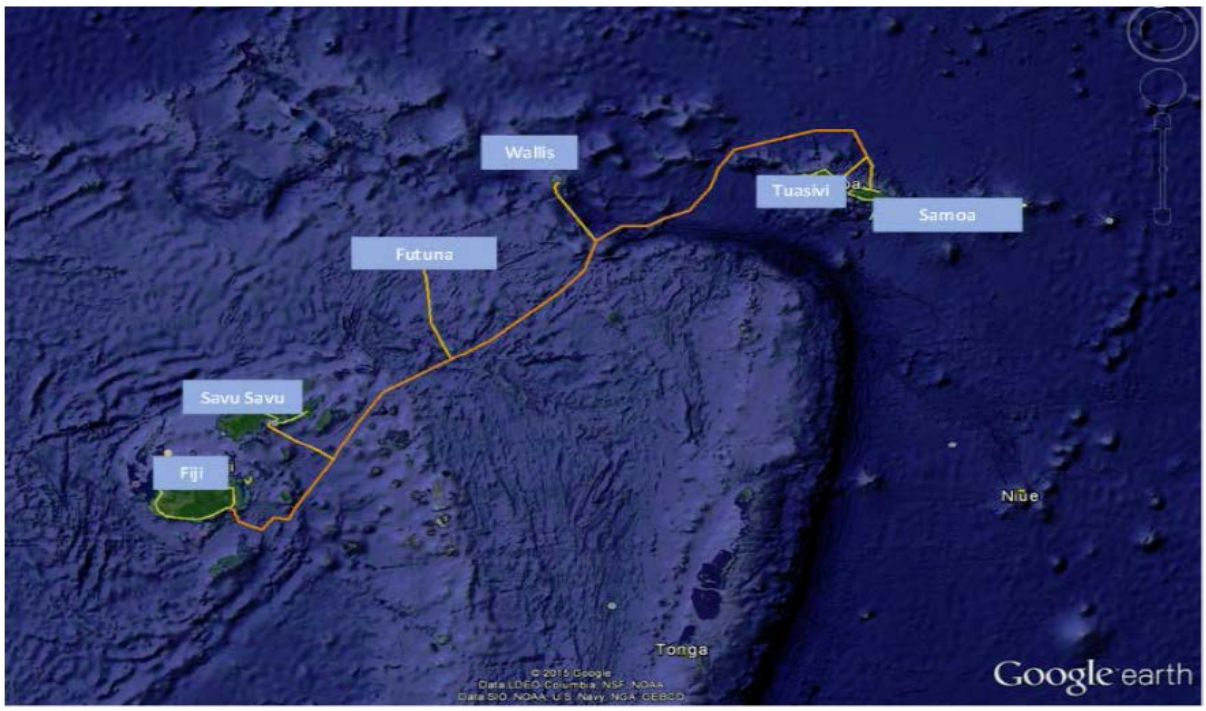


Figure 2.1: Proposed subsea cable route for the Fiji-Samoa Connectivity Project

The Project components are described in full in MCIT (2015)[1]. In summary, the infrastructure components will comprise:

- Approximately 95km of fibre optic cable from the point of branching with the main cable to the shore (Figure 2.1), laid on or beneath the sea floor using hydro-jetting (Figure 2.2). Hydro-jetting is useful in applications where seabed materials are fairly consolidated and is proposed to be undertaken in submarine areas up to 30m depth beyond which the cable will be laid on the sea floor. The cable will consist of double armoured cable to 200 metres depth followed by single armoured cable to 1000 metres depth (Figure 2.3).
- At the shoreward end across the intertidal zone, between the subtidal zone and the beach manhole, the cable will be covered with lightweight protection consisting of standard articulated piping bolted to the substrate.
- A beach manhole (BMH) landing facility likely to comprise a small concrete manhole approximately 2m x 2m x 2m. (Figure 2.4).
- Use of existing TFL ducting along existing road corridors.
- A cable landing stations (CLS). Two options are available for the current Project including the AFL Communications Site across the road from Savusavu Airport runway and the TFL Building in Savusavu.

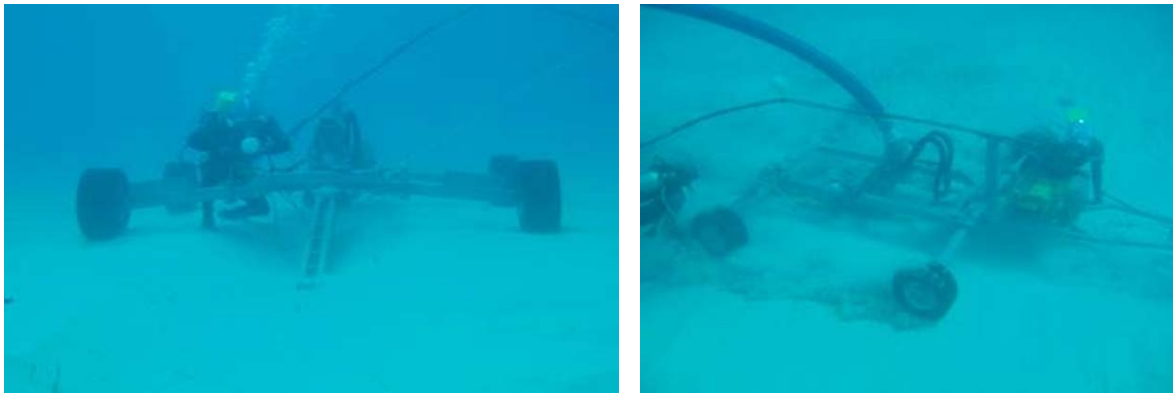


Figure 2.2: Hydro-jetting apparatus

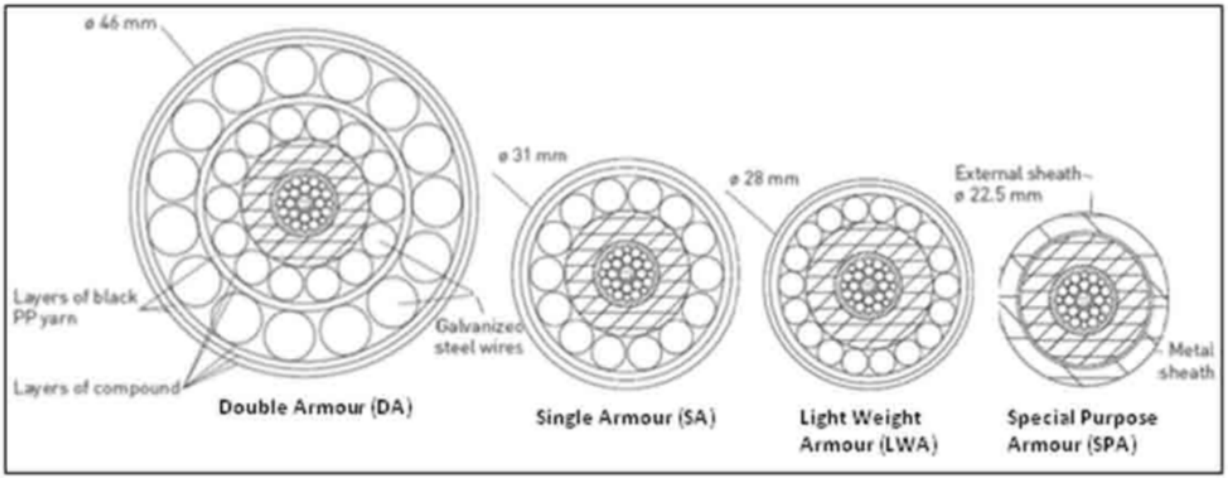


Figure 2.3: Fibre optic cable options

The cable installation process is also described in detail in MCIT (2015)[1]. In summary, the deeper water routes are extensively mapped so that sensitive marine features (such as hydrothermal vents and sea mounts) are avoided and, for nearshore cable placement, a marine ecologist is required for detailed route planning and divers are used to assist with the cable laying process.

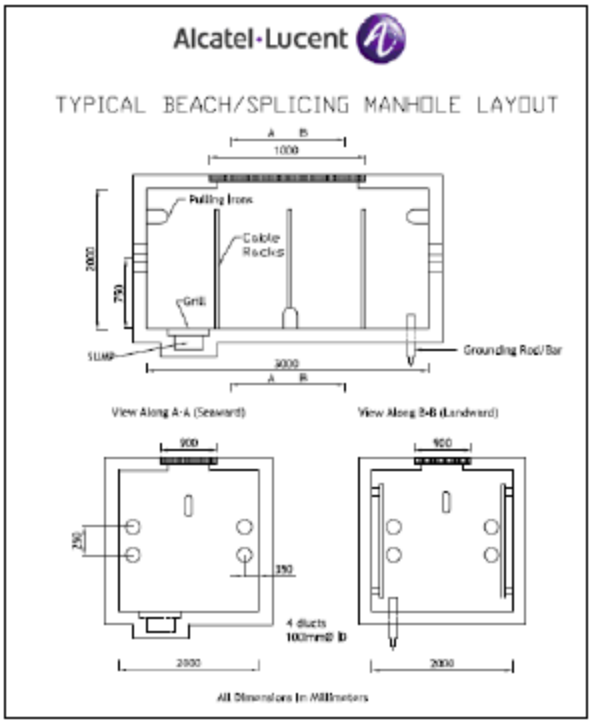


Figure 2.4: Typical layout of a beach manhole landing facility

2.3 Project Location

An Addendum to the TOR (Appendix 1) described a recent site visit by Director of Ministry of Communications, FINTEL, TFL and World Bank representatives. The aim of the visit was to identify suitable beach manhole and cable landing station locations for further more detailed site evaluation. These sites are shown in Figure 2.5 and described in Table 2.1.

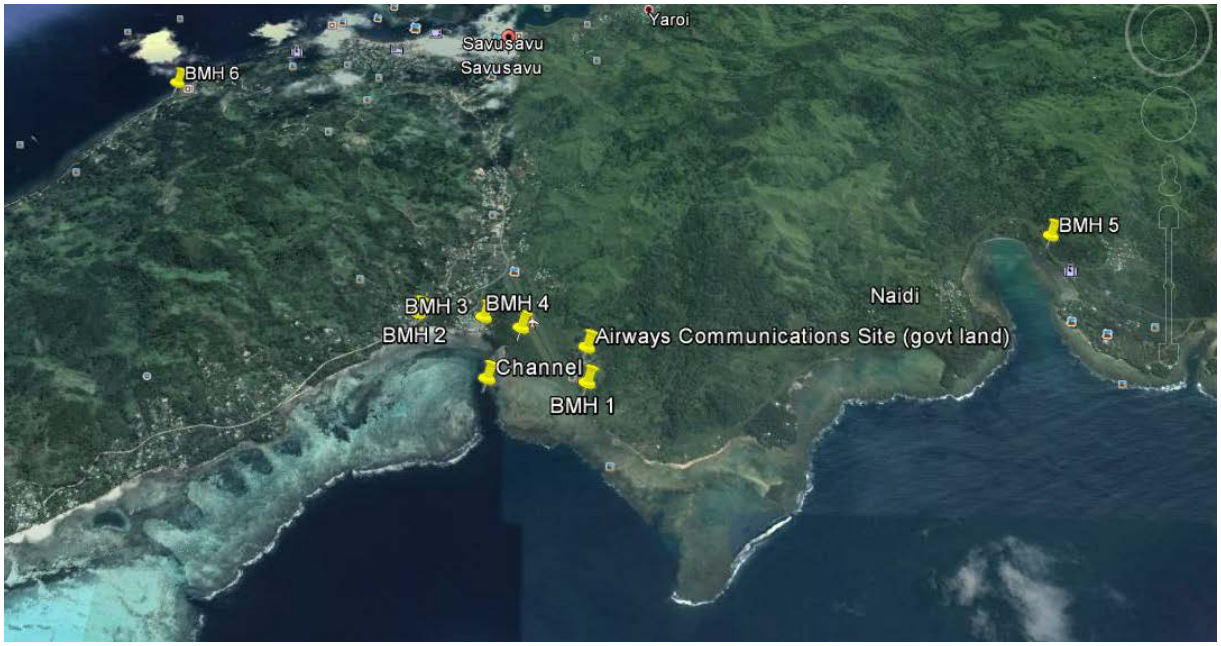


Figure 2.5: Preferred beach manhole (BMH 1-6) locations

The outcome of this initial site visit was that detailed marine field work should focus on the two preferred sites for the BMH (1 & 2). This includes the probable submarine cable path from the outer reef to the two beach sites. BMH 3, 4, 5 and 6 are considered potential alternatives but do not require detailed marine surveys or investigations.

Section 4.5 presents a summary of the findings of the investigations of these sites the full report is presented in Appendix 2.

Table 2.1: Beach manhole and cable landing stations identified during the initial site evaluation

Preference	Site Code	Site Description
Beach Man Hole Locations		
Most preferred	BMH 1	Located at Eastern end of AFL Runway on Government Land. Cable would cross a small section of reef. Within 1km of AFL Comms site for Cable Landing Station. Terrestrial cable would use existing TFL ducts along road reserve.
	BMH 2	West of Runway on road reserve adjacent to foreshore. Govt Land. Cable would cross the reef via a natural sandy channel. Terrestrial cable would follow existing TFL ducts to either Cable Landing Station option.
Least preferred	BMH 3	West of Runway – iTaukei land which would require iTaukei Land Trust Board to assist with land acquisition / lease / easement. Submarine cable would cross the reef via a natural sandy channel. Terrestrial cable would follow existing TFL ducts to either Cable Landing Station option.
	BMH 4	Private land to West of Runway. Currently covered in 'scrub' and palms (not plantation). No current land use / agriculture observed. Could not get access to the BMH site during the site visit. Short access path/road across the site from the road or runway would be required and vegetation would need to be cleared. Submarine cable would cross the reef via a natural sandy channel. Terrestrial cable would go under the runway or along road within existing TFL ducts to either Cable Landing Station option.
	BMH 5	Naidi Bay. BMH at Road Reserve adjacent to the beach / small estuary. Cable would enter the bay without crossing a reef. Several kilometres of terrestrial cable to either Cable Landing Station.
	BMH 6	Daku Resort. South of Savusavu town in Savusavu Bay. The 'original site' drawn in the contractors tender documents. BMH in road reserve. Exposed coastline with evidence of erosion from recent cyclone Winston. Shipping channels, leisure boating, fishing within the bay. Several kilometers of terrestrial cable to TFL site in Savusavu. No existing TFL ducting.
Cable Landing Stations		
	AFL Communications Site across the road from runway	Elevated site. TFL cable ducts go along the road past this site and into Savusavu. The site currently has a small shed that houses communications equipment. There is space for a new building / structure and easy access directly off the Hibiscus Highway.
	TFL Building, Savusavu	There is space for new building or internal refit. Existing housekeeping is poor and would need to be improved. 5km + of terrestrial cabling required within existing TFL duct along the Hibiscus Highway.

3 Policy, Legal & Administrative Framework

3.1 Fiji

3.1.1 Administrative Framework

The following key agencies have responsibilities with regard to the Project development in Fiji:

- The Department of Environment which administers the *Environment Management Act 2005*, compliance of environmental impact assessments with the Act and implementation of environmental management plans by Project proponents and developers. The Department also manages Fiji's participation in international conventions on biodiversity and the environment.
- The Department of Lands and Survey is vested with authority to grant lease over State Land including soil under Fiji's waters should such a lease be deemed necessary in order to lay the cable.
- The Fiji Ports Corporation Limited has authority, under the *Sea Ports Management Act 2005* and the *Marine Act 1986*, over the port of Suva and its approaches, including all shipping operations and shore and sea-based installations.
- The Ministry of Fisheries and Forests manages fisheries in Fiji and administers the *Fisheries* Regulations *2004*.
- The iTaukei Lands Trust Board administers leases on iTuakei land, on behalf of the custom land owners.
- The Maritime Safety Authority of Fiji has responsibilities to manage shipping movements and other aspects of marine safety during cable laying, and administering protective measures once the cable has been laid, such as updating maritime charts with new infrastructure and enforcing no-anchoring zones.

The majority of land in Fiji is under customary land ownership by iTaukei. The State owns the seabed below High Water Mark. Customary rights to fishing and marine resources in the reef, or *qoliqoli* rights, are assigned to much of the coastline. These are administered by the iTaukei lands and Fisheries Commission.

3.1.2 Legal Framework

The *Environment Management Act 2005* has a geographic jurisdiction to the limit of Fiji's Exclusive Economic Zone (EEZ). Its purpose is to apply the principles of sustainable use and development of natural resources and to identify matters of national importance to Fiji. The Act provides for environmental assessments (EA) to be reviewed by the Environment Management Unit, but there is minimal guidance in relation to submarine communications cables. A public hearing must be undertaken in the vicinity of the proposed development (s34), once an EA is complete. Projects are assessed according to their scale and potential impacts under Part 1 of the Act.

The *Crown Lands Act (CAP 132)* allows for the disposal of State Land permanently or, more commonly, temporarily under lease. Importantly, State Land is defined also to include foreshore land below high water mark and soil under the waters of Fiji. Under the Act, the granting of a foreshore land lease or lease of any soil under the waters of Fiji must be with the approval of the Minister and shall only be granted after declaration that the granting of such lease does not create a substantial infringement of public rights.

The *Marine Spaces Act* (CAP 158A) clarifies that the State owns marine resources from the high water mark to the edge of the EEZ, but also acknowledges the customary marine tenure system of Fiji. The country is divided into 410 customary fishing grounds as recorded by the Native Lands and Fisheries Commission. The Act allows for the Minister of Fisheries to make regulations over many activities within Fiji's waters (including foreign fishing vessels access to Fijian fish stocks).

The *Fisheries Act* (CAP 158) established the Native Fisheries Commission under the Ministry of iTaukei Affairs to administer a titling system over very reef, river and lagoon in Fiji (Minter 2008). The Commission protects native customary rights to fish in coastal

(*qoliqoli*) areas for non-commercial purposes. There are two customary groups (Vanua Nacekoro and Vanua Raranipolo) recognized under this Act as having user-rights for fishing in proximity to the BMH1 & 2. The Fisheries (Protection of Turtles) (Amendments) Regulations 2004 gives absolute protection to turtles and turtle eggs of any species.

The *Continental Shelf Act* (CAP 149) makes provision for the protection, exploration, and exploitation of the natural resources of the continental shelf. Section 6 allows the Minister to make orders prohibiting ships from entering or remaining in any area specified as a safety zone. Section 10 allows the Minister to make regulations prescribing things for giving effect to the provisions of the Act.

The *Sea Ports Management Act 2005* vests authority over the ports in Fiji (including Suva) in Fiji Ports Corporation Limited.

The *Marine Spaces Act 1986* and related amendments and regulations contain numerous provisions relating to legal compliance and safety while undertaking a marine operation in Fijian waters.

The United Nations Convention on the Law of the Sea (UNCLOS) was signed by Fiji in 1982.

3.1.3 Permitting Requirements

MCIT (2015)[1] describes the permitting arrangements for Fiji. In summary, a landing party agreement (LPA) will need to be established between FinTel and the preferred Submarine Cable Company (SCC) and confirmed by Ministry of Communications. FinTel will need to seek permits and approvals from the following stakeholders:

- The Ministry of Foreign Affairs (MoFA) and Marine Safety Authority of Fiji (MSAF) will need to be consulted for consent and guidance in laying the cable on Fiji's Continental Shelf and ensure the cable path avoids interference with navigation of vessels. FinTel will need to submit the LPA, EIA report and letter from the Fijian Government to MoFA, who in turn, provide a formal permit to FinTel and SCC for the Project.
- The Department of Lands will provide consent for the cable landing given there is no land acquisition or reclamation required for the cable landing. No adverse impacts to marine areas under customary ownership are anticipated (see Section 6.2.3 for further discussion).
- The Department of Environment (DoE) will need to review and approve (with or without conditions) the environmental impact assessment (EIA) report for the Project and for any new land development for the cable lay.
- The Harbour Master at Fiji Ports Corporation Limited will need to be consulted so whether there is a requirement (if any) to notify vessels in proximity to the landing site.
- Airports Fiji Limited (AFL) will need to sign an MoU or similar agreement if the cable landing site is within their land.
- Savusavu Town Council will need to be notified of the small-scale civil works to install the cable in the foreshore areas.

3.2 World Bank

3.2.1 Introduction

The relevant World Bank Policies for this project are summarised below. OP4.12, Involuntary Resettlement is not triggered because the options for land use all involve government owned land.

3.2.2 Operational Policy 4.01 – *Environmental Assessment*

The WB requires an Environmental Assessment (EA) of Projects proposed for WB financing to ensure they are environmentally sound and sustainable, thereby improving decision-making. Operational Policy (OP) 4.01 requires (i) detailed qualitative and quantitative analysis to determine project impacts, (ii) determination of tangible measures to prevent, minimise, mitigate or compensate for those adverse impacts, (iii) public

consultation and disclosure as part of the EA process and (iv) requires and Environmental Management Plan (EMP) to address set mitigation along with monitoring and institutional measures to be taken during design, implementation, operation and maintenance phases of the project.

3.2.3 Operational Policy 4.04 – *Natural Habitats*

OP 4.04 requires the conservation of natural habitats and specifically prohibits the support of projects that involve significant conversion or degradation of critical habitats, as defined by the policy. The policy further requires the EA to identify impacts on biodiversity and species and to determine endemism, endangered species and to determine project impacts on these species and to propose acceptable mitigation and monitoring measures.

3.2.4 Operational Policy 4.10 – *Indigenous Peoples*

OP 4.10 requires the GOF to engage in a process of free, prior and informed consultation with Indigenous Peoples (IP's), as described by the policy in situations where IP's are present in, or have collective attachment to, the project area and for the preparation of an Indigenous Peoples Plan (IPP) and /or Indigenous Peoples Planning Framework (IPPF).

3.2.5 Operational Policy 4.11 – – *Physical Cultural Resources*

OP 4.11 seeks to avoid the disturbance and/or destruction of Physical Cultural Resources (PCR) as defined by this policy by the projects activities. PCR includes places of worship, buried artefacts, cemeteries, and archaeological assets, etc. The policy further requires, (i) EA to undertake an exhaustive desk review and/or site investigation to pre-identify and locate PCR's in the PIA, (ii) EA/EMP to propose management measures and (iii) to include "chance find" clauses in civil works contracts during construction and maintenance stages.

4 Description of the Environment

4.1 Introduction

This section provides information on the physical, biological and socio-economic elements of the environment, which forms the baseline data set that can be used as benchmarks for future monitoring.

The area considered for assessment of baseline conditions (the PIA) consists of the cable route as it enters the nearshore coastal environment, the beach manhole sites and the terrestrial cable route to the cable station. The PIA is defined through consideration of the project footprint including all ancillary project components and potential impacts on environmental, economic and social resources.

Table 4.1 outlines the guidelines that have been followed in determining the PIA for the Viti Levu – Samoa cable Project (see MCIT (2015)) which is based on best practices from previous similar studies and by adopting a precautionary approach. Note that the environmental issues associated with the deeper water effects of the cable extending to the Viti Levu – Samoa cable are similar in nature to those addressed in MCIT (2015) and are not addressed here in any detail.

All data was obtained by desktop study and a field survey conducted on 15 August 2016.

4.2 Location & Setting

The Fiji Islands is comprised of a group of more than 300 islands, of which 105 are inhabited. Spread over an area of 860,000 km^2 of ocean in the central South Pacific, its total land area is approximately 18,300 km, the two major islands of Viti Levu and Vanua Levu make up 10% of the land area.

Table 4.1: Project influence areas delineations and conditions

Environment	PIA
Important Species Habitat	In specific regard to the migratory humpback whale population of Fiji, a 1km belt either side of the cable (2km in total) has been identified in WD less than 200m and is described in MCIT (2015).
Offshore (>3nm from coastline)	The accuracy of the placement of the cable on the sea floor reduces as the depth increases and currents play a part. A 500m corridor either side of the cable is a good precautionary limit for a PIA and is described in MCIT (2015).
Inshore & Coastal Waters (<3nm from coastline)	As the accuracy of cable placement increases, the PIA reduces. Taking a precautionary approach, a 250m corridor either side of the cable (500m total) has been used for the foreshore
Terminal stations	250m radius from the center point of new terrestrial buildings
Terrestrial cable route	A 50m corridor will be assessed for any terrestrial trenching activities.

Many of the smaller islands are low-relief coral atolls. Most of the islands are fringed by coral reefs and, due to the volcanic nature of the islands, and the sea bottom deepens rapidly. This is certainly the case for the coastline adjacent to the Savusavu Airport, which is the subject of the current investigations.

Figure 4.1 presents a google earth image of the key site investigated and probable submarine cable route investigated in the current survey. These sites were identified in a previous site visit (see Appendix 1).

4.3 Physical Environment

4.3.1 Geography

Viti Levu and Vanua Levu are volcanic with steep terrain, cut by numerous streams and rivers feeding into coastal alluvial plains. A number of islands, Kadavu, Taveuni, Gau, Koro, Ovalau and Yasawa are also volcanic but much smaller in size, with little or no coastal plains and generally with much steeper topography.

4.3.2 Climate

Fiji has a tropical climate a with a hot-wet season (November-April) having a maximum average temperature of 32°C and a cool dry season having a minimum average temperature of 14°C. It experiences south-easterly trade winds for most of the year.

The combination of the trade winds and steep relief of the volcanic islands results in distinct rainfall patterns on the windward and leeward side, with defined wet and dry zones respectively. The windward side is generally defined as the south-eastern region of the larger volcanic islands. While the windward side receives rainfall almost throughout the year, prolonged periods without any rain are experienced in the leeward dry zones. The wet season results in a changed weather pattern, with rains over most part of the country. The wet season also is characterised by intense low pressure activity in the region, some of them resulting in tropical cyclones and hurricanes with very high winds, up to 120 knots, and heavy rainfall. The wet side receives an annual average of 5.2 hours of sunshine while the dry side receives 6.9 hours of sunshine daily. Average daily rainfall for the wet and the dry sides are 8.3 and 5.1 mm respectively.

The climatic patterns are regularly influenced by the El Nino phenomenon, resulting in reversal of wind and rainfall patterns and prolonged dry seasons.

Figure 4.1: Google earth image of the sites investigated in the current survey

4.3.3 Demography

The population of Fiji is estimated at 755,000 (1994 Census) with an annual growth rate of 1.9 %. About 90 % of the population live on Viti Levu and Vanua Levu with the remainder scattered over the rest of the group.

About 38 % live in urban and peri-urban areas with 19 % concentrated in and around Suva. The rural population is characterised by people living in isolated farmsteads, pockets of medium-density settlements in cane farming areas, and traditional villages throughout the country.

4.3.4 Tides

Fiji has a maximum tidal variation of just over 2 meters (meso-tidal). The tides are semi-diurnal (2 tides a day) with a strong diurnal inequality with the twice-daily tides showing considerable variability in amplitude. Inclement weather systems have a marked impact on the tidal height and can cause increased coastal erosion if they coincide with high water periods. The placement of landing points relative to mean sea level will be important to plan well if erosion and related issues are to be avoided.

4.3.5 Waves

The most important sources of waves are from trade wind-driven seas and swell from storms to the south. On the northern facing shores of the group, the seasonal northerly swell from northern hemisphere storms replaces southerly swell as an important contribution. Wind seas driven by infrequent tropical cyclones, which can severely affect the

group, occasionally have a major impact. Winds (and hence wind seas) are predominantly south-easterly to easterly throughout the year. Southeasterlies are much more frequent in winter. In summer, northeasterlies and northwester lies are also quite common. Wind speeds are lowest in January to March and highest in July to August.

Wave energy arriving on the southern shores of the two largest islands Viti Levu and Vanua Levu tends to be large compared with the northern facing reefs and shores which is significantly less.

Tropical cyclones occur occasionally in Fijian waters, mostly from November to April. On average, a little more than one cyclone occurs per year. The variation in wave height through the year (Figures 4.2 & 4.3) is weak both to the south and north of the group, although wave heights are a little higher in the winter on average. The frequency distribution of peak wave period from the Wave rider measurements offshore Kadavu (Figure 4.4) show the dominant waves are most often long-period swell (>10 secs), although shorter wind seas also occur regularly. Wave periods exceeding 20 seconds occur on rare occasions.

4.4 Ecological Environment

4.4.1 Introduction

Set out below is a summary of the ecological resource assessment of the key sites undertaken in August 2016. Appendix 2 presents the full report.

4.4.2 Marine Ecology

Benthic Community

The intertidal reef flat community along the cable route to BMH1 consists of a range of species that commonly occur in Fiji. The intertidal sandflats along the cable route to BMH2 is largely devoid of significant fauna but includes areas of seagrass. The subtidal benthic cover of the reef edge is comprised primarily of abiotic (i.e., non-living) features and live coral species. The coral community is dominated by massive coral species. Benthic invertebrates observed included brittle star and crown of thorns starfish. T3, located in close proximity to the preferred cable alignment to BMH1, has a higher proportion of abiotic features (i.e., coral rubble, sand) compared to live coral.

Further offshore, the seafloor extending into deeper waters consists of softer sediments. The benthic community is likely to consist of a range of infauna and epifaunal organisms common in Fiji.

Overall, the condition of the subtidal coral reef communities is variable with the more seaward reef being ‘healthier’ and more diverse which is likely to be due to less impact from sedimentation, etc.

Reef & Pelagic Species

The characteristics of the reef fish communities present can be described as follows:

- A total of 36 species were present across all transects. The most common include mangrove red snapper, daisy parrotfish, clown Tang and striated surgeonfish.
- Fish abundances are typically low with many being observed as a few (i.e., 2-10) or as single individuals. Only one species have abundances exceeding 100. Transect 3, adjacent to the potential cable alignment to BMH1, had the lowest number of fish species and abundance.

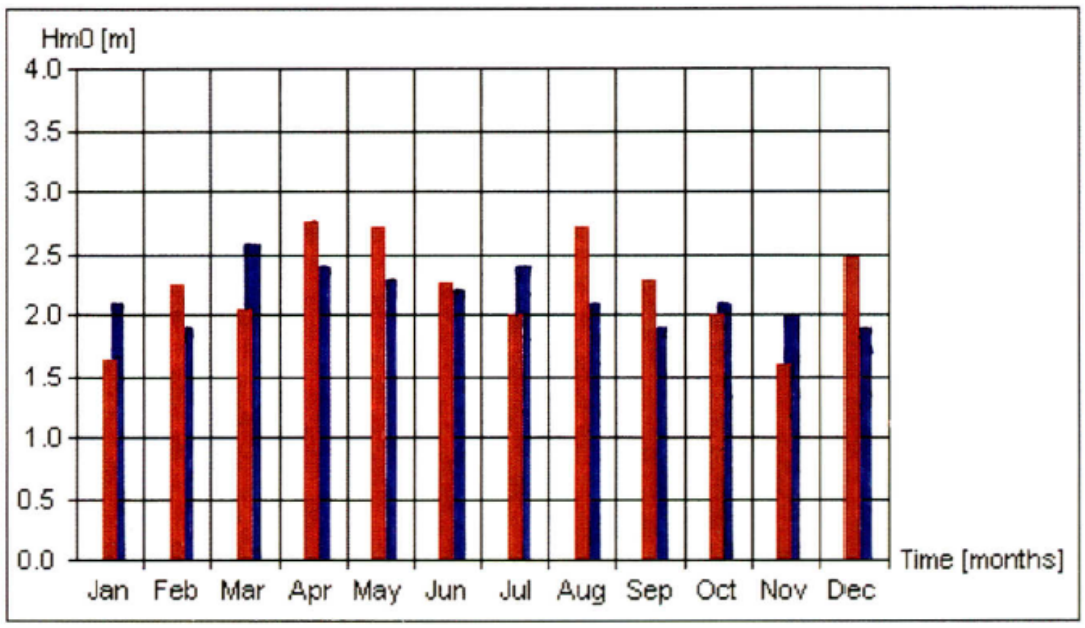


Figure 4.2: Monthly variation in average significant wave height from satellite measurements (red) and waverider data (blue) south Fiji

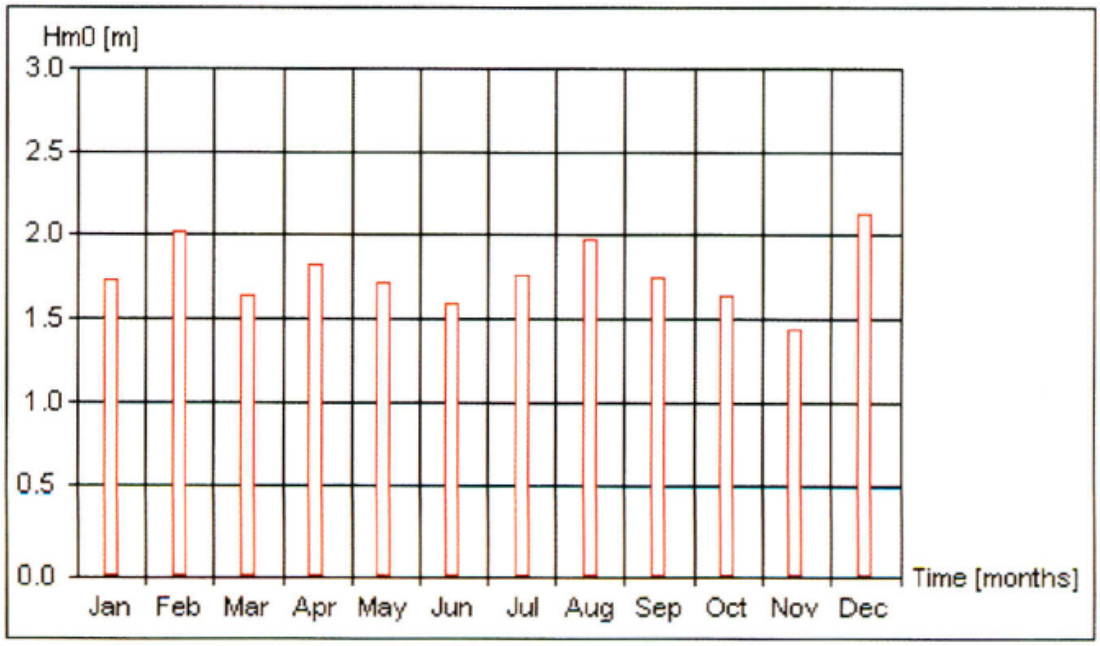


Figure 4.3: Monthly variation in average significant wave height from north of Fiji

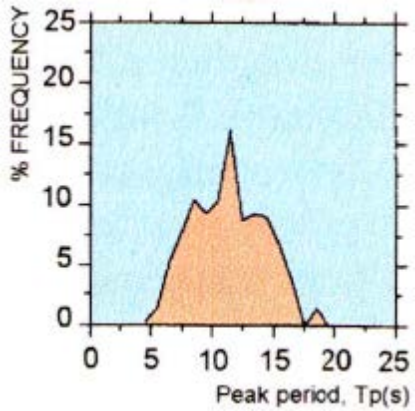


Figure 4.4: Frequency distribution of measured peak wave period (Tp), for Fiji

A total of 10 species of whales and dolphin are known to use Fijian waters[2] (Table 4.2). Of these only the Humpback whale *Megaptera novaeangliae* is considered endangered by IUCN and the Sperm whale *Physeter microcephalus* vulnerable. For 5 species there is insufficient data available. In addition there an additional 15 species that are considered to be probably present within Fijian waters including Minke whale *Balaenoptera acutorostrata* , Blue whale *Balaenoptera musculus* and Fin whale *Balaenoptera physalus*.

Five species of marine turtles have been recorded from Fijian waters (see Table 4.2). The most common species are: Hawksbill turtles (*Eretmochelys imbricata*) and Green turtles (*Chelonia mydas*) due to their nesting grounds being located at various sites throughout Fiji and are considered to be critically endangered and endangered respectively by IUCN.

The other species include: Loggerhead turtle (*Caretta caretta*), Leatherback turtle (*Dermochelys coriacea*), and the Olive Ridley turtle (*Lepidochelys olivacea*), with unconfirmed sporadic nesting incidences but mainly sightings, which are considered Vulnerable by IUCN.

No specific turtle breeding habitat was identified or is known to be present in or immediately adjacent to the proposed Project site.

Table 4.2: Confirmed cetacean species within Fijian waters

Common name	Scientific name	IUCN
Common minke whale	*Balaenoptera acutorostrata*	LC
Humpback whale	*Megaptera novaeangliae*	EN
Short-finned pilot whale	*Globicephala macrorhynchus*	DD
Killer whale	*Orcinus orca*	DD
False killer whale	*Pseudorca crassidens*	DD
Pantropical spotted dolphin	*Stenella attenuata*	LC
Spinner dolphin	*Stenella longirostris*	DD
Common bottlenose dolphin	*Tursiops truncatus*	LC
Sperm whale	*Physeter macrocephalus*	VU
Blainville's beaked whale	*Mesoplodon densirostris*	DD

Notes: IUCN red-list status (IUCN 2016): EN (Endangered); VU (Vulnerable); LC (Least concern); and DD (Data deficient).

Table 4.3: Turtle species within Fijian waters

Common name	Scientific name	IUCN
Hawksbill turtle	*Eretmochelys imbricata*	CE
Green turtle	*Chelonia mydas*	EN
Loggerhead turtle	*Caretta caretta*	VU
Leatherback turtle	*Dermochelys coriacea*	VU
Olive Ridley turtle	*Lepidochelys olivacea*	VU

Notes: IUCN red-list status (IUCN 2016): CE (Critically Endangered); EN (Endangered); VU (Vulnerable).

[2] Miller, C., Batibasaga, A., Chand, P., Dulunaqio, S., Fox, M., Jupiter, S., Naisilisili, W., Nand, Y., Sharma-Gounder, S. & Smith, B. 2015. Cetacean diversity, common occurrence and community importance in Fijian waters. Pacific Conservation Biology. January 2016.

4.4.3 Terrestrial Ecology

Terrestrial ecological resources at the BMH 1 & 2 sites, along the road corridors from these locations to the possible cable landing station at the AFL communications site have been impacted by past clearance activities and primarily consists of invasive and adventive weed species and rank grasses. No bird species of any conservation significance were identified.

4.5 Socio-Cultural & Economic Environment

4.5.1 Introduction

The two preferred manhole sites (BMH) and potential cable routes (CR) are both located within the road reserve, and the cable landing sites (CLS) are located within or immediately adjacent to existing commercial properties.

The two preferred landing site beaches are not considered to be of high tourist value and, based on discussions with local villagers, have limited recreational value or use.

4.5.2 Cultural Heritage Resources

The consultation process did not identify any cultural heritage resources of significance in close proximity to the preferred BMHs, CRs and CLS's.

While no impacts are anticipated to the cultural heritage resources of Fiji, mitigation measures will be designed to handle "chance finds" of archaeological items.

4.5.3 Fishing

Fishing and reef gleaning for subsistence living is undertaken by local villagers on the reef on the eastern side of the main channel and within the channel itself. The reef area on the western side of the channel is a 'no-take' area (or 'Tabu'). Nacekoro and Raranipolo are the mataqali (land-owning units) who have *qoli qoli* (fishing rights) in the Project area.

4.5.4 Land Use

Land use activities in the general vicinity of the Project site are limited to the day to day activities that occur within the Nacekoro Village and Nabaka Settlement, and the residential dwellings present along Nukubalavu Road. Occasional subsistence cropping occurs but there is limited arable land of any significance.

AFL operate the Savusavu Airport adjacent to Buka Bay Road and the Communications Centre, located on elevated land to the east of the runway, is a proposed CLS site (Lot 2 DP 1977 7386).

Figures 4.5 & 4.6 presents maps showing landownership arrangements adjacent to proposed BMH1, 3 & 4.

The key points to note are as follows:

- BMH 1 and 2 (not shown) are located in state foreshore land.
- BMH3 & 4 are located in private freehold land.

4.5.5 Marine Traffic

Although the channel is used by local villagers to access fishing grounds located further afield, the marine traffic is limited.

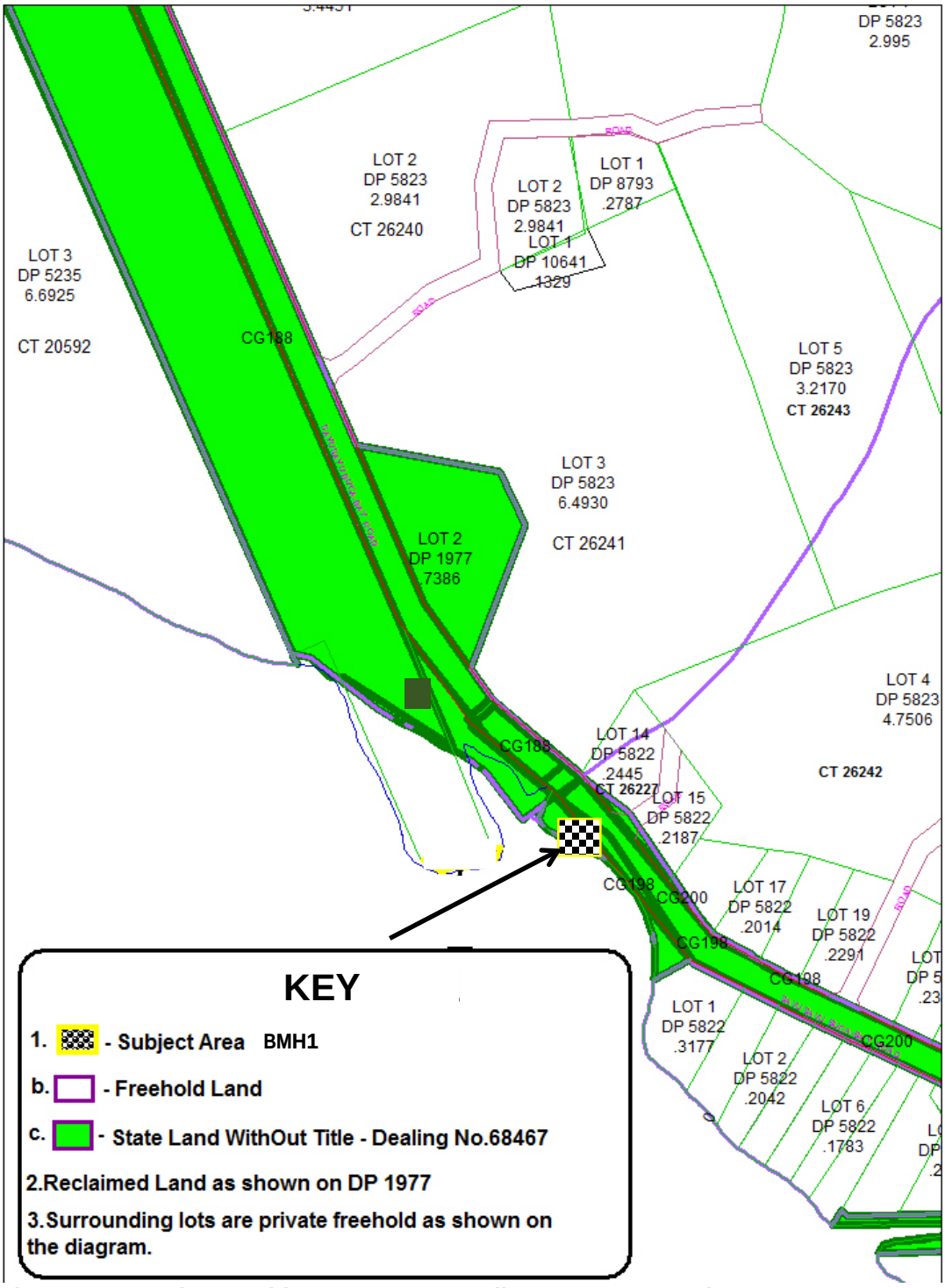


Figure 4.5: Landownership arrangements adjacent to proposed BMH 3 & 4

Figure 4.6: Landownership arrangements adjacent to proposed BMH 3 & 4

4.5.6 Public Consultation

Consultation with the public has been undertaken as follows:

- Discussions with local villagers at the time of the site survey on 22-23 August 2016
- *Ad hoc* discussions with key stakeholders such as AFL, FinTel Lambasa and Savusavu, etc
- An initial public consultation meeting held on 20 September 2016 in Savusavu. In order to maximise local turnout the meeting was widely advertised on local radio and print media as well as through dissemination through local villagers. Appendix _ presents the list of attendees.

The response to date has been overwhelmingly positive. Key issues raised to date are:

- New ICT service will provide resilience to natural disasters.
- Benefits to local business and tourism.
- Potential short term impact during construction outweighed by long term advantages.

Consultation will be ongoing throughout the project, with further detailed discussions held with local communities during the detailed design phase and prior to cable laying. A stakeholder engagement plan will be prepared by the PMU to provide a framework for how and when to continue these discussions.

5 Analysis of Alternatives

5.1 Alternative Technologies

An analysis of alternative technologies has been undertaken in MCIT (2015). In summary, both fibre optic cable and satellite connections were considered during the early feasibility studies[3], but the latter in use on both states had serious limitations in available bandwidth and was often restricted by the satellite service provider, leaving both states with very limited connectivity. The fibre optic cable would allow for much broader bandwidth and a level of service that is controlled by Samoa, not an external entity. It was therefore agreed that a second and higher capacity fibre optic cable option would be pursued.

5.2 Alternative Alignments

Table 5.1 presents an analysis of the two preferred beach landing and manhole sites. Overall, based on an analysis of a range of Engineering & Technical, environmental, social and cost factors, **BMH1 landing site is considered the most appropriate location** particularly in light of the informal fishing reserve present on the intertidal sand flats area adjacent to BMH2.

Table 5.1: Analysis of the two preferred beach landing and manhole sites

TYPE	**ALTERNATIVE LANDING SITES**	
	BMH1	**BMH2**
Marine/Coastal		
Engineering/Technical a. landing engineering b. proven reliability c. marine traffic d. coral e. existing access	 a. Across reef and sands b. Yes c. Minimal d. Yes although damaged e. None	 a. Trenching through sands b. Yes c. Minimal d. Sands/coral bommies in channel e. None
Social a. Land acquisition b. Displacement	 a. Road Reserve (Government Land) b. None	 a. Road Reserve (Government Land) b. None
Environmental a. sensitive sites b. live coral affected c. cetaceans migration	 a. yes b. yes although damaged c. possible of coast	 a. none b. no c. possible of coast
Cost	Requires BMH and cable along road corridor – similar costs	Requires BMH and cable along road corridor – similar costs
Other considerations	Cable station sites in close proximity	Cable station sites in close proximity
Terrestrial		
a. trenching distance (to AFL site)	500m	1.8 km
b. access disruption	Partial road closures	Partial road closure
c. electromagnetic interference	N/A as landside cable not powered	N/A as landside cable not powered
Conclusion	**Preferred location -** Minimal environmental and social impacts	Least preferred - Likely unsuitable given cable route is through fishing reserve

[3] World Bank. 2009. Regional Telecommunications Backbone Network Assessment and Implementation Study. World Bank Project Report.

6 Assessment of Potential Impacts, Risk & Mitigation Measures

6.1 Introduction

The Cable extension has the potential to create a variety of impacts if it is implemented. These potential impacts can be either positive or negative depending on the receptors involved and other parameters. The impact of this project on the physical, biological and social environment has been assessed using methodology described in this chapter.

The impact assessment process initially involves identification of the project's activities and potential environmental and social impacts resulting from each activity during the project phases. A project activity could include site preparation, construction, reinstatement, operation and maintenance.

Within this EIA, an impact is defined as "any change to the physical, biological or social environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services".

6.2 Potential Impacts

This section provides an assessment of the potential construction and operational impacts of the proposed Project on the physical and ecological and socio-economic resources on and adjacent to the site. Potential impacts have been identified and evaluated as to whether they are adverse, positive, or have a negligible or neutral impact.

These issues are discussed in the following sections in relation to the proposed Project activities.

6.2.1 Deep Subtidal Waters

Key environmental issues associated with submarine cable deployment and maintenance have been described previously[4]. Disturbances and impacts caused by cable laying and maintenance should be viewed in the context of the frequency and extent of these activities. The one-off disturbance associated with cable placement is restricted mainly to a strip of seabed less than 5–8 m wide and unless a cable fault develops, the seabed will not be disturbed again within the system's design life (approximately 25 years).

By comparison, bottom trawl and dredge fishing operations are repetitive and more extensive and a single bottom trawl can be tens of metres wide, sweep substantial areas of seabed in a single operation and is likely to be repeated over a year at the same site. A single impact, such as a cable placement or burial, is preferred to continuous, multiple or recurring impacts.

The United Nations Convention on the Law of the Sea (UNCLOS) advocates the freedom to lay, maintain and repair cables outside territorial seas, but these are not necessarily inconsistent with the need to protect deep-ocean habitats and ecosystems, described as follows:

- Cable deployment in the deep ocean, i.e. laying of a 17–20 mm diameter tube on the surface of the ocean floor, has a minor if not negligible one-off impact; and
- Cable repairs can result in substrate disturbance. However, cable failures in deep water are relatively rare and are mainly caused by major natural events.

[4]Carter, L., Burnett, D., Drew, S., Marle, G., Hagadom, L., Bartlett-McNeil, D., and N. Irvine., 2009. Submarine cables and the oceans – Connecting the World. UNEP-WCMW Biodiversity Series No. 31 – ICPC/UNEP-WCMC.

In addition, the submarine cable industry, together with environmental regulators, attempt to reduce or avoid any impact on vulnerable deep-water ecosystems by:

- utilizing modern seabed mapping and navigation systems that allow identification of benthic habitats in unprecedented detail and accuracy. Together with modern cable-laying techniques, it is now possible to deploy cables to avoid ecologically and biologically sensitive areas; and
- avoiding the deployment of cables on or through habitats such as seamounts, submarine canyons and hydrothermal vents, which are also unsuitable as cable routes due to the risk of natural hazards. For example, canyons are often swept by powerful currents that may abrade or break cables; and seamounts can be volcanically active and subject to landslides and hydrothermal venting.

Modern deep-water fibre-optic cables are composed of several pairs of hair-like glass fibres, a copper power conductor and steel wire strength member, which are all sheathed in high-density polyethylene.

Where extra protection is required - as for areas of rocky seabed or strong wave and current action - additional steel wire armour is added. Of these materials, cable-grade polyethylene is essentially inert in the ocean. Processes such as oxidation, hydrolysis (chemical breakdown in water) and mineralization are extremely slow; the total conversion of polyethylene to carbon dioxide and water will take centuries.

The effects of ultraviolet light (UV-B) - the main cause of degradation in most plastics - are minimized through the use of light-stabilized materials, burial into the seabed and the natural reduction in light penetration through the upper ocean, where the photic zone rarely extends beyond 150 m depth. Any mechanical breakdown of a cable's plastic sheathing to fine-grained particles on the energetic continental shelf – a potential hazard for marine life – is minimized by armouring and burial.

Hence, the overall potential environmental impacts arising from the project are limited. The key environmental interactions are in the near shore areas where cable requires burial to avoid potential entanglement with fishing activities and other human activities.

6.2.2 Intertidal Coastal Areas

Potential impacts to both the intertidal reef (adjacent to BMH1) and soft bottom (adjacent to BMH2) include:

- Direct loss of habitat in along the cable route.
- Physical effects of sedimentation on benthic communities as a result suspension of fine materials and off-site deposition.
- Reduction in water clarity due to increases in water-borne suspended solids concentrations and potential impacts on fish communities.
- Reduced access of local villagers to traditional fishing areas.

However, overall the potential impacts are not expected to be significant due to:

- The area disturbed represents a very small proportion of the total intertidal habitat present.
- The reef community has already been heavily modified as a result of sediment deposition and wave action.
- The short duration of trenching activities.

- Ability of the community to recolonise over time.

6.2.3 Land Acquisition and Resettlement

As described in Section 4.5.3, several mataqali have fishing rights in close proximity to the proposed subsea cable route. Given the nature of the proposed cable laying activities (i.e., installation period of short duration with low physical impact) it is not anticipated that these fishing rights, including and access to fishing resources will be adversely impacted.

The preferred BMH sites are located within state owned land. In addition, the cable will connect to cable stations to be located either at the AFL communications building adjacent to Savusavu Airport runway or the TFL building in Savusavu via an existing landing point, beach manhole and duct route.

No additional acquisition of private or iTaukei land is required. In addition, there will be no displacement of tenants or other land uses. In the highly unlikely event that any assets or livelihoods are found to be affected once the detailed design is completed, (perhaps tree trimming or temporary disruption of roadside stall), then the PMU will assess the losses and considerations with the affected people and ensure that no one is left worse off. The outcome will be documented in the project reporting.

6.3 Terrestrial Impacts

The terrestrial environmental and social impacts associated with the proposal are expected to be minor. Cable routes will be situated in public road reserves. None of the infrastructure placements require significant clearance of vegetation or interaction with significant habitats. As discussed above, it is possible there may be minor impacts on neighbouring people or property as a result of civil works, such as tree trimming, temporary, minor disruptions to traffic during installation.

6.4 Risk Assessment & Impact Identification Methodology

Risk Assessment is routinely undertaken as part of the ESIA process. In assessing a projects environmental risk, impacts are rated to determine the appropriate response or management actions that should be implemented to minimise potential impacts. The risk assessment methodology for the SCS Project is described in this Section.

The commonly adopted Australasian Standard for Risk Management[5] has been used to assess the level of risk posed by the activities associated with the Project and is based on the following: the likelihood or probability of an event; and the consequences of the impacts of that event occurring (see Table 6.1).

Table 6.1: Qualitative risk analysis matrix

	Consequence				
	1	2	3	4	5
Likelihood	Catastrophic	Major	Moderate	Minor	Insignificant
A - Almost certain	E	E	E	H	H
B - Likely	E	E	H	H	M
C - Possible	E	E	H	M	L
D - Unlikely	E	H	M	L	L
E - Rare	H	H	M	L	L

Risk Map Color Code
E = Extreme
H = High
M = Moderate
L = Low

[5] AS/NZS ISO 31000 Risk Management – Principles and Guidelines & the HB203:2006 Environmental Risk Management: Principles and Processes.

This is a conventional risk management framework and is considered applicable in the context of this assessment which has a focus on high level identification of biodiversity and ecosystem services risks. It is envisaged that the subsequent ESIA process will provide detail on these risk areas as appropriate.

There are four main levels of risk after combining the 'likelihood' and 'consequences' factors (see Tables 2 & 3). Each level has a response or management control action. The four 'Risk Levels' are:

- Extreme (E) Risk - those impacts that require immediate action at the highest level of management.
- High (H) Risk - those impacts requiring action at senior management level.
- Moderate (M) Risk - those that require policies in place to address impacts and monitoring programs.
- Low (L) Risk - those impacts that do not require any specific management actions but may be part of routine management and monitoring plans.

Table 6.2: Qualitative measures of consequence

Level	Descriptor	Env/Social Impacts	Legal	Public/Media Attention	Financial
1	Catastrophic	Significant extensive detrimental long term impacts on the environment, community or public health. Catastrophic and /or extensive chronic discharge or persistent hazardous pollutant. Damage to an extensive portion of aquatic ecosystem. Long term impact on water resource.	License to operate likely to be revoked or not granted	Probable public or media outcry with natonal/internati onal coverage. Significant green NGO campaign.	> $1 million
2	Major	Off-site release contained with outside assistance. Short to medium term detrimental environmental and social impact off-site or long term environmental damage on-site.	May involve significant litigation and fines. Specific focus from regulator.	May attract attention of local and state media and local community groups.	$500,000-$1,000,000
3	Moderate	Onsite release contained with outside assistance. Significant discharge of pollutant, possible source of community annoyance. Non persistent, but possible widespread damage to land. Damage that can be remediated without long term loss or very localised long persistence damage.	Probably serious breach of regulation. Possible prosecution and/or fine. Significant difficulties or delays experienced in gaining future approvals.	May attract attention of local media, heightened by local community.	$50,000-$500,000
4	Minor	On site release immediately contained without outside assistance. Ongoing or repeat exceedances of odour, dust or noise/vibration limits.	Minor on the spot fines or formal written correspondence from regulator.	Local community attention or repeated complaints.	$5,000-$50,000
5	Insignificant	Negligible environmental impact. Minor transient release of pollutant including odour, dust and noise/vibration. Minor social impact.	No serious breach of regulation. Minor license non-compliance.	Local landholder verbal discussion/compl aint.	< $5,000.

Table 6.3: Qualitative measures of likelihood

Level	Descriptor	Example	Frequency
A	Almost certain: Environmental issue will occur, is currently a problem or is expected to occur in most circumstances.	Is expected to occur in most circumstances	> once per year
B	Likely: Environmental issue has been a common problem in the past and there is a high probability it will occur in most circumstances.	Will probably occur in most circumstances	Once per year
C	Possible: Environmental Issue may have arisen in the past and there is a high probability that it should occur at some time.	Could occur	Once every 5 years
D	Unlikely: Environmental issue may have occurred in the past and there is a moderate probability that it could occur at some time.	Could occur but not expected	May happen within Project Life
E	Rare: Environmental issue has not occurred in the past and there is a low probability that it may occur in exceptional circumstances.	Occurs in only exceptional circumstances	Not likely to happen with Project Life

6.5 Outcome of Risk Assessment & Impact Identification

Tables 6.4 and 6.5 present the results of the risks associated with the proposed SCS Project. Key points in relation to identified 'Extreme' and 'High' Risk Project activities are outlined in the following Sections of this report.

Table 6.4: Issues & risk assessment - Construction

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation / General Comments	Post-Mitigation Residual Impact
			C	L	Rating		
1. Employment & OHS							
Cable trenching, Manhole construction, cable installation	Earthworks, vegetation clearance, etc	Employment opportunities	3	B	H	Positive overall benefit, no mitigation required	H
	OHS risk due to Earthworks, vegetation clearance, etc	Potential human hazards due to large machinery, noise, dust	1	C	E	Appropriate OSH policy implemented and OSH training offered	L
2. Terrestrial Ecology							
Cable installation	Minor vegetation removal and earthworks during cable trenching	Direct loss of terrestrial habitat	5	C	L	Little or no significant vegetation present, no mitigation required	L
		Terrestrial habitat fragmentation, general disturbance, pathway for invasive species	5	C	L	Little or no significant vegetation present, no mitigation required	L
		Impact on ecotourism operations due to loss of business as a result of construction activities	4	D	L	Construction period of short duration, no mitigation required	L
	Earthworks machinery	Noise & vibration creating bird (and other species) disturbance	5	C	L	No species of conservation significance identified, Construction period of short duration, no mitigation required	L
	Soil disturbance, spoil disposal	Sediment runoff into downstream watercourse, visual effects	4	D	L	Minor earthworks required, no spoil disposal required, mitigation consists of immediate trench re-instatement	L
3. Marine ecology							
Cable installation	Sub-tidal cable laying using cable trencher	Disturbance to soft bottom benthic communities	5	A	H	Minor construction footprint, sediments already prone to disturbance, no mitigation required	L
	Vessel movements associated with sub-tidal cable laying using cable trencher	Disturbance to pelagic species such as whales, dolphins, turtles	4	C	M	Limited occurrence with species in nearshore coastal environment, vessel movement slow, a trained independent observer to be present on board	L
	Cable installation along subtidal reef	Disturbance to coral reef communities due to presence of cable, colonization of cable	5	C	L	Very minor cable footprint, no mitigation required	L
	Intertidal earthworks during cable trenching	Disturbance of intertidal reef communities / birds	5	A	H	Minor earthworks required, small construction footprint, short duration activity, mitigation consists of immediate trench re-instatement	L
	Subtidal & intertidal works affecting informal fishing reserve	Direct & indirect impacts on fish & benthic communities within the adjacent fish reserve	4	D	L	Significant separation between Project site and fish reserve	L

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation / General Comments	Post-Mitigation Residual Impact
			C	L	Rating		
4. **Recreational & Heritage**							
Cable trenching, Manhole construction, cable installation	Earthworks activities	Loss of or disturbance to potential recreational & heritage resources	2	H	H	There are no known heritage resources at the proposed landing sites, or areas used for recreational purposes. Chance findings of heritage resources during the course of the project will trigger WB OP4.11 **TBC**	L
5. **Traffic**							
Cable installation, manhole construction, etc	Additional land traffic movements, lane closures	Issues due to additional traffic movements, congestion, increased risk of accidents, etc	2	H	H	Existing roads will be used to deliver and remove construction materials, and deliver equipment to and from the proposed landing sites. Additional vehicle movements expected to be minimal. No mitigation required.	L
	Vessel activity in nearshore coastal environment	Potential impact on existing recreational and commercial vessel activity	4	C	M	Ports Authority & local residents will be notified in advance	L
6. **Solid Waste**							
Manhole construction, etc	Residual materials following construction	Impacts on waste handling facilities	4	D	L	No mitigation required	L
7. **Noise & vibration**							
All construction activities	Construction machinery and related traffic	Impacts on adjacent sensitive receptors from excessive noise	4	C	M	Construction activity of short duration, limited sensitive receptors in close proximity, apart from appropriate noise attenuators on machinery no additional mitigation required.	L
8. **Air quality**							
All construction activities	Construction machinery and related traffic	Impacts on adjacent sensitive receptors from excessive dust	4	D	L	Construction activity of short duration, limited sensitive receptors in close proximity, apart from dust suppression using a water cart (if required), no additional mitigation required.	L
9. **Subsistence & livelihoods**							
Cable installation	Cable trenching activities in subtidal areas	Impacts on fish harvested for subsistence as a result of vessel movements	4	D	L	Nearshore cable installation of short duration, mitigation to include notice to locals of upcoming activities	L
	Cable trenching activities across intertidal reef	Impacts on both subsistence commercially targeted benthic fauna (e.g., sea cucumbers, octopus, clams, seaweeds, etc) in immediate areas of cable trenching	4	D	L	Construction footprint small and installation activity of short duration, subtidal reef already impacted, mitigation to include notice to locals of upcoming activities	L

Table 6.5: Issues & risk assessment – Operation (including maintenance activities)

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation / General Comments	Post-Mitigation Residual Impact
			C	L	Rating		
1. Employment & livelihoods							
Cable installation	Access to fibre cable	Improved telecommunications access to businesses and residents leading to additional employment opportunities	2	B	E[1]	Positive overall benefit, no mitigation required	E[1]
2. **Traffic**							
Cable installation	Vessel activity in nearshore coastal environment	Entanglement of anchor on cable	4	D	L	Due to burial and trenching of cable there is low risk of this occurring.	L

Notes: [1] The 'extreme' rating refers to a positive 'risk' and residual impact.

6.6 Cumulative & Induced Impacts

Cumulative impacts are those that result from the successive, incremental and/or combined effects of an action, project of activity.

It is envisaged that the SCS Project will not result in any long term adverse impacts to any identified environmental or social resources. No adverse cumulative or induced impacts are expected for all phases of this project.

6.7 Relevance of World Bank Safeguard Policies

WB Operational Policy	Application to Project	Potential Impacts	Mitigation Measures
OP4.01 Environmental Assessment	This OP is triggered by the commencement of the SCS Project because there will be minor environmental and social impacts to be managed.	As outlined in Section 6.2	Implementation of the ESMP (Section 7)
OP4.04 Natural Habitats	This OP is triggered as there may be some disturbances to marine ecosystems.	A) Cable laying activities in coral colonised near shore areas, particularly adjacent to BMH1, could cause damage to the live coral and result in unstable positioning of the cable. B) The laying of the cable in the marine environment will result in the loss of a small area of habitat including flora, specifically, seagrasses which provide habitat for juvenile fish species and benthic invertebrates.	A) Use diver and/or marker buoy guided cable placement and post lay surveys to ensure that the cable comes to rest on the sea floor in the wide channels identified through field surveys. B) No mitigations possible, loss of some seagrass areas are highly likely, however, the cable will either be buried during construction or the cable will bury itself in soft sediments over time. Seagrass areas will regenerate over time.
OP 4.11 Physical and Cultural Resources	This OP is triggered as a precaution. There are no known physical or cultural resources within the project impact area but chance find mitigations are recommended.		Any physical or cultural resources, as defined in WB OP4.11 that are discovered by chance during the course of the project development will be covered by the chance find procedures.

7 Environmental & Social Management Plan

7.1 Introduction

As outlined in MCIT (2015), the ESMP is organized into two cross-referenced tables, namely the environmental mitigation table (ESMiT) and monitoring table (ESMoT) provided in Tables 7.1 & 7.2 below. These two tables list in detail the mitigation measures and monitoring actions that the Executing Agency has committed to implement, from the planning through the operating period of the project. The ESMP table numbering is consistent such that reference can be made in the bid documentation or during any other monitoring activity and the correct mitigation and monitoring measure will always be found.

This approach makes for an ESMP that is practical and can be easily be used during bid document preparation as well as during project implementation. The ESMP will inform the Contractor's ESMP which will be prepared following detailed design.

7.2 Performance Indicators

Given that nearly all of the potential negative impacts would occur during the construction period, and that robust environmental contract clauses will be able to avoid all impacts. Key performance indicators will be as follows:

i) confirmation that the ESMP tasks are defined as specific individual or grouped environmental and social clauses in the contract bid documents.

ii) confirmation that environmental management criteria are included as part of the contractor selection process, including their experience preparing and implementing ESMPs, working in sensitive tropical locations such coral reefs, recognizing fish aggregation/spawning areas, seagrass meadows and seamounts;

iii) a safeguards advisor with marine ecology expertise located and retained as an advisor by the PMU, providing assistance with ESMP implementation, contractor briefing on marine habitat protection, contractor ESMP supervision (including observations during cable laying within the reef), and participation in community consultation;

iv) a written record of the briefing on safeguards and inspection of vessels, according to the tasks as they are defined in the ESMP and contract specification, completed with the survey and cable placement contractors, as soon as the contractors have been selected.

v) compliance monitoring checklists prepared and being used by the contractor and safeguards consultant and due diligence notes, completed as defined in the ESMP, and making the notes available in an easily accessible file for the contractor, Technical Coordinator, PMU Project Manager and others to use.

vi) a written mitigation and monitoring completion report, listing all mitigation and monitoring measures defined in the ESMP, their implementation timing, monitoring and any follow up actions; and,

vii) a written record of interviews with local fishers, examining any cable placement issues, vis-à-vis fishing gear damage.

The safeguards advisor will be responsible for preparing a performance indicator report on behalf of the PMU, by listing the seven items above and provide a short text to indicate how these items were implemented and their success as of the start of the operating period of the project.

7.3 Implementation Arrangements

The Project Management Unit (PMU) within the MOC will provide project management services on behalf of the MOC. It will be staffed by a number of consultants, including a part time safeguards advisor who will assist the PMU project manager with activities such as: ensuring the tender documents attach the ESIA/ESMP, and a requirement for contractors to prepare CESMP in accordance with the ESMP, review of Contractor's

CESMP, prepare and implement stakeholder engagement plans, and prepare safeguards reports as part of overall project reporting.

Contractual arranagements and supervision of the cable laying company will primarly be done by the SSCC and their TC. The PMU will work closely with this team. The safeguards advisor will ensure that the monitoring and supervision of the cable laying activities are coordinated with the Fiji-Samoa safeguards team.

7.4 Institutional Capacity

The Fijian Government has competent environmental compliance staff (Department of Environment) with likely sufficient capacity to fulfil their role in project delivery. Project management staff will have overall responsibility to ensure safeguard compliance in the preparatory and construction phase and will work in collaboration with key agencies with regard to safeguard requirements. The safeguards consultant will fill the gap in institutional safeguards capacity, to undertake the roles as outlined above. The World Bank safeguards specialists will also assist to build capacity for implementation of World Bank safeguards instruments during supervision missions.

7.5 Mitigation and Monitoring Costs

The cost of a part time safeguards advisor, with marine ecology experience, to implement the ESMP and monitor the Contractor's CESMP (including observations during cable laying within the reef area) is budgeted at $US60,000.

This work would include all reporting and contractor briefing. Monitoring vessels and any equipment will be provided by the Fisheries Department and/or the villages (paid for as a service by MOC), with the project also paying for fuel.

Social mitigation and monitoring measures where required are detailed in the ESMP.

Table 7.1: Environmental and Social Impact Mitigation Table (ESMiT)

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING/ DURATION	IMPLEMENTATION	SUPERVISION
1.0 Pre-Construction Period (Planning and design actions to prevent future impacts)						
1.1 Ecological Environment						
Ecological Environment	Disturbance of marine & terrestrial organisms and habitats	Prepare routing report based on detailed design demonstrating avoidance of significant habitat areas	Subtidal, Intertidal & terrestrial cable route	Prior to start of Construction	CLC & TC	PMU Safeguards Advisor
'No take' areas	Disturbance of marine organisms and habitats in 'no take 'areas	Cable alignment to avoid 'no take' areas	Subtidal & Intertidal cable route	Prior to start of Construction	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor
Reef Communities	Destruction of coral assemblages	In contract specifications instruct cable survey team to survey cable alignment for coral outcrops, and design alignment to avoid. Coral assemblages to be marked on design drawings.	Subtidal & Intertidal cable route	Preparing bid construction contract documentation	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor
Species potentially at risk (whales, dolphins, turtles)	Disturbance of marine cetaceans and turtles	Contract specifications to include best practice for operating vessels in proximity to marine mammals as included in the Code of Environmental Practice (COEP) document (see MCIT 2015).	Subtidal & Intertidal cable route	Bid & construction contract docs preparation	CLC, TC, contract specialist, PMU Safeguards Advisor	PMU & TC
1.2 Socio-Economic Environment						
Community Information	Misconceptions raising people's fears regarding project footprint and potential damages to marine food supply.	Specify in contract docs that at least one community consultation prior to commencement of civil works, during construction and after project completion to reduce concerns about construction impacts.	Savusavu, local villages (including Nacekoro)	Before civil work begins	PMU & TC	CLC
Community Grievances	Minor concerns/issues developing community resentment due to unaddressed project related concerns	Establishment of grievance redress mechanism prior to commencement of civil works and making this known to villages during follow up meetings before the work begins.	Local villages (including Nacekoro)	Before civil works begin	PMU	PMU

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING/ DURATION	IMPLEMENTATION	SUPERVISION
Access during landside trenching	Failure of contractors to do trenching work with minimal damage and access restrictions to property	Contract specs to include instruction concerning full rehabilitation immediately after trenching completed in one area. Develop notification protocol to provide notice of access restrictions, comprising the following steps: • Notification of the roadside residents by letter providing details of the project, potential access restrictions and likely timing of activities; • Follow-up telephone contact to confirm letter receipt and offer further consultation; • On-site meetings with affected residents (if requested); and • "Door-knock" notifications of residents 48 hours prior to trenching to provide details of work program, duration of access restriction and contact details in case of grievance. Develop a specific procedure, in consultation with hospital management, to ensure emergency access is maintained to local Hospital at all times.	Residents with access affected by trenching	Before civil works begin	PMU Project Manager	PMU safeguards advisor
2.0 Construction Period (Impacts associated with the work)						
2.1 Ecological Environment						
'No take' areas	Disturbance of marine organisms and habitats in adjacent fish reserve.	According to contract specs., the contractor(s) will ensure that: Cable is laid along surveyed route providing for a safe distance (≥ 75m) from FR as per cable laying specifications; & all survey and support vessels are kept at a safe (≥ 75m) distances from FR	Inshore Coastal area	When work is under taken.	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor
Reef Communities	Disturbance of coral reef communities	Contractor(s) to adhere to avoidance rule and lay cable along surveyed route, as per cable-laying specification, thus avoiding coral reefs and outcrops. Cable placement in to be diver-assisted to avoid coral heads.	Off & Inshore coastal areas	When work is under taken. Before work in coastal areas begins	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING/ DURATION	IMPLEMENTATION	SUPERVISION
Species of special Interest – Cetaceans	Disorientation of cetaceans due to sea floor mapping using standard sonar gear Entanglement in cable risk for deep diving cetaceans	Contractor to be provided with ECOP which contains detailed guidelines on minimally intrusive oceanographic survey method, which need to be adhered to. Control cable tension so that laid cable conforms to undulations of seabed as per cable laying specification and-or provide anchors if needed.	Oceanic deep-sea areas.	When work is under taken.	CLC, TC, contract specialist, PMU Safeguards Advisor	PMU & TC
2.2 Socio-Economic Environment						
Coastal Resource Users– subsistence and artisanal fisheries	Damage to local nearshore fishing grounds or introduce greater chances of gear entanglement	As per the contract specifications, contractor is to confine trenching activities to as narrow a corridor as possible and restore site when finished and confine trenching/laying activities to as short a period as possible Request Fisheries authorities to advise local fishers of cable laying activities, dates, and avoidance measures. Consider placing warning markers along cable line in shallow (<10 m) waters.	Offshore, Inshore Coastal areas.	When work is under taken.	CLC	PMU Safeguards advisor
Coastal shipping – commercial shipping and ports	Damage to ships through cable entanglement. Disruption to shipping during cable laying.	Ensure shipping notice is issued, warning of cable-laying, dates, and safe clearance for other activities. Request Port Authorities to advise local shipping of laying activities and avoidance measures. Contractors to provide written statement to TC that marine navigation lights and other national maritime measures are closely followed by contractors' vessels at all times.	Offshore and inshore areas (particular issue associated with main shipping channel).	When work is under taken.	CLC & TC	PMU Safeguards advisor
Land Use	Detour from agreed cable alignment Community perception of cable encroachment to 'no-go' fishing areas	Conduct a series of consultations with government, private sector and non-government organizations including women and youth on progress of work and cable alignment. These consultations have the objective of informing all interested people on the work and general alignment location and methods to used.	Savusavu	When work is under taken.	CLC	PMU Safeguards advisor
Access	Temporary loss of local communities access to fishing grounds during cable laying	Provision of electronic and print notices to local communities/ fishermen of construction schedule and contact person in case of inquiries.	During cable laying	When work is under taken.	CLC	PMU Safeguards advisor

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING/ DURATION	IMPLEMENTATION	SUPERVISION
Inadequate information disclosure	TC and CLC fail to include villages in final alignment planning and decision making	TC and CLC, prior to start of work, present draft plan to villages and seek input and agreement on final alignment plan, etc.	Savusavu, Nacekoro & Raranipolo	At start of construction	CLC & TC	PMU Safeguards advisor
3.0 Operating Period						
3.1 Physical & Ecological Environment						
Perceived marine pollution from work	Fear of potential damages to marine life and impact to food supplies by communities	Cable Operating Company to develop inhouse procedures for receiving and addressing complaints.	Savusavu	At start of operating period	Cable Operating Company	MoC
3.2 Socio-Economic Environment						
Impact associated with improved Internet—better access to harmful sites	Failure to adopt measures and continue mitigation actions defined in the Construction Period Environmental Completion report.	Make population aware of 'internet site blocking features available to every subscriber; possibly via a village advisory group.	When in use.	At all times	Service provider and An appointed NGO or women's group	MoC

Table 7.2: Environmental and Social Impact Monitoring Table (ESMoT)

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
1.0 Pre-Construction Period						
1.1 Ecological Environment						
Ecological Environment	Disturbance of marine & terrestrial organisms and habitats	Ensure routing report is prepared demonstrating route avoidance of habitats	Prior to construction	Routing report	CLC & TC	PMU Safeguards Advisor
'No take' areas	Disturbance of marine organisms and habitats in 'No take' areas.	Confirm contract specification in place as indicated in ESMP	During preconstruction period	Written and signed DD inspection note-to file	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
Reef Communities	Failure to plan route around sensitive reef communities	Confirm that appropriate specification contained bid documentation	During preconstruction period	Written and signed DD inspection note-to file	CLC, TC, contract specialist & PMU	PMU Safeguards Advisor
Species potentially at risk	Ocean sonar survey affecting cetaceans. Entanglement in cable by deep diving cetaceans such as the sperm whale.	Confirm inclusion in contract specifications	When specifications are being written	Record to file	CLC, TC, contract specialist, PMU Safeguards Advisor	PMU & TC
1.2 Socio-Economic Environment						
ESMP implementation monitor	Lack of an experienced safeguards advisor will likely lead to delayed or failed implementation of ESMP items, e.g. no clauses in the bid docs.	Confirm that an experienced safeguards advisor is on staff at the start of the project	At start of the detailed design stage	Note to file	PMU Project Manager	MoC, World Bank
Community Information	Misconceptions regarding the project raising people's fears regarding project footprint and potential damages to marine food supply.	Confirm that community consultation activities are taking place	At key project milestones	Note to file	PMU project manager	Safeguards Advisor
Community Grievances	Minor concerns/issues developing community resentments due to unaddressed project related concerns.	Confirm that requirements for a grievance redress mechanism is in Contract specifications. GRM is also implemented and records kept by PMU.	During detailed design stage At all stages	A note to file Records kept	PMU project manager	Safeguards advisor
Access during landside trenching	Failure of contractors to do trenching work with minimal damage and quick complete rehabilitation or roadside damage	Confirm that specifications are in contract documents and that notification protocol for access has been developed.	During contract preparation period	Note to file that check was completed	PMU Project manager	Safeguards advisor

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
2.0 Pre-Construction Period						
2.1 Ecological Environment						
Fish Reserve	Disturbance of marine organisms and habitats in FR.	Inspect cable laying operation in coastal waters and confirm avoidance	As soon as work takes place inside the passage into nearshore waters	Record of inspection and findings—written and photos	Safeguards Advisor	TC
Coastal and Deep Ocean Habitats	Accidental discharge of pollutants from vessel.	Inspect both survey and cable laying vessel of contractor and confirm compliance	At start of work and for all vessels used	Written compliance checklist	Safeguards Advisor	TC
Coral Communities	Disruption to coral communities	Inspect cable laying operations in vicinity of coral formations and confirm compliance	When work is in vicinity of coral areas Defined during the detailed design work	Written compliance report. Confirm that CLC has coral map	Safeguards Advisor	TC
Species of Special Interest – Cetaceans	Entanglement in cable risk for deep diving cetaceans	Discussion with person in charge of cable placement to confirm understanding re cetacean sensitivity	At start of survey and start of cable placement	DD note to file	Safeguards Advisor	TC
2.2 Socio-Economic Environment						
Land Use	Straying of agreed to cable alignment into adjacent areas. Community perception of cable encroachment to 'no-go' fishing areas.	Obtain review and file record/notes/ minutes of consultations completed	Within 5 days of land use issue consultation taking place	Copy of record of meeting completed	CLC	PMU safeguards advisor
Access	Temporary loss of access to fishing grounds for local communities during cable laying.	Inspect material distributed and confirm timely distribution	At start of construction where access restrictions could arise	Copy of material distributed	CLC	PMU safeguards advisor

8 Grievance Redress Mechanism

No significant environmental and involuntary resettlement issues associated with the proposed project have been identified at this stage. However, a grievance redress mechanism (GRM) is presented in the event that at a later stage there is a need. A grievance could, in theory, arise as a result of fishing gear becoming entangled on the cable, presumed to be due to due to faulty cable placement or as a result of the failure of the contractor to restore the trench following completion of cable installation.

The GRM is scaled to the risks and adverse impacts of the Project. If promptly addressed, and using an understandable and transparent process that is gender responsive, culturally appropriate, and at no costs and without retribution, the concerns and complaints of potentially affected people will usually be resolved.

The GRM mechanism does not impede access to regular judicial process, but simply provides a simpler access to complaint resolution. The PMU will inform community members about the GRM before commencement of any civil works. This will be done as part of consultation session where engineering details costs and feasibility will be tabled (see Table 7.2 ESMoT Item 3.1).

The following six-step mechanism (Table 8.1) is proposed for grievance redress of social and environmental matters.

Table 8.1: Grievance Redress Process

Step	Process	Duration
1	Affected Person (AP) / village elected or traditional chief takes grievance to PMU or Contractor	Any time
2	PMU or contractor reviews issue, and in consultation with village matai or traditional chief, relevant agencies and contractor (if appropriate), agrees to a solution and records the results.	2 weeks
3	PMU reports back to Mataqali and AP and gets clearance the complaint has been resolved.	1 week
If unresolved		
4	Mataqali take grievance to MoC staff for resolution (or the Department of Environment)	Decision within 2 weeks
5	If not resolved MoC staff or DoE staff must take matter to MoC Permanent Secretary for decision.	2 weeks
6	Permanent Secretary can deliberate for ≤ four weeks and resolve the case	4 weeks
If unresolved or if at any stage and AP is not satisfied with progress		
Mataqali can take the matter to appropriate state or national court.		

Notes: Adapted from MCIT (2015)[1]

During implementation, the PMU project manager will be responsible for interacting with the GRM. The PMU will be the grievance focal point, and receive and address project related concerns, via the designated staff member. Concerns will be resolved first by the PMU project manager and contractor. Affected people will be made fully aware of their rights regarding land ownership and environmental degradation (Fiji Department of Environment). During the construction period the contractor will be a key participant in the grievance redress process, and the PMU Project Manager will need to confirm that the contractor has assigned a GRM coordinator. The safeguards consultant can support this process and provide any guidance / advice as required.

Any complaint will be recorded and investigated by the PMU project manager and the contractor (as appropriate). A complaints register will be maintained, and will show the details and nature of the complaint, the complainant's name, the date and actions taken as

a result of the investigation. The register will also cross-reference any non-compliance report and/or corrective action report or other relevant documentation filed in relation to the original complaint.

When construction starts, a sign will be erected at all sites providing the public with updated project information and summarizing the grievance redress mechanism process including contact person details at the PMU. All corrective actions and complaint responses carried out on site will be reported back to the PMU. The PMU will include the complaints register and reporting on corrective actions/responses in its semi-annual progress reports to the World Bank.

Throughout this process, the Department of Environment will always be available to hear public complaints and provide advice if the complainant feels that PMU responses are not satisfactory. The PMU will make sure that this cooperation is available.

9 Appendices

Appendix 1: ToR & Addendum

Terms of Reference

Environmental Assessment

Savusavu Branch of the Samoa – Fiji Submarine Cable Project

A. BACKGROUND AND PROJECT DETAILS

1. The Government of Fiji (GoF), is planning to invest in a submarine cable system (SCS) to connect Savusavu, Vanua Levu, with the proposed Samoa – Viti Levu cable, thereby connecting Fiji's second largest island to the same standard of ICT access as Viti Levu. The GoF has approached WB for funding support for Savusavu Branch Project (the Project).

2. Rapid technological changes, a volatile business environment and weaknesses in the regulatory environment can create commercial and sovereign risks for the development of an SCS. In addition, any environmental and social issues that may arise from an SCS development need to be assessed and mitigation and management plans prepared in accordance with Fiji legislation and WB safeguard policies.

3. The objective of the Project is to reduce the cost and increase the availability of ICT services to support social and economic development on Vanua Levu. The Project is expected to contribute to improved public service delivery (including online government services, health and education and financial services); increased private sector development opportunities, and reduced transaction costs for businesses and individuals; and national and regional integration objectives of improved service delivery, trade and communications between Viti Levu, Vanua Levu and other Pacific island economies.

4. The implementing agency, and the project proponent, is the Division of Communications in the Ministry of Communications and Information Technology (MOCIT).

Key infrastructure and location

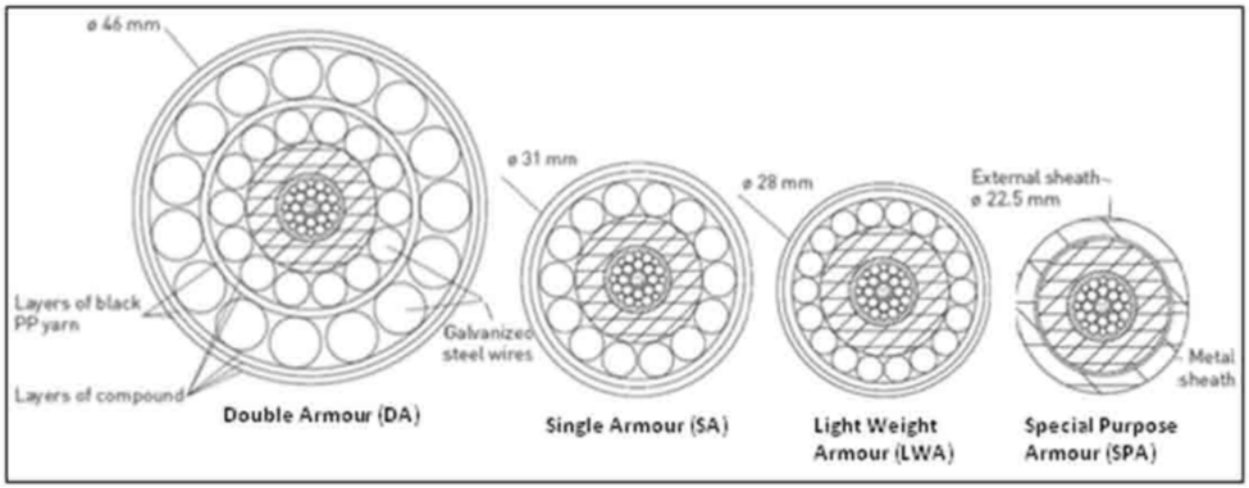
5. The basic infrastructure components will comprise:

   a. approximately 200km of fiber optic cable (incorporating repeaters) laid on or beneath the sea floor;

   b. a beach manhole landing facility and cable station at Savusavu.

   c. The diagram below shows indicative cross-sections of potential cable types.

Figure 1 Cross Section of Potential Cable Types



Location

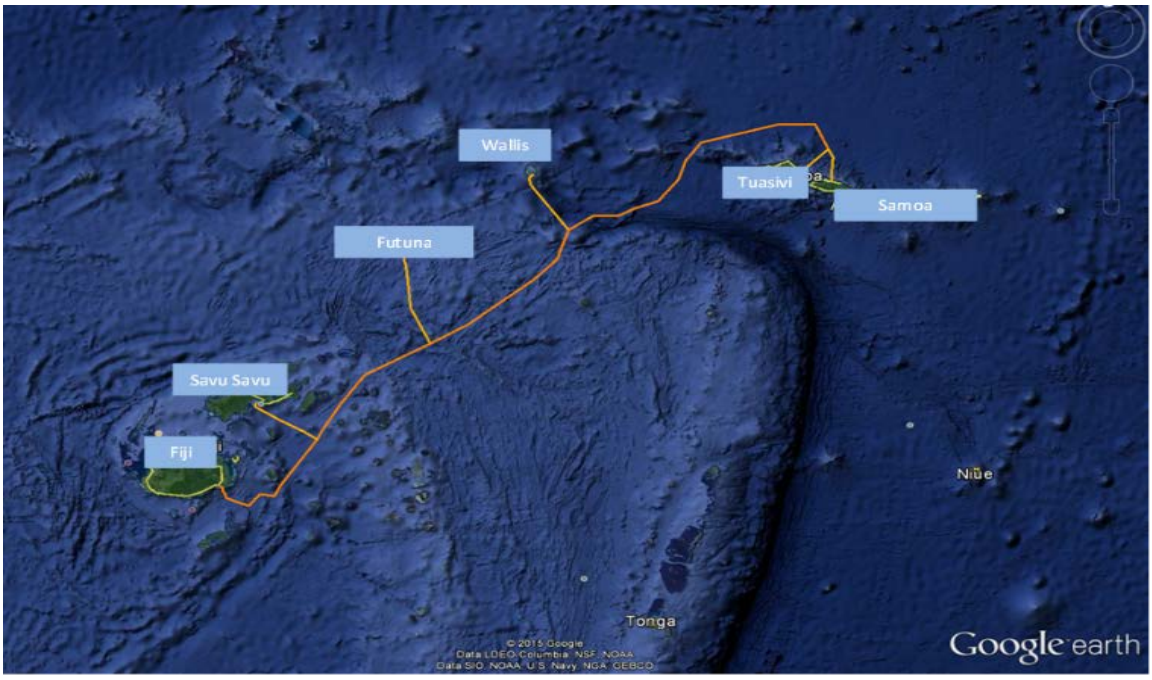
6. The location of the MH landing site and cable station at Savusavu has not yet been confirmed, but there are two probable options:

   a. Beach manhole near the airport and a connection to Telecom Fiji's (TFL's) building in Savusavu (buried cable for a short distance along the road edge).

   b. Beach manhole near the airport and construction of a small landing station 200m above on hill.

7. The defined route and the location of the beach manhole and cable station will be determined through the design process and will be informed by the EMP prepared under this Tor. The Fiji-Samoa route, with the Savusavu branch, is shown below.

Figure 2 Samoa to Fiji Cable Route, Showing Suggested Savusavu Branch



8. For the purposes of this ToR, the Consultant shall screen the broader area around the airport for high risk areas that should be avoided.

Project Design and Installation Process

9. It is proposed that the Savusavu link will be installed at the same time as the Fiji-Samoa Cable. The feasibility studies and surveys will be done concurrently. Feasibility studies include a detailed desk top study of the environmental features and technical aspects of proposed routes, landing sites and on-shore infrastructure.

10. Following the feasibility and safeguards due diligence studies, the main construction-phase activities of the Project will be:

a. a detailed marine survey to characterize the route and avoid hazards and/or environmentally significant zones. Surveys include water depth and seabed topography, sediment type and thickness, marine faunal/floral communities, and potential natural or human-made hazards. A marine route survey for a SCS installation commonly assesses a seabed corridor from 1 to 10 km wide with repeat passes where necessary;

b. detailed design of the submerged infrastructure – the cable and repeaters. This will determine the cable route and cable types and quantities, and clarify the nature of its deployment on the seafloor – surface laying, or trenching and burial, supplementary protection, etc.;

c. confirmation of the detailed design by the GoF;

d. application for all relevant permits and authorizations by the various Fiji Government agencies (including preparation of EIA and land access authorisations), and clearance of safeguards documents (such as EMP) by the World Bank;

e. construction of a landing facility and cable station at Savusavu. It is likely to comprise a small beach manhole (BMH) approximately 2m x 2m x2m. The shore end, from the BMH to the sea, will be covered with standard articulated piping bolted to the rock shelf then double armoured cable to a depth of 200 metres followed by single armoured cable to 1000 metres depth and then lightweight protection. The marine survey and system design in (a) and (b) above will determine this.

f. cable laying – the cable will likely be buried in the shallow water approaches to the landing site and surface-laid along the deep water route. In sections where the cable is not buried it will lie directly on the seabed. Where burying is undertaken, the most effective method is by sea plough (i.e. as a cable approaches the seabed, it is fed through the plough, which inserts the cable into a narrow furrow).

g. The exact terrestrial arrangement is still to be defined but likely to involve burying cable between the beach manhole and the cable station and the construction and operation of the cable station (a small building with electrical equipment to allow for connectivity between the cable and the local communications networks). This is most likely to be situated on existing telecommunications or other Government owned land in Savusavu, in the line of sight of existing satellite communications equipment.

Scope of WB Safeguards Requirements

11. In accordance with WB safeguards policy OP4.01 Environmental Assessment, an

environmental assessment of the Project is required to adequately screen and assess potential environmental and social impacts, and to prepare an Environmental Management Plan (EMP).

12. The EMP shall be consistent with the Samoa – Fiji Connectivity Project EMP, as the projects will be implemented concurrently under the same, or similar supply contract, and the risks and issues will be similar in nature and scale.

13. The EMP shall be subject to consultation with affected stakeholders and publicly disclosed prior to the World Bank project appraisal.

B. COUNTRY CONTEXT

14. The Project is intended to deliver high-capacity lower cost Internet services to the relatively disadvantaged Northern Division of Fiji, consistent with the Government's policy objectives of accelerating development in those areas. Following telecoms market liberalization in 2008, access to ICT infrastructure and services has improved dramatically across the country. However, access, particularly to internet, is not evenly distributed. Vanua Levu and neighbouring islands account for about 16 percent of the country's population (about 150,000 people), but only about 10 percent of total telecom traffic, in aggregate. Demand for Internet bandwidth in the Northern Division is forecast to increase from present levels of about 1.5 Gbps to 19 Gbps in the next 10 years and to 170 Gbps within 25 years. Existing connectivity solutions for Vanua Levu via satellite or microwave links will be insufficient to provide the required bandwidth capacity and quality. High-speed Internet offers wide-ranging economic and social development benefits. In addition, and as evidenced by recent experience in Fiji, an optical fibre cable backbone offers greater resilience than terrestrial backbone (microwave) in the event of cyclones.

15. The majority of land in Fiji is under customary land ownership by iTaukei. The State owns the seabed below High Water Mark. Customary rights to fishing and marine resources in the reef, or qoliqoli rights, are assigned to much of the coastline. These are administered by the iTaukei lands and Fisheries Commission.

16. A list of some of key agencies have responsibilities with regard to the Project development in Fiji. These are:

a. The **Department of Environment** whom administer the *Environment Management Act 2005*, compliance of environmental impact assessments with the Act, issuance of environmental permits and implementation of environmental management plans by Project proponents and developers. The Department also manages Fiji's participation in international conventions on biodiversity and the environment.

b. The **Department of Lands and Survey** is vested with authority to grant lease over State Land, including soil under Fiji's waters, should such a lease be deemed necessary in order to lay the cable.

c. The **Fiji Ports Corporation Limited** has authority, under the *Sea Ports Management Act 2005* and the *Marine Act 1986*, over the port of Suva and its approaches, including all shipping operations and shore and sea-based installations.

d. The **Ministry of Fisheries and Forests** manages fisheries in Fiji and administers the *Fisheries Regulations 2004*.

e. The **iTaukei Lands Trust Board** administers leases on iTuakei land, on behalf of the custom land owners.

f. The **Maritime Safety Authority of Fiji** has responsibilities to manage shipping movements and other aspects of marine safety during cable laying, and administering protective measures once the cable has been laid, such as updating maritime charts with new infrastructure and enforcing no-anchoring zones.

17. An Environmental Impact Assessment and Environmental Management Plan may be required by the Department of Environment for the environmental permit, once the detailed design has been completed. It is not the subject of this Terms of Reference.

C. SCOPE OF SERVICES

18. A consulting firm (or team of individual consultants) will be hired to prepare safeguards documents in compliance with WB safeguards policies and the country safeguards requirements of Fiji[1]. In general the following tasks are required:

a. Undertake a scoping of the environmental and social context, and screening of potential impacts, in the proximity of the likely location of infrastructure;

b. Prepare an EMP to cover the Project's design, construction / installation, and operation and maintenance, consistent with the Fiji-Samoa Connectivity Project ECMP;

c. Prepare an Environmental Code of Practice (ECOP), consistent with the Fiji-Samoa Connectivity Project ECOP;

d. Identify stakeholders, and assist with consultation and disclosure of safeguards documents.

19. The consultant will submit final drafts for comment, and submit a final and acceptable documents.

D. DETAILED TASKS FOR THE CONSULTANT

20. The safeguards assessments will be undertaken in compliance with both WB policies and requisite laws of Fiji.

Task A: Consultation, Lessons Learned Analysis and Review of Existing Information.

21. The Consultant will be provided with a description of the proposed activity from the Department of Communications.

22. For further background information, the Consultant should review the safeguard documents and consult with the project management unit for the Fiji-Samoa Connectivity Project (World Bank project no. P128904) and review the technical and safeguards documentation. These consultations should focus on the adequacy of environmental and social safeguards and lessons learnt from project implementation. Similar recent projects include: Tonga-Fiji Connectivity Project (World Bank project no. P113184), Tonga-Fiji Submarine Cable Project (ADB project no. 44172-022), Palau-

[1] As discussed in paragraph 18, it is anticipated that the preparation of EIA and environmental permit applications under the Environment Management Act will not be required as part of the scope of work, but the Consultant should ensure that the work is consistent with this and other legislation.

Federated States of Micronesia Connectivity Project (World Bank project no. P130592).

Task B: Policy, Legal and Administrative Framework.

23. The consultant will review and document applicable policy, legal and administrative mechanisms related to both the biophysical and socio-economic environments. This will include the policies, legislation and permitting requirements of the various government Ministries and agencies, relevant international statutes and agreements related to the marine environment and applicable WB safeguard policies.

24. The consultant will also be guided by, and include consideration of, WB's draft Environmental and Social Safeguard Instruments for the Pacific Island Countries (ESSIP).

Task C: Description of the Environmental and Social Context

25. The consultant is to define a suitable project influence area (PIA) based on the proposed corridor of the marine cable, and the proposed location(s) of terrestrial infrastructure, and all reasonable alternatives. This must cover the land-based and reef-based activities.

26. The consultant will compile relevant data on the biophysical and socio-economic environment within, and in proximity to, the PIA. This compilation is to include maps and illustrations where appropriate. The studies will include desk top collation of information and will involve one field visit to Savusavu. The purpose of the data collection is to describe the nature of the environment, describe the social context, identify sensitive sites and receptors that should be avoided by the project.

27. The consultant is required to complete the following surveys within the project area of influence:

    a. Confirm the land uses and land ownership at probable proposed beach manhole and cable station locations in Savusavu.

    b. Marine survey of the reef area between the outer reef and the high water mark, along proposed / likely cable routes. This shall include a visual survey of the benthic and pelagic species / communities present in the reef at representative sample sites. Data shall include GPS location, water depth, water currents / movement, weather, water clarity / visibility, substrate, percent live coral cover and general condition of the reef, notable species (fish, hard and soft corals, other invertebrates, mammals, turtles), and notable communities (sea grasses, mangroves and live corals). Shipwrecks and other archaeological, cultural or historical artefacts or sites should also be noted.

    c. Informal and commercial activities and uses of the reef and foreshore areas, such as fishing, gleaning, sand mining, tourism, shipping or other maritime activities or industries.

28. The following information is to be gathered through desk top review and interviews with stakeholders / key informants:

    a. Near shore and reef hydrography and bathymetry, tidal data or any other data required to support the marine survey.

    b. Conservation and marine management areas, including qoli qoli fisheries areas,

marine protected areas and terrestrial conservation areas/protected areas.

c. Archaeological sites, sites of cultural significance or other physical cultural resources.

d. Social context of Savusavu and Vanua Levu. Characteristics should include basic socio-economic data, population, current access to internet and other communications technology and benefits of the project (access to markets, connectivity, employment etc.), issues relating to gender or vulnerable persons in relation to ICT, land ownership and tenure and marine resources ownership and tenure.

Task D: Impact assessment

29. The consultant will identify the sensitive receptors in the PIA and identify potential positive and negative environmental and social impacts associated with each phase of the project: Design / Route Selection, Cable Laying and construction of land based infrastructure, (ii) Phase 2- Operations & Maintenance Phase. The assessment will clearly identify any information gaps to be filled during project implementation / detailed design phase.

30. Sensitive receptors may include: protected areas (cultural, conservation, resource management), in-tact / healthy coral communities, breeding or refuge grounds (sea grasses, mangroves), and vulnerable households or communities.

31. The consultant shall also note any areas of potential conflict with the laying of the cable that should be avoided, such as: shipping lanes, anchorage sites, dredging or mining sites.

32. The consultant shall identify the social benefits and negative impacts from the project, with a focus on the connectivity of Vanua Levu to improved communications technology. This should focus on any specific benefits or impacts based on gender or the vulnerability of groups. The EMP should highlight any relevant proactive measures to ensure project benefits to women as well as men.

Task E: Environmental Management Plan (EMP)

33. The Consultant shall prepare the EMP, in accordance with the outline proposed in Annex 2 and consistent with the Fiji-Samoa Connectivity Project EMP and the Environmental and Social Safeguard Instruments for the Pacific Island Countries (ESSIP).

Task G: Environmental Code of Practice (ECOP).

34. The consultant will prepare a code of environmental practice (COEP) for submarine cables based on the ECOP prepared for the Samoa Cable Project, adapted where relevant for the Savusavu context. The ECOP will be appended to the EMP.

Task I: Meaningful Consultations and Disclosure of Safeguard Documents.

35. The consultant will identify potentially affected stakeholders (with the assistance of Government of Fiji representatives) and hold at least one meeting with these stakeholders (as a group, or individually), to present and discuss the findings and proposed mitigation measures in the EMP, and to seek views and inputs before finalizing the EMP.

36. The consultant will maintain adequate records of the consultation process and will present a summary in the final EMP. Consultation materials should be translated to the local language and disclosed locally to ensure that there is widespread understanding of the project, its objectives and timeline.

Task J: Grievance Redress Mechanism.

37. The consultant will establish and define the Grievance Redress Mechanism (GRM). The GRM should be based on existing and traditional mechanisms to the extent possible, and describe the options available to stakeholders and/or project affected persons for redress of any grievances they may have about the process, the identification of eligible people for compensation, the valuing and compensation and any other complaints (including issues or concerns about environmental impacts) they may have with the entire process. It should be consistent with the ESSIP and World Bank safeguard policies.

38. The GRM mechanism should also have an in-built monitoring mechanism to check on responsiveness to complaints or grievances lodged. The different forms of receiving the complaints should be clearly described together with the different stages of the process, who is involved and when. In addition, the GRM shall indicate alternatives, in case the proposed mechanism, for any reason, does not respond to all grievances and complaints.

E. REQUIRED SKILLS OF THE CONSULTANT

39. The assignment requires a suitably qualified individual or team with knowledge of, and relevant professional experience with conducting environmental and social impact assessments for similar projects. Experience in conducting assessments and consultations in Fiji will be advantageous. The consultant must have experience in producing ESIA and EMP under World Bank safeguards policies or other similar donor safeguards policies. The following skill sets are required[2]:

a. Marine ecologist: At least a degree qualification in environmental science, marine science, ecology, resource management or similar. Experience in environmental impact assessment in the Pacific in the past five years and demonstrable experience in competently undertaking scientific marine visual assessment surveys of tropical reefs.

b. Social specialist: At least a degree qualification in social science, public policy, planning, anthropology or similar. Experience in public and stakeholder consultation, social impact assessment and / or land acquisition for similar infrastructure projects in the Pacific in the past five years. Gender and poverty assessment experience is an advantage. Experience and knowledge of the laws and regulations of land and natural resources in Fiji is required.

40. A team leader should be assigned who will be responsible to (i) take overall responsibility for quality and timely delivery, monitoring and reporting on all outputs by managing and coordinating the activities of the other consultants; (ii) to prepare a work plan/schedule for the completion of the safeguards documents, consultation and disclosure; (iii) and (iv) prepare the documents as required in Section F.

[2] This is not a list of personnel, and one person may be able to fulfill more than one role. Additional team members may be included where necessary.

41. Anticipated level of effort required in total: 18 days.

F. DELIVERABLES OF THE CONSULTANT

42. The consultant will be required to visit Vanua Levu to compile baseline data, undertake marine survey, to conduct stakeholder and key informant meetings to identify issues.

43. Consultations will be required in Suva, with relevant Government agencies, and in Savusavu with potentially affected stakeholders.

44. Subject to the guidance and approval of the Division of Communications, a set of documents that will comply with WB requirements, consistent with the laws of Fiji, will be prepared:

a. Environmental Management Plan, incorporating the ECOP

G. Timeline

45. The assignment will be implemented against the following, suggested, timetable. Work is expected to be completed by xxxxx. On contract signing the timetable will be reconfirmed.

Milestone	Time from Contract Signing
Field trip to Savusavu	Week 1
Draft documents	Week 3
Division of Communications and WB review of draft	Week 3
Consultations in Suva and Savusavu	Week 3
Final of all documents	Week 4

ANNEX 1 – RELEVNANT WORLD BANK SAFGEUARD POLICIES

Environmental Assessment (EA) (OP4.01) – inter alia, requires (i) detailed qualitative and quantitative analysis to determine project impacts,(ii) determination of tangible measures to prevent, minimize, mitigate or compensate for these adverse impacts, (iii) public consultation and disclosure as part of the EA process and (iv) requires an EMP to address set of mitigation, monitoring and institutional measures to be taken during design, implementation, operation of maintenance phases of the project.

http://go.worldbank.org/K7F3DCUDD0

Natural Habitats (OP4.04) – This policy requires the conservation of natural habitats and specifically prohibits the support of projects that involve significant conversion or degradation of critical natural habitats, as defined by the policy. The policy further requires the EA to identify impacts on biodiversity and species and to determine endemism, endangered species and to determine project impacts on these species and to propose acceptable mitigation and monitoring measures.

http://go.worldbank.org/GIFQKJA130

Physical Cultural Resources (OP4.11) – This policy seeks to avoid the disturbance and or destruction of PCR as defined by the policy by the projects activities. PCR includes places of worship, buried artifacts, cemeteries and archeological assets, etc. The policy further requires, (i) EA to undertake an exhaustive desk review and/or site investigation to pre-identify and locate PCR's in the project influence area, (ii) EA/EMP to propose management measures and (ii) to include chance find clauses in civil works contracts during construction and maintenance stages.

http://go.worldbank.org/UBUBZD7NA0

FIJI Connectivity Project (P159297)
Addendum to the TOR for Environmental Assessment

3 August 2016

Outcomes of Recent Field Visit by Project Team

1. The Director of Ministry of Communications, FINTEL, TFL and World Bank representatives visited Savusavu, Vanua Levu, on 21 and 22 July to identify suitable beach manhole and cable landing station locations. Six beach manhole and two cable landing station locations were visited and the relevant field notes are attached.

2. There are two preferred beach man hole (BMH) locations near to the Savusavu airport (BMH1 and BMH2) which are technically feasible, have few environmental and social issues and are on Government land which will should make land acquisition / easements simple. Site BMH1 is at the eastern end of the runway, on Government owned land (Airports Fiji Limited (AFL)) and requires the submarine cable to cross a short section of reef. Site BMH 2 would take advantage of the natural channel in the reef and the submarine cable would come to shore to a beach manhole on the adjacent road reserve. The preferred cable landing station site is on Government land across the road from the runway. The site is used for various communications equipment for AFL, including a small shed and aerials, and there is room for an additional structure.

3. The Ministry of Comms may take two alternatives, or a preferred alternative through to project appraisal by the World Bank.

Updates to the TOR for the Environmental Assessment

4. Detailed marine field work shall focus on the two preferred sites for the BMH. This includes the probable submarine cable path from the outer reef to the two beach sites. BMH 3, 4 , 5 and 6 shall be assessed as potential alternatives in the documentation, and will need a site visit, but do not require marine surveys or detailed investigations.

5. Unless the Ministry of Comms provides the consultant with a final preference, the EMP must consider both BMH1 and BMH2 and both cable landing stations in the assessment and mitigation / monitoring plans.

6. The Ministry of Communications and FINTEL have agreed to lead public and stakeholder consultations in Savusavu before the 26th of August. This will be a public meeting and possibly a site visit to discuss the purpose and benefits of the project, and to discuss the potential impacts from civil works and cable laying and present the EMP. The Consultant shall provide materials to support the consultation, but is not required to be present or to manage the public consultation process. The Consultant can undertake separate stakeholder discussions and consultations as part of their investigations.

7. The Consultant is not required to prepare or adapt a specific COEP for Savusavu. Rather the Consultant shall just refer to the COEP in the Fiji-Samoa documentation.

Annex 1: Notes From Field Trip 21,22 July 2016

The purpose of the site visit was to identify suitable sites for the beach manhole and cable landing station from a technical and safeguards perspective. A summary of the sites visited are provided in the table below.

The preferred sites are:
Beach man hole:
BMH 2 – West of Runway, Road Reserve, or
BMH 1 – Eastern end of Runway, Airports Fiji Limited (AFL) land
Cable landing station: AFL Communications Site, over the road from Savusavu runway

Site Code	**Site Description**	Safeguards Discussion	Comparative Safeguards Ranking
Beach Man Hole Locations			
BMH 1	**Eastern end of Runway.** Govt Land (AFL). Submarine cable would cross a small section of reef. Within 1km of AFL Comms site for Cable Landing Station. Terrestrial cable would use existing TFL ducts along road reserve. Some reef use by fishers / gleaners.	Potential risks to laying cable across reef (unknown until ESIA carried out). Govt land means straight forward land acquisition. MOU or similar could be obtained by appraisal.	Good. Need ESIA to identify risks with laying the cable over the reef.
BMH 2	**West of Runway – Road Reserve** Road reserve adjacent to foreshore. Govt Land. Cable would cross the reef via a natural sandy channel. Terrestrial cable would follow existing TFL ducts to either Cable Landing Station option.	Govt land means straight forward land acquisition. MOU or similar could be obtained by appraisal. No significant habitats.	Best
BMH 3	**West of Runway – iTaukei land** Village / iTaukei land to the West of the Runway. Will require iTaukei Land Trust	Impossible to consult and get land acquisition / lease / easement approvals before appraisal. Community support or	Poor

	Board to assist with land acquisition / lease / easement. Submarine cable would cross the reef via a natural sandy channel. Terrestrial cable would follow existing TFL ducts to either Cable Landing Station option.	opposition unknown. No significant habitats.	
BMH 4	**Private land to West of Runway.** Currently covered in 'scrub' and palms (not plantation). No current land use / agriculture observed. Could not get access to the BMH site during the site visit. Short access path/road across the site from the road or runway would be required and vegetation would need to be cleared. Submarine cable would cross the reef via a natural sandy channel. Terrestrial cable would go under the runway or along road within existing TFL ducts to either Cable Landing Station option.	Difficult/impossible to consult and get land acquisition / lease / easement approvals before appraisal. Mangroves present and should be avoided. Some vegetation clearance required for access which should be minimized.	Poor
BMH 5	**Naidi Bay** BMH at Road Reserve adjacent to the beach / small estuary. Cable would enter the bay without crossing a reef. Several kilometres of terrestrial cable to either Cable Landing Station.	Govt land means straight forward land acquisition. MOU or similar could be obtained by appraisal. No significant habitats.	Good
BMH 6	**Daku Resort** South of Savusavu town in Savusavu Bay. The 'original site' drawn in the contractors tender documents. BMH in road reserve. Exposed coastline with evidence of erosion from recent cyclone Winston.	Exposed site which may require more civil works to protect ducting in the road reserve along the coastline. Govt land means straight forward land acquisition. MOU or similar could be obtained by appraisal. Busy use of marine area suggests significant	Poor

	Shipping channels, leisure boating, fishing within the bay. Several kilometers of terrestrial cable to TFL site in Savusavu. No existing TFL ducting.	consultation would be required. The cable may lead to restrictions in marine area use. Unknown environmental risks for submarine cable (need to be determined in ESIA).	
Cable Landing Stations:			
AFL Communications Site across the road from runway	Elevated site. TFL cable ducts go along the road past this site and into Savusavu. The site currently has a small shed that houses communications equipment. The site has three communications aerials at various heights. There is space for a new building / structure. There is easy access directly off the Hibiscus Highway.	Limited terrestrial civil works required as part of project between BMH and Cable Landing Station. Need approval / sign off from AFL and possibly Civil Aviation Authority of Fiji that there will be no interference with aviation operations.	Good
TFL Building, Savusavu **Approx. 5km from airport**	There is space for new building or internal refit. Existing housekeeping is poor and would need to be improved. 5km + of terrestrial cabling required within existing TFL duct along the Hibiscus Highway.	Needs more terrestrial civil works than AFL site. Communications site from preferred BMH sites, but not substantial.	Good

Figure 1 Site Visit Locations 1

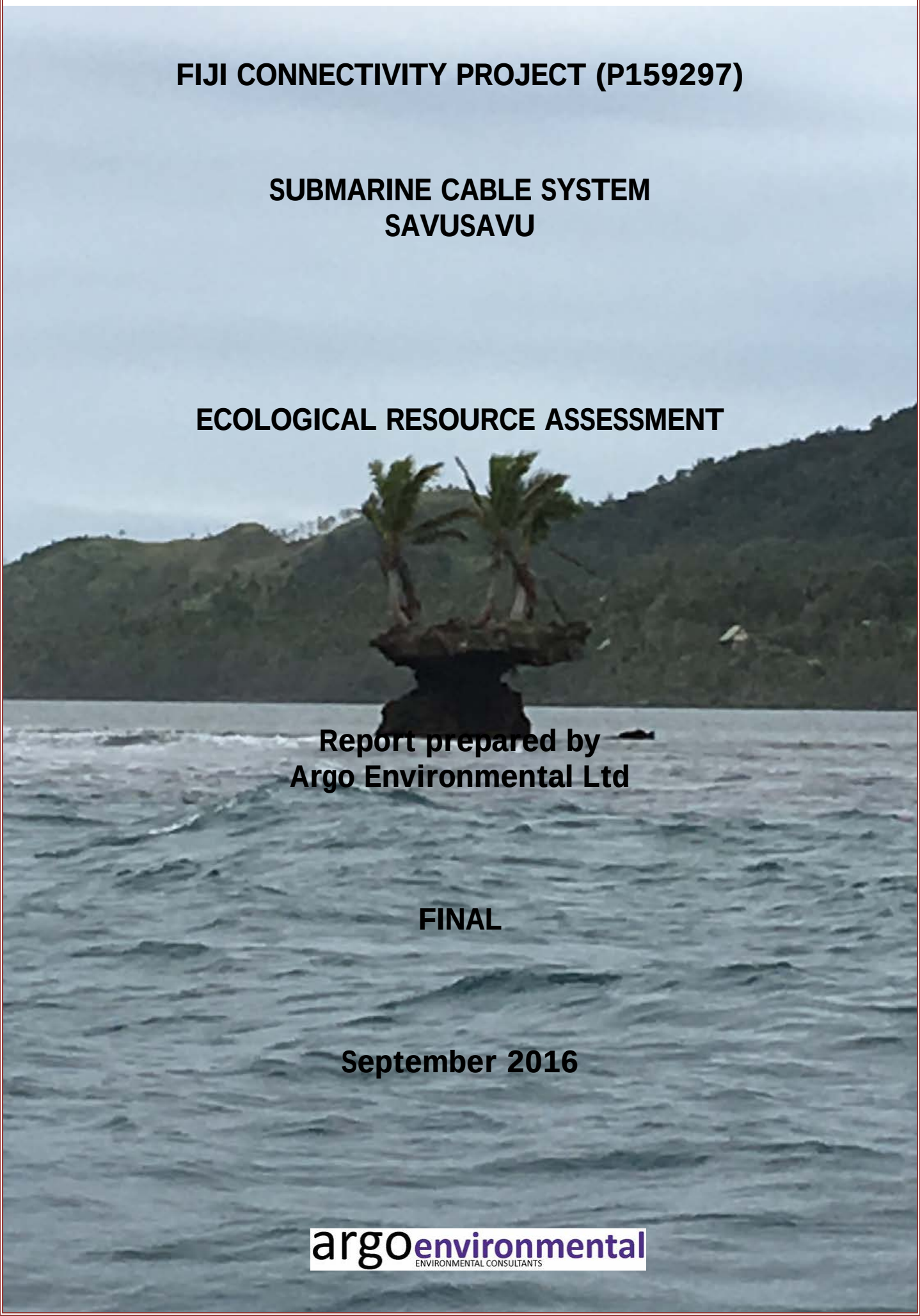
Figure 2 Site Visit Locations 2

Appendix 2: Ecological Assessment

FIJI CONNECTIVITY PROJECT (P159297)

SUBMARINE CABLE SYSTEM
SAVUSAVU

ECOLOGICAL RESOURCE ASSESSMENT



Report prepared by
Argo Environmental Ltd

FINAL

September 2016

argo environmental
ENVIRONMENTAL CONSULTANTS

TABLE OF CONTENTS

1. Introduction

1.1 Background

The World Bank Project Management Unit in association with the Fijiian Ministry of Communications & Fintel, is proposing to install a branch off the Fiji (Viti Levu)-Samoa submarine cable system (SCS) to Vanua Levu at Savusavu (see Figure 1).

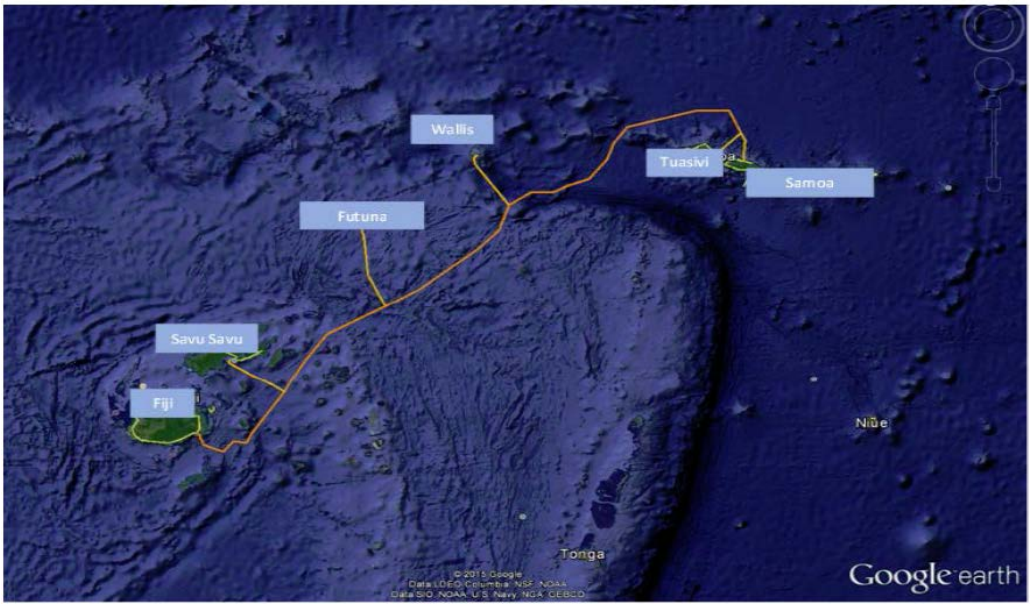


Figure 1: Proposed subsea cable route for the Fiji-Samoa Connectivity Project

This report presents the results of an assessment of the nearshore coastal marine (habitat and fish communities), water quality and terrestrial ecological resources of the adjacent coastal marine area potentially impacted as a result of the proposed works. This study has been undertaken to allow the potential impacts of the proposed works on these resources to be determined.

1.2 Proposed Development

The proposed works are described in detail in the Project ESIA[1]. In summary, the installation works will consist of the following:

- The cable at the shoreward end will extend across the intertidal zone, between the subtidal zone and the beach manhole, and will be covered with lightweight protection consisting of standard articulated piping bolted to the substrate.
- A beach manhole (BMH) landing facility likely to comprise a small concrete manhole approximately 2m x 2m x 2m.
- A cable landing stations (CLS). Two options are available for the current Project including the AFL Communications Site across the road from Savusavu Airport runway and the TFL Building in Savusavu.

Figure 2 presents a 1:20,000 topographical map for the general location.

[1]Argo 2016. Environmental & Social Impact Assessment. Fiji Connectivity Project (P159297). September 2016.

Figure 2: Proposed subsea cable route for the Fiji-Samoa Connectivity Project

In addition, approximately 200km of fiber optic cable from the point of branching with the main cable to the shore laid on or beneath the sea floor. The potential impacts of this activity are described in MCIT (2015)

An Addendum to the Terms of Reference (see ESIA (2016)) for the current investigation identified six potential BMH sites, two of which were to be investigated in detail (BMH1 & 2) and determined the focus of this study. Figure 3 presents the location of the proposed BMH and CLS locations.

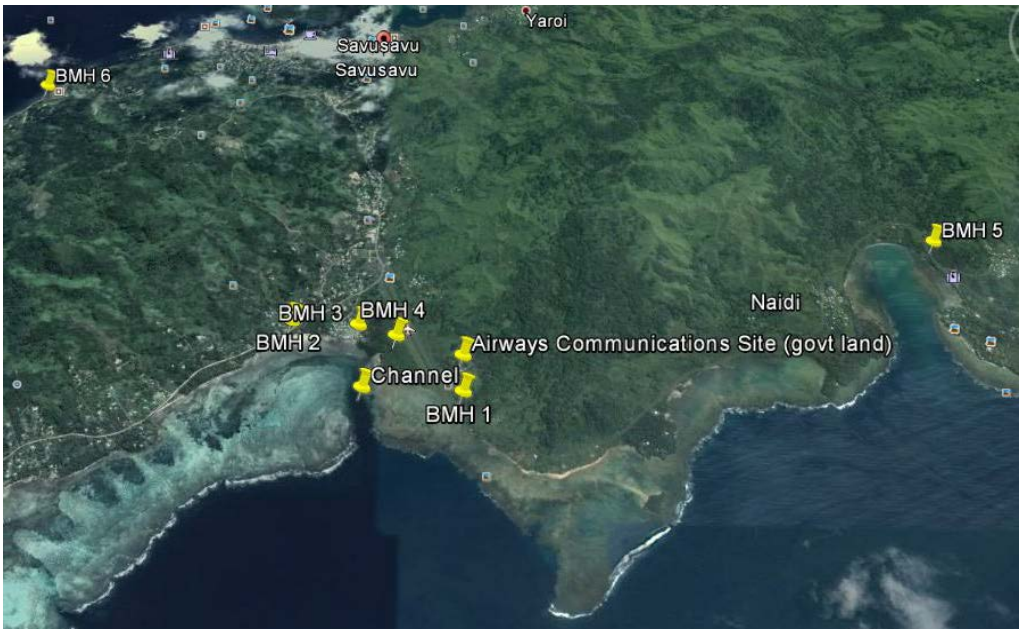


Figure 3: Aerial showing the proposed Beach Manhole & Cable Landing Stations

The key points to note in terms of the potential construction impacts of the Project on ecological resources are as follows:

- Direct loss of a small area of intertidal marine habitat in the cable footprint which will be recolonised over time.
- A potential increase in sediment load from exposed work areas affecting adjacent coastal marine flora / fauna.
- Potential loss of terrestrial habitat at BMH locations, along the cable route in the road corridor and at the cable landing stations will regenerate over time.

1.3 General Environment Description

The majority of the BMH sites (BMH1-4) are located in Savusavu on the southern coast of Vanua Levu adjacent to Airport Fiji Ltd (AFL) runway. The marine ecological habitat in this area consists of: sandy beach and harder reef flats (located above the intertidal and within the intertidal zone respectively); and sub-tidally, the reef slope and muddy sands of the deeper sea floor. Several subtidal reefs or coral 'bommies' are present in the tidal channel. The reef on the western side of the channel is an informal fishing reserve observed by the local mataqali (Nacekoro & Raranipolo).Figures 4 & 5 present potential beach manhole sites, cable alignments and cable landing stations for each of the six sites.

Figure 4: Potential submarine and terrestrial cable alignments and cable landing stations for BMH 5 (top) and BMH6 (bottom) with the potential CLS at the TFL building.

Figure 5: Potential submarine and terrestrial cable alignments for BMH 1-4, the cable landing station at AFL communications site, and the approximate boundary of the local fishing reserve

2. Methodology

2.1 Coastal Marine Ecological Resources

The Addendum to the Project Terms of Reference (see Argo 2016[1]) indicated that "*Detailed marine field work shall focus on the two preferred sites for the BMH*" i.e., BMH 1 & 2. The methodology outlined below is designed to reflect this intent.

Coastal marine habitat and fauna (fish, benthic communities, etc.) adjacent to each BMH and along the potential cable alignments was described during a site visit conducted on 22 August 2016.

The assessment of subtidal ecological resources was undertaken along five 30m transects on the subtidal fringing reef at high tide to describe fish and benthic communities present (Figure 2). Benthic cover was identified and described using reef check methodology[2] and counts made of invertebrate and fish species present.

A qualitative assessment of intertidal ecological resources was undertaken along 6 transects on the intertidal sand and reef flats adjacent to each of the BMHs at low tide, and taxa observed recorded.

2.1.1 Sampling Sites

Table 1 present details of the locations sampled to assess water quality, determine habitat type and undertake fish counts during field investigations. Figure 6 presents sampling site locations.

Table 1: Summary of field work tasks undertaken at sampling sites

Site/ Transect	Water Quality		Habitat	Fish counts	GPS	Notes
	Field	Lab				
ST1/WQ1	✓		✓	✓	S16°48'52.2" E179°20'46.9''	Reef edge, 670m south of BMH1 cable alignment
ST2	✓		✓	✓	S16°48'46.9" E179°20'42.1''	Reef edge, 350m south of BMH1 cable alignment
ST3/WQ2	✓	✓	✓	✓	S16°48'32.0" E179°20'32.1''	Reef edge, along possible BMH1 cable alignment
ST4/WQ3	✓		✓	✓	S16°48'31.0" E179°20'18.6''	Reef edge in channel, 400m north-west of ST3
ST5/WQ4	✓		✓	✓	S16°48'16.2" E179°20'13.2''	Reef edge in channel, 730m north-west of ST3
IT1			✓		S16°48'32.0" E179°20'32.1'' (start) - S16°48'28.8" E179°20'35.2'' (finish)	Intertidal reef flats inshore from ST3 along possible cable alignment to BMH1
IT2			✓		S16°48'16.2" E179°20'13.2'' (start) - S16°48'12.4" E179°20'14.4'' (finish)	Intertidal reef flats along possible cable alignment to BMH4
IT3			✓		S16°48'32.0" E179°20'32.1'' (start) - S16°48'28.8" E179°20'35.2'' (finish)	Intertidal reef flats along possible cable alignment to BMH3
IT4			✓		S16°48'14.5" E179°20'02.5'' (start) - S16°48'11.8" E179°20'01.01'' (finish)	Intertidal sand flats along possible cable alignment to BMH2
IT5			✓		S16°47'49.9" E179°22'16.8'' (start) - S16°47'46.8" E179°22'16.7'' (finish)	Intertidal sand flats along possible cable alignment to BMH5 (Naidi Bay)
IT6			✓		S16°47'05.1" E179°18'56.8'' (start) - S16°47'05.5" E179°18'57.1'' (finish)	Intertidal sand flats along possible cable alignment to BMH6 (Savusavu Bay)

Notes: WQ – Water quality. ST – Subtidal. IT – Intertidal. GPS co-ordinates for ST are inshore point of transect.

[2] www.reefcheck.org

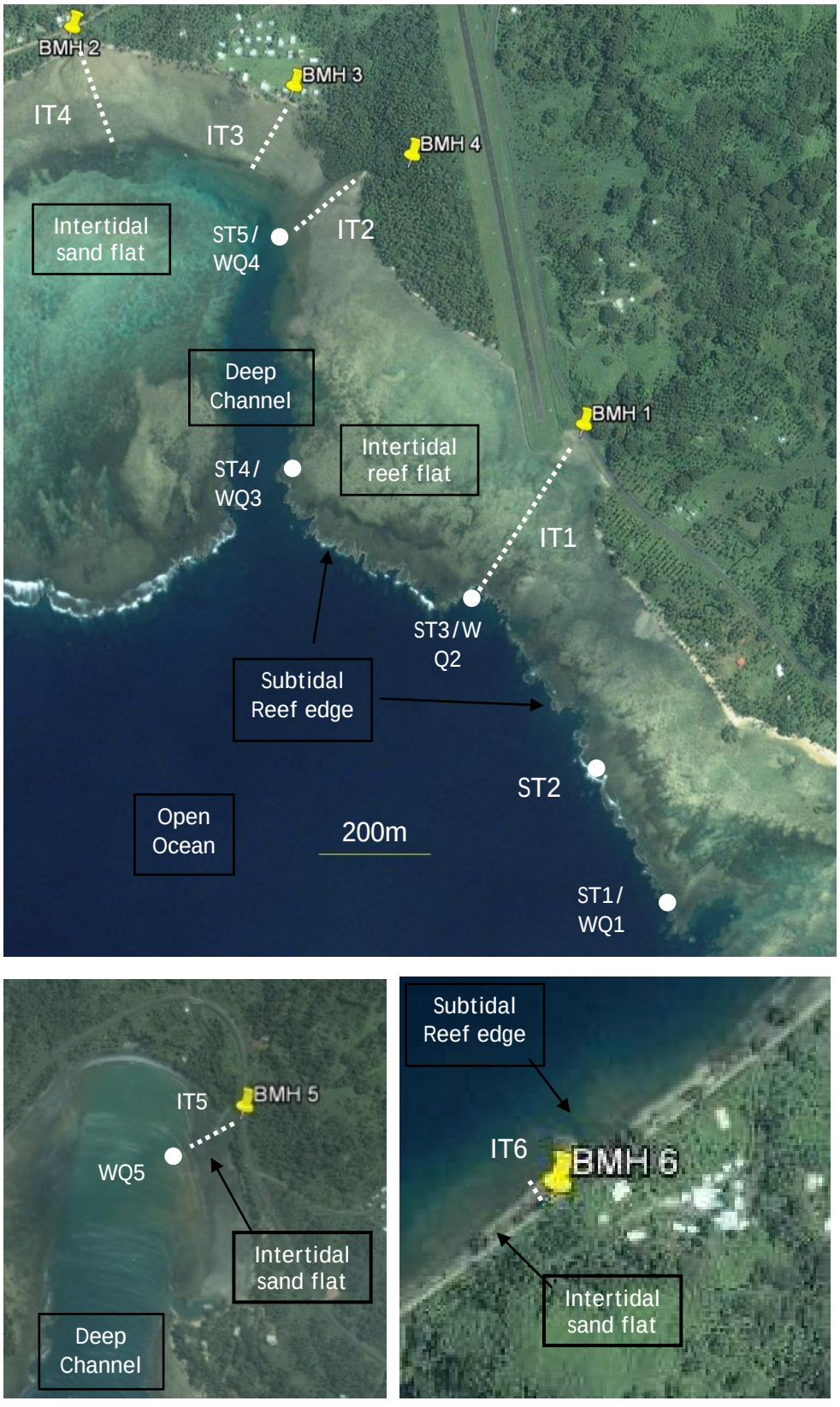


Figure 6: Subtidal (ST1-4) and intertidal (IT1-6) transects used to describe key habitat types and water quality (WQ1-5) sampling locations

2.1.2 Water Quality

Field measurements were undertaken at five sites using a TPS WP-81 (DO (concentrations & saturations) pH, conductivity, salinity) water quality meter (see Figure 6). Laboratory analysis was undertaken for a range of parameters including: TSS (total suspended solids) and turbidity. The water sample was retained in ice in a chilli bin and delivered to the laboratory within the required timeframes using standard APHA[3] analytical procedures.

2.2 Terrestrial Ecological Resources

A qualitative assessment of the vegetation present at each BMH was undertaken, and any birds observed were recorded.

[3]APHA 1995. Standard methods. 19th Edition. American Public Health Association, Washington, DC.

3. Water Quality

3.1 Overview

This section of the report provides a comparison of water quality data for the sample collected in the current survey with ANZECC (2000) trigger value guidelines for inshore marine ecosystems in tropical Australia (see Tables 2 & 3). These guidelines have been used as they are considered to be the most applicable. Appendix A presents the raw data from the current survey and Appendix B presents the laboratory report.

3.2 Results

Field parameters

- Dissolved oxygen saturations are typically below the ANZECC (2000) default trigger value of >90 g/m^3 with the exception of sites WQ3 & 4 (93.2 & 106.5% respectively). Dissolved oxygen concentrations range from 5.8-7.1 g/m^3.
- The water temperature of 24.4-25.1°C reflects the time of day and year the samples were collected.

Table 2: A comparison of summarised water quality data for a site located adjacent to the proposed development site with accepted guidelines (mean ± SD presented).

	Site					
Parameter	**WQ1**	**WQ2**	**WQ3**	**WQ4**	**WQ5**	**Guidelines[1]**
DO	6.0	5.8	6.2	7.1	5.8	-
DO (%)	89.2	86.7	93.2	106.5	85.6	>90
Temperature (ºC)	24.9	25.1	25.1	25.1	24.4	-
TSS		0.5				-
Turbidity (NTU)		0.35				1-20

Note: all results mg / L unless stated. [1]ANZECC (2000) default trigger values for slightly disturbed tropical Australia marine ecosystems.

Suspended Material

- Total suspended solids concentrations at WQ2 (0.5 g/m^3) are low and is likely to be due to the good weather conditions experienced at the time of sampling.
- Turbidity at WQ2 (0.35 NTU) is also very low and below the ANZECC (2000) default trigger value of 1-20 NTU.

4. Coastal Marine Resources

4.1 Habitat Types

As previously described, the habitat of the coastal marine area adjacent to the BMH sites consists of the following:

- Beach habitat in the upper intertidal zone at all sites, and mangrove communites adjacent to IT2.
- Reef flats (at IT1-IT3) extending across the intertidal to the reef edge containing a range of habitat types including patches of seagrass, seaweed, etc (at IT1).
- Sand flats (at IT4-IT6) extending across the intertidal containing patches of seagrass towards the lower intertidal (IT4).
- Subtidal reef edge (at ST1-4), and several coral 'bommies' in the adjacent channel, which provide habitat for a range of coral, sponge, fish and invertebrate species.
- The open ocean seafloor consisting primarily of sand.

The different habitat types are described in further detail below. Appendix C presents the raw data from the current survey.

4.2 Intertidal communities

4.2.1 Introduction

The intertidal zone of the reef and sand flats extends from the upper intertidal to the top of the subtidal zones. Figs 7-10 present images of individual transect alignments.

4.2.2 Reef Flats

Qualitative assessment of the benthic communities present on the intertidal reef flats indicates the following:

Intertidal Transect 1

The benthic substrate is dominated by the following elements

- Upper intertidal - primarily coarse sands.
- Mid intertidal harder reef flats with pools containing: seagrass (*Halodule* sp.) *Halimeda* sp. (a green algal turf) and occasional *Padina* sp. ypical of nutrient enriched environments; abundant brittle seastar (*Ophiomastix* sp.), and occasional sea cucumber (*Holothuria edulis*) starfish, sponge and coral species (see Figure 11).
- Lower intertidal pools containing coral rubble and a range of seaweed species, occasional corals and crown of thorns starfish.

Intertidal Transect 2

- Upper intertidal - coarse sands (beach) and muds in the mangroves.
- The mid to lower intertidal – the benthic substrate is dominated by abiotic elements primarily coral rubble and muds.

Figure 7: Typical habitat along IT1 alignment including sandflats (top), seagrass in shallow pools (bottom left), and seaweed species on the lower intertidal (bottom middle & right)

Figure 8: Typical habitat along IT2 alignment including sandflats and mangroves (top of left) at the top of the intertidal and coral rubble (right) lower down the intertidal.

Figure 9: Typical habitat including sandy beach at the top of the intertidal and coral rubble at IT3 (left), patches of seagrass at IT4 (middle), and largely devoid of biotic material at IT5 (right).

Figure 10: Typical habitat including vegetation (left) and sandy beach in the upper intertidal at IT6.

Intertidal Transect 3

- Upper intertidal - coarse sands (beach)
- The mid to lower intertidal - benthic substrate is dominated by abiotic elements primarily coral rubble and muds.

4.2.3 Sand Flats

Qualitative assessment of the benthic communities present on the intertidal sand flats indicates the following:

Intertidal Transect 4

- Upper intertidal - coarse sands (beach)
- The mid to lower intertidal - benthic substrate is dominated by fine sands and seagrass (*Halodule* sp.)

Intertidal Transects 5 & 6

- The entire intertidal is dominated by coarse sands.

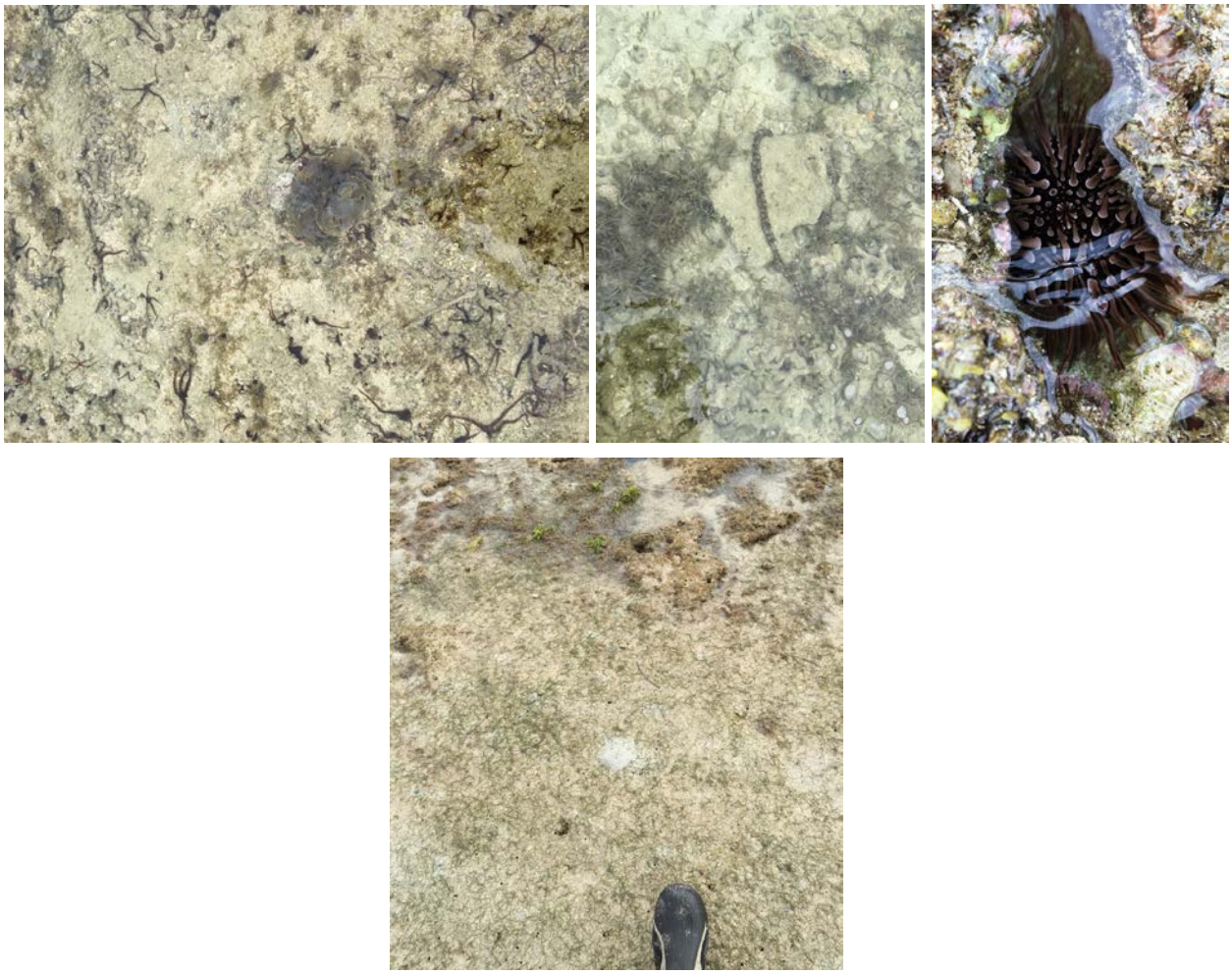


Figure 11: Typical species encountered along IT1 including brittlestar and padina (top left), sea cucumber (top middle) and crown of thorns (top right) and along IT3 including seagrass (bottom).

4.2.4 Mangroves

Mangroves in Fiji are comprised of seven main species of trees which can be categorised into three functional groups depending on growth habit (see Figure 12):

- *Red mangrove* ('Tiri') which grow at the water's edge, with "prop" roots that stabilise trees in soft mud and wave zones. There are two species of trees which live in this manner, and one sterile hybrid when both species are present. Red Mangroves consist of: *Rhizophora stylosa* usually found directly fronting the sea; *R. samoensis* usually found closer to rivers; and the hybrid *R. selela* consisting of taller trees found in mixed forest.
- *Black mangrove* ('Dogo') or *Bruguieria gymnorhiza* usually found behind red Mangroves in muddy areas that flood at high tide. They may have prop or elbow roots that protrude out of the mud, sometimes both.
- *White mangrove* which are very salt-tolerant trees that grow on dry land immediately behind the wet mangrove areas and can survive occasional salt-water inundation and salty soil. The four species consist of: *Lumnitzera littorea*; *Heritiera littoralis*; milky mangrove (*Excoecaria agallocha*); and puzzlenut tree (*Xylocarpus granatum*).

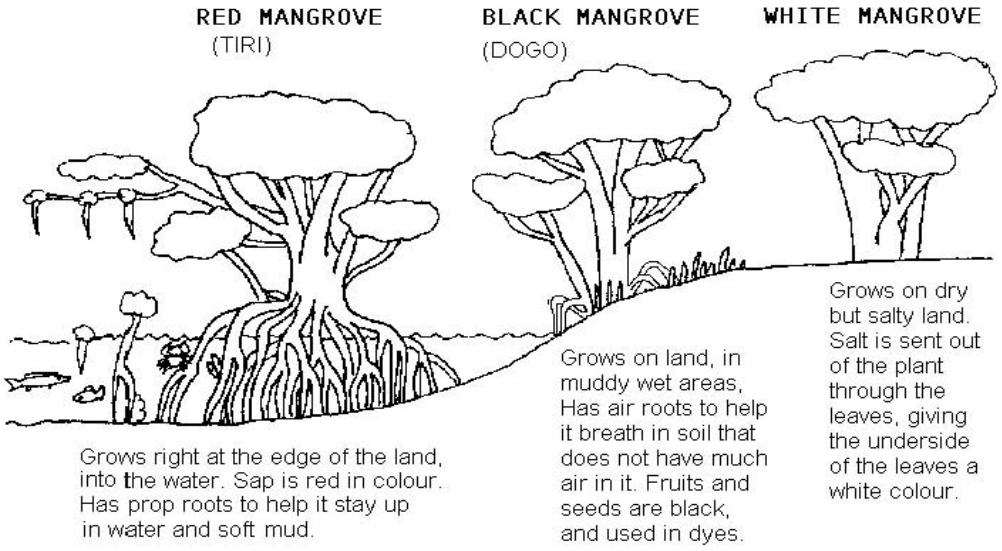


Figure 12: Mangrove zones based on growth habit

The Environment Management Act 2005 recognises mangrove swamp as *"an ecosystem of national importance"* requiring projects to seek approval from the Environment Impact Assessment Administrator for *"a proposal that could damage or destroy … mangrove swamp …"*

It has been estimated previously that there are over 38,000 hectares of mangrove forest most of which are found on Viti Levu and Vanua Levu, and that more than 60% of Fiji's commercially important food fishes use the mangrove at some stage of their life cycle.

Mangroves are currently under the jurisdiction of the Department of Lands and Survey as an integral part of the foreshore. A National Mangrove Plan was formulated in 1986 but has not been made law and there is currently little protective legislation for mangroves. However, under this plan, the main mangrove areas across Fiji were zoned as: Reserves (Resource Reserve or National Reserve); small scale use not involving clearance (i.e., wood production, traditional use, shoreline protection or sewage processing); or clearance and conversion to dry land use (for urban, tourism or agriculture (not clear felled along water courses).

The mangroves in the upper intertidal adjacent to IT2 consist primarily of the red mangrove primarily *Rhizophora stylosa* (Figure 13).

Figure 13: Mangroves in the upper intertidal adjacent to IT2

4.3 Subtidal communities

4.3.1 Overview

Living benthic communities identified, which extend below the lower intertidal into the subtidal zone, consist of the following:

- Coral communities located at the edge of the sand and reef flats on the reef slopes and offshore coral 'bommies'.
- The macrofauna associated with the sediments in deeper waters offshore from the reef slope.

Figure 14 presents examples of typical flora and faunal species encountered.

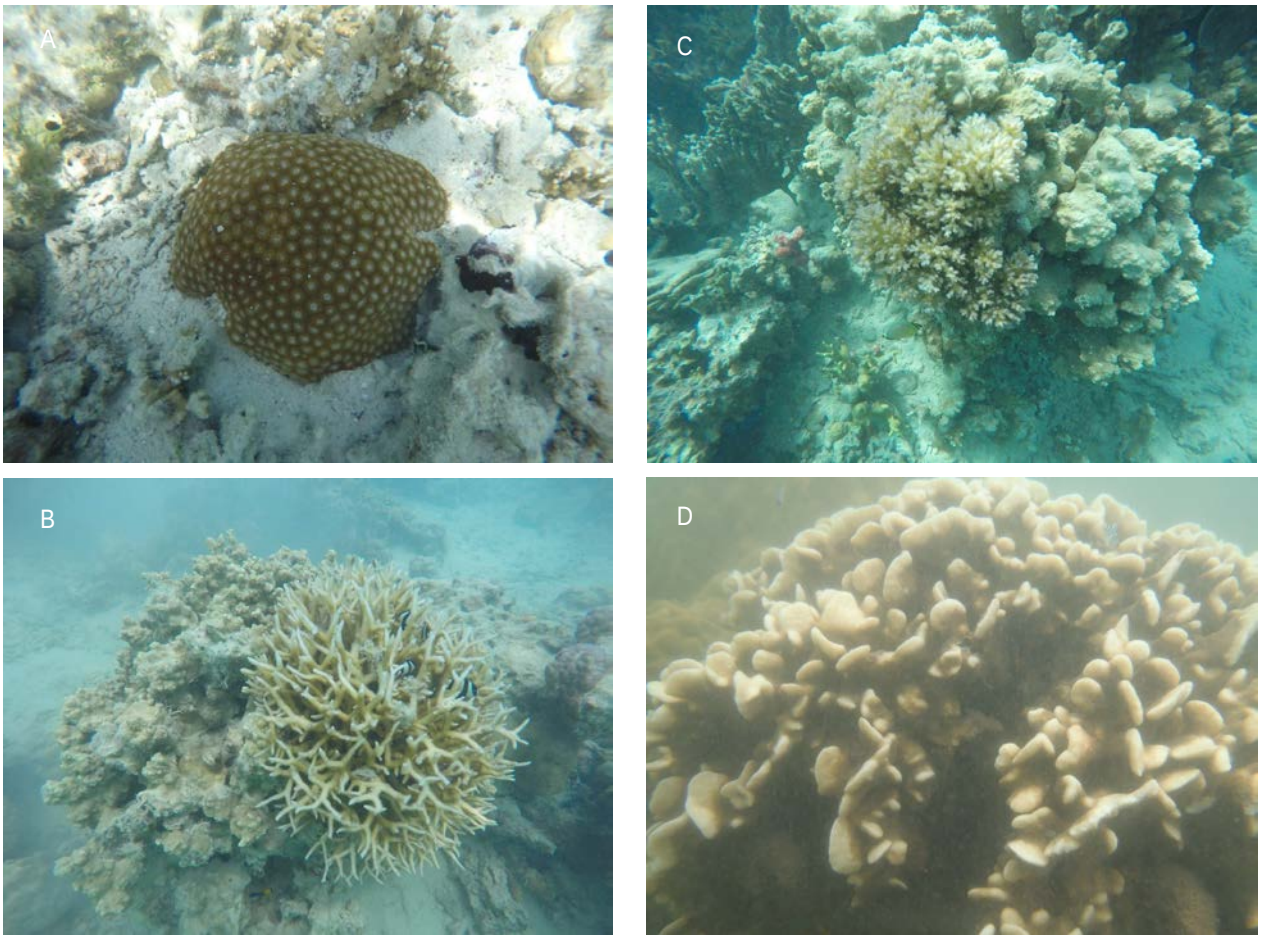


Figure 14: Typical benthic substrate found along transects including: *Diploastrea* sp. (A); *Acropora* sp. (B); *Pocilliopora* sp. (C) and *Pavona* sp.(D).

4.3.2 Reef edge

Benthic Cover

The benthic cover at the seaward edge of the sand flats on the reef slope adjacent to the Project area is dominated by abiotic elements (i.e., Sand/rock (17.3%) and coral rubble (25%)) (see Figure 15). Live coral (32.3%) is the next most dominant benthic cover.

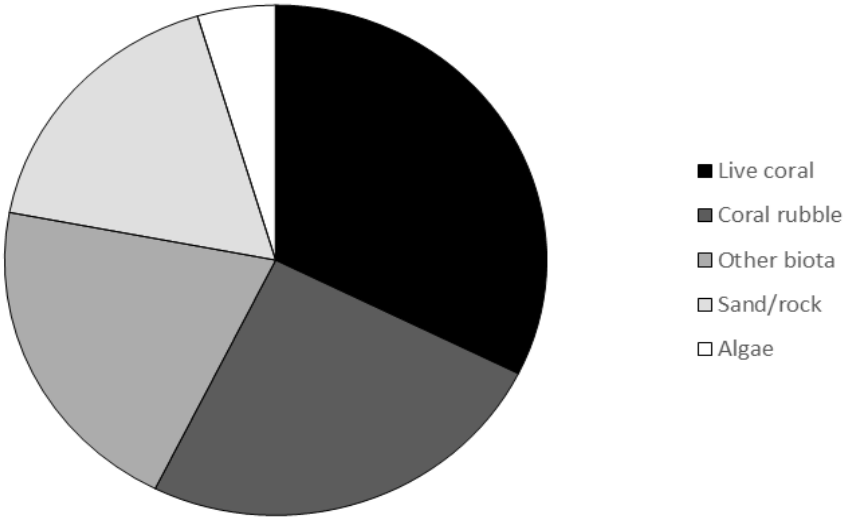


Figure 15: Summary of key benthic types for all subtidal transects

The coral community (see Figure 16) is dominated primarily by massive corals (34.0%). The next most dominant type is encrusting and branching corals (18.6%). Foliose corals are present in the lowest proportion (1.0%).

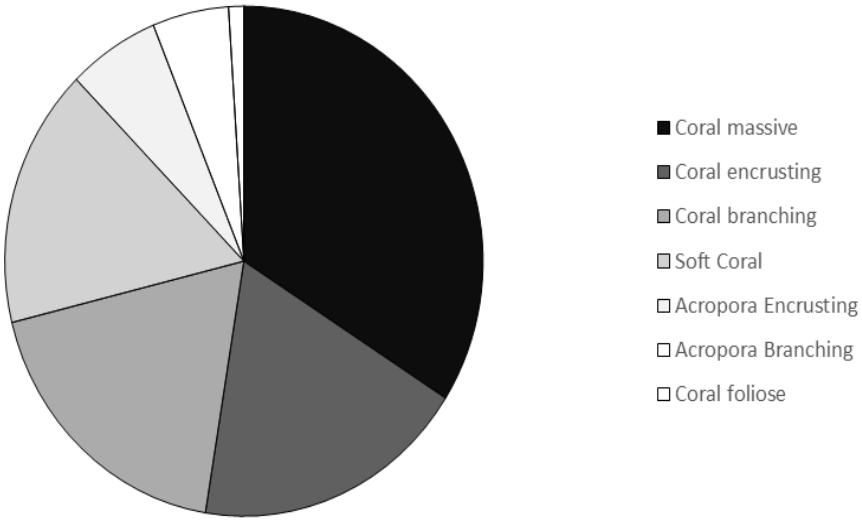


Figure 16: Summary of key coral types for all subtidal transects

Overall, a number of key points can be made regarding the individual transect data (see Figure 17) as follows:

- Abiotic elements (coral rubble, sand and rock), the most dominant benthic type, is present along all transects (except ST2) and ranges from 12% (ST1) to

85% (ST3 & ST5). Coral rubble (94%) contributes significantly to abiotic elements at ST3, and sand and rock (92%) at ST5. Live coral, present along all transects except ST5, ranges from 8% (ST3) to 63% (ST2).

- Algae (primarily coralline algae) is present on all transects ranging from 4% (ST3) to 16% (ST1). Interestingly, although the nutrient-indicating algae *Padina* sp was observed intertidally, it was not identified along any of the subtidal transects.

Of the corals present, massive corals are the most dominant of all, ranging from 4 - 14% (at ST3 and ST2 respectively) (see Figure 18). The next most dominant coral cover, branching coral, is present along all transects (where coral is present) ranging from 1 - 10% (ST3 and ST2 respectively). Branching acropora was only found on ST1 (5%) and foliose coral on ST4 (1%).

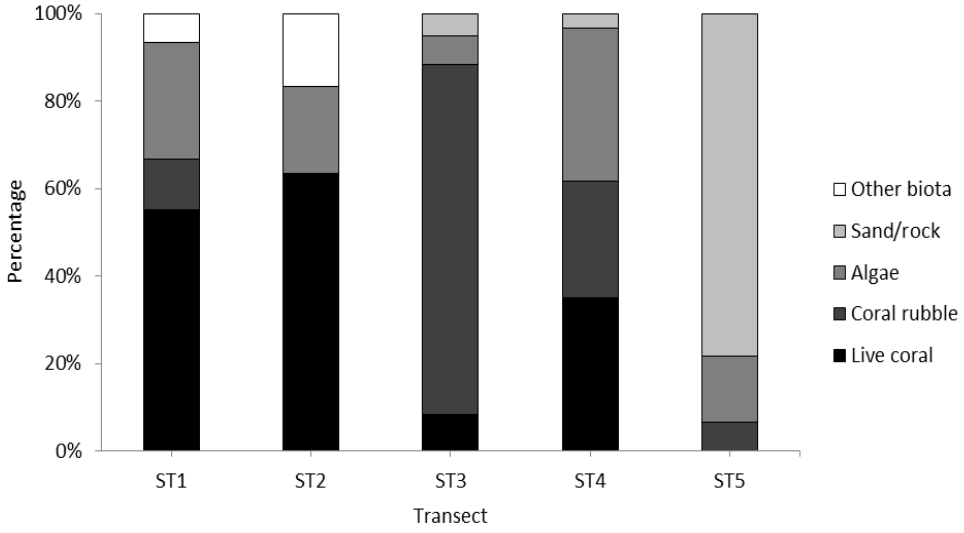


Figure 17: Benthic cover type present on subtidal transects

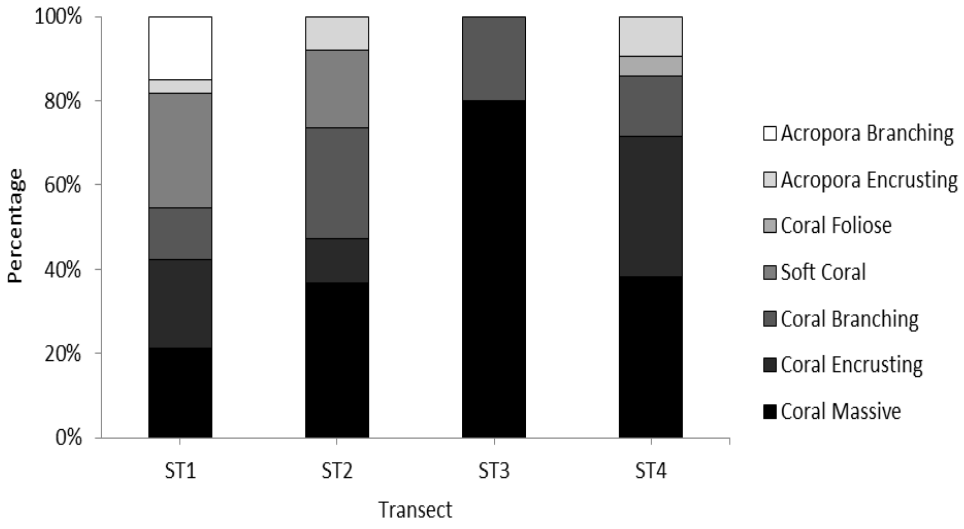


Figure 18: Coral type present on subtidal transects

Benthic Invertebrates

Small numbers of benthic invertebrates were recorded with key species consisting of crustaceans such as crabs, sea cucumber, giant clam (*Tidachna* sp.), triton shell *Charonia tritonis* and crown of thorns *Acanthaster planci* starfish.

Summary

The subtidal reef communities present range in condition from relatively good (ST1 & ST2) to poor which is likely to be due to the large amount of recent wave action (ST3) during the recent cyclone and sedimentation (ST5).

4.3.3 Subtidal soft bottom communities

Based on discussions with local divers, the channel bootom adjacent to ST4 & ST5 is hard rock seafloor with deeper waters dominated by softer sediments. Although no sampling of these softer sediments was undertaken it is likely that they are dominated by a range of gastropod (snails) and bivalve (clams) mollusc species; crustaceans (shrimps and crabs); echinoderms (brittle star); and polychaete and nemertean worm.

4.4 Fish

The results of the current survey of fish present on the reef edge adjacent to the potential Project area are shown in Table 3. The key points to note are as follows:

- A total of 36 species are present across five transects. The most common is mangrove red snapper *(Lutjanus argentimaculatus)*, daisy parrotfish (*Chlorurus sordidus*), clown Tang (*Acanthurus lineatus*) and striated surgeonfish (*Ctenochaetus striatus*). The sixbar wrasse (*Thalassoma hardwicke*) was observed on the most transects (four).
- The most abundant species (11-100 individuals) are striated surgeonfish, dark banded fusilier (*Pterocaesio tile*), daisy parrotfish, rivulated parrotfish (*Scarus rivulatus*) and mangrove red snapper. Blacktail snapper (*Lutjanus semicinctus*) is the only species observed in abundances greater than 100.
- A large number of species (23 of the 36 species or 64%) were observed on a single occasion with several species only as a single individual. These least common fish species include humpnose big eye bream (*Monotaxis grandoculis*), tripletail wrasse (*Chelinus trilobatus*), dash and dot goatfish (*Parupeneus barberinus*), Indian goatfish (*Parupeneus indicus*) and halfmoon triggerfish (*Sufflamen chrysoptera*).
- A total of 12 fish families are present with the most common type being snapper, parrotfish and surgeonfish or tang which comprise of 72.2% of the total fish species (see Figure 19). Fish species as individuals (Category 1) or in groups of 2-10 (Category 2) are the most prevalent across all transects comprising 85.7% (Figure 20).
- ST3 (adjacent to BMH1) had the lowest number of fish species (4) compared with ST5 (the outer most transect) which had the highest number of species (17) (Figure 21).

Table 3: Fish species identified in the current survey along transects located adjacent to Project area

Family	Scientific name	Common Name	Transect					TOTAL
			T1	T2	T3	T4	T5	
Acanthuridae	*Acanthurus lineatus*	Clown Tang	2	3		2		3
	Ctenochaetus striatus	Striated surgeonfish	3	3		2		3
	Zebrasoma scopas	Brown Tang		2				1
	Zebrasoma veliferum	Sailfin Tang	2	2				2
Balistidae	*Sufflamen chrysopterum*	Halfmoon triggerfish			1			1
Caesionidae	*Pterocaesio tile*	Dark banded fusilier	3					1
Chaetodontidae	*Chaetodon basrosessa*	Butterflyfish sp		2				1
	Chaetodon citrinellus	Speckled butterflyfish		2				1
	Chaetodon pelewensis	Sunset butterflyfish	2			2		2
	Chaetodon rafflesi	Latticed Butterflyfish		2				1
	Chaetodon vagabundus	Vagabond butterflyfish	2					1
	Heniochus varius	Horned bannerfish			2	2		2
Holocentridae	*Chlorurus bleekeri*	Bleekers parrotfish				2		1
	Chlorurus sordidus	Daisy parrotfish	3	3		2		3
	Scarus niger	Black parrotfish	1	1				2
	Scarus rivulatus	Rivulated parrotfish					3	1
	Scarus schlegeli	Yellowband parrotfish	2	2		2		3
Labridae	*Bodianus mesothorax*	Splitlevel Hogfish	1			1		2
	Chelinus trilobatus	Tripletail wrasse				1		1
	Epibulus insidiator	Slingjaw wrasse	1			2		2
	Halichoeres hortulanus	Checkerboard wrasse	2		1	2		3
	Halichoeres trimaculatus	Three-spot wrasse					2	1
	Thalassoma hardwicke	Sixbar wrasse	2		1	2	2	4

Family	Scientific name	Common Name	Transect					TOTAL
			T1	T2	T3	T4	T5	
Lethrinidae	*Lethrinus harak*	Thumbprint emperor					2	1
	Monotaxis grandoculis	Humpnose big eye bream	1					1
Lutjanidae	*Lutjanus argentimaculatus*	Mangrove red snapper	3					1
	Lutjanus fulvus	Blacktail snapper	4					1
	Lutjanus gibbus	Humpback red snapper					2	1
	Lutjanus semicinctus	Black-banded snapper				2		1
Mullidae	*Parupeneus barberinus*	Dash and dot goatfish				1		1
	Parupeneus indicus	Indian goatfish					1	1
	Parupeneus multifasciatus	Banded goatfish			2			1
Serranidae	*Epinephelus merra*	Honeycomb grouper				2		1
Siganidae	*Siganus doliatus*	Barred spinefoot	2					1
	Siganus spinus	Spinefoot sp.					2	1
Zanclidae	*Zanclus cornutus*	Moorish Idol		1		2		2

Notes: Numbers of fish are presented as one of four abundance codes: 1 - Single (one individual). 2 - Few (2 – 10), 3 – Many (11- 100), 4 – Abundant (more than 100).

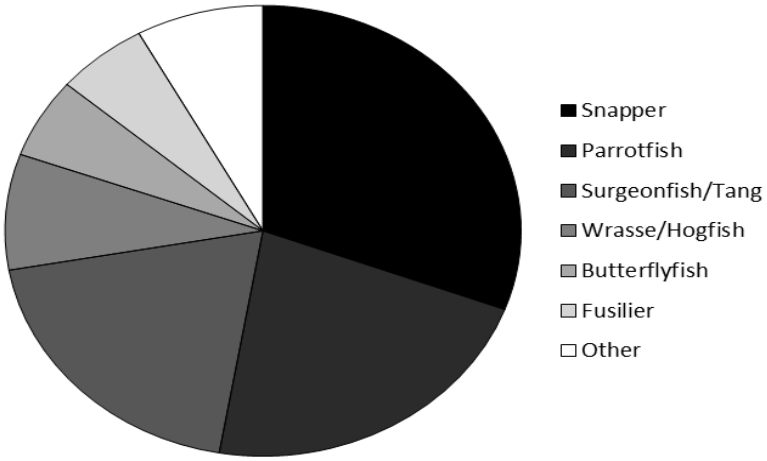


Figure 19: Proportion of key fish families observed across all transcects in the current survey.

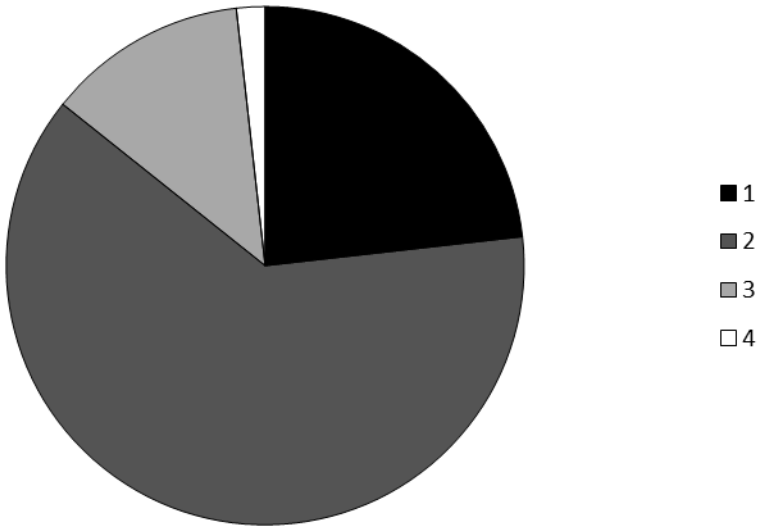


Figure 20: Total number of fish species based on abundance categories (i.e., 1 = single (one individual). 2 = few (2 – 10), 3 = many (11- 100), 4 = abundant (more than 100)) in the current survey for all transects.

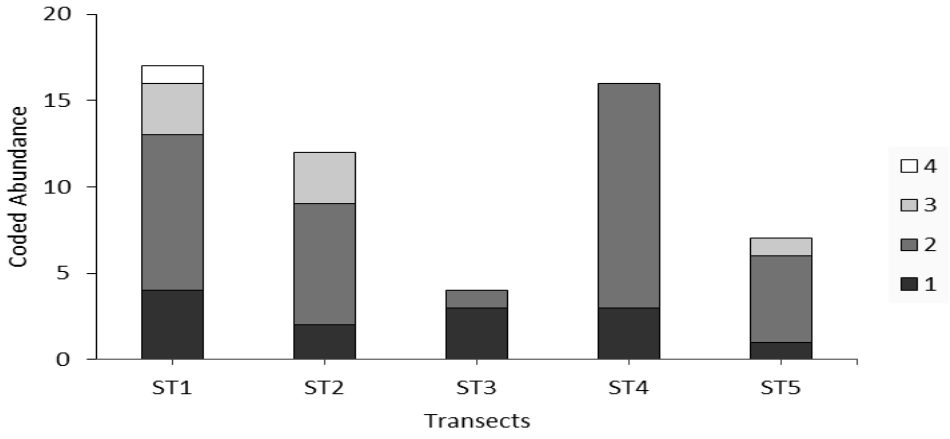


Figure 21: Total number of fish species observed and number of fish species based on abundance categories (see Figure 12 for key).

5. Terrestrial Resources

5.1 Vegetation

Vegetation at the BMH 1 & 2, along the road corridors from these locations to the possible cable landing station at the AFL communications site (see Figure 22) primarily consists of invasive and adventive weed species and rank grasses. The most prevalent tree species in the general vicinity of these locations is the Raintree *Samanea saman,* coconut *Cocos nucifera* and common bamboo *Bambusa valgaris*.

Overall, it is evident that the vegetation has been modified by past disturbance including general clearance activities. Apart from the pest African tulip there are no species of particular ecological concern.

Figure 22: Vegetation at BMH 1 (top), BMH 2 (middle), and the possible cable landing station at the AFL communications site (bottom).

5.2 Birds

A number of bird species are present in and adjacent to the various sites which were observed during fieldwork (Table 4). All of the native birds identified are common in Fiji and are of no particular conservation concern according to the IUCN Red List of Threatened Species[4].

Table 4: Key bird species identified during the current study.

Common name	Scientific name	Status
Pacific Black Duck	*Anas superciliosa*	Native
Wood swallow	*Artamus metalis*	Native
Wattled Honeyeater	*Foulehaio carunculatus*	Native
Fiji parrotfinch	*Erythrura pealii*	Native
Common mynah	*Acridotheres tristis*	Introduced

[4] http://www.iucnredlist.org/

6. Summary

This report presents the results of an assessment of the ecological resources (marine & terrestrial) and water quality adjacent to the SCS Project site, Savusavu. This assessment is based on site investigations undertaken in August 2016.

Marine Habitat

- Marine habitat of the Project area typically consists of: upper intertidal sandy beaches, intertidal reef and sand flats and subtidally, the reef slope and sands of the deeper sea floor. Several coral bommies are present in the adjacent tidal channel. The intertidal area on western side of the channel, which includes the possible cable route to BMH2, is an informal fishing reserve.

Water Quality

- Several sites comply with ANZECC (2000) default trigger values for inshore marine systems for tropical Australia for dissolved oxygen saturations. Visibility at fringing reef sites was high with low total suspended solids concentrations and turbidity below the ANZECC (2000) trigger limit.

Marine Benthic Communities

- The intertidal zone consists of reef (Transects IT1-3) and sand flats (IT4-6) dominated by a range of seaweed species including *Padina* sp, a symptom of eutrophication. Benthic invertebrates observed included brittle stars and crown of thorns starfish.
- The subtidal benthic cover of the reef edge is comprised primarily of abiotic features (i.e., non-living coral rubble, sands, etc) and live coral species. The coral community is dominated by massive coral species. Transect ST3, located adjacent to the proposed cable route to BMH1, has a significantly higher proportion of abiotic features (i.e., coral rubble) compared to other locations. Transect IT2, located adjacent to the proposed cable route to BMH2 on intertidal sandflats, has patches of seagrass considered to be ecological sensitive habitat.
- Further offshore in the tidal channel, the seafloor consists of harder bottom with softer sediments into deeper waters. The soft bottom benthic community is likely to consist of a range of organisms common in Fiji.
- Overall, the subtidal reef communities range in condition from relatively good (ST1 & ST2) to poor which is likely to be due to recent wave action (ST3) and sedimentation (ST5).

Fish Populations

- A total of 36 species were present across all transects. The most common is mangrove red snapper, daisy parrotfish, clown Tang and striated surgeonfish.
- Fish abundances are typically low with many being observed as a few (i.e., 2-10) or as single individuals. Only one species have abundances exceeding 100. Transect IT3, adjacent to the potential alignment to BMH1, had the lowest number of fish species and abundance.
- Overall, the fish present are dominated by a range of species that are common to Fiji waters.

Terrestrial Ecology

- Terrestrial ecological resources at the BMH 1 & 2 sites, along the road corridors from these locations to the possible cable landing station at the AFL communications site have been impacted by past clearance activities and primarily consists of invasive and adventive weed species and rank grasses. No bird species of any conservation significance were identified.

Appendices

Appendix A Laboratory Report

Watercare Laboratory Services

Auckland
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Auckland Airport,
Auckland, 2150
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Fax: (09) 539 7601

Invercargill
142 Esk Street,
PO Box 747,
Invercargill, 9840
(03) 214 4040
(03) 214 4041

Queenstown
74 Glenda Drive,
PO Box 2614,
Wakatipu,
Queenstown, 9349
(03) 409 0559

www.watercarelabs.co.nz
clientsupport@water.co.nz

Certificate of Analysis
Laboratory Reference:160825-085

Interim Report

Attention:	Vitalii Furt	*Report Number:*	**195594-0**
Client:	**ARGO ENVIRONMENTAL**	*Report Issue Date:*	**06-Sep-2016**
Address:	**101 Customs Street East, Auckland Central, 1010**	*Received Date:*	**25-Aug-2016**
Client Reference:	**Samples**		
Purchase Order:	**Not Available**	*Quote Reference :*	**6536**

Sample Details		WATERS	WATERS
Lab Sample ID:		**160825-085-1**	**160825-085-2**
Client Sample ID:			
Sample Date/Time:		24/08/2016 09:00	24/08/2016 08:00
Description:		Site 2 - Savu savu	Site 3 - Wailoaloa
General Testing			
Ammoniacal Nitrogen (as N)	mg/L	-	0.53
Dissolved Reactive Phosphorus (as P)	mg/L	-	0.054
Nitrate (as N)	mg/L	-	0.29
Nitrite (as N)	mg/L	-	0.044
Total Kjeldahl Nitrogen (as N)	mg/L	-	0.80
Total Nitrogen (as N)	mg/L	-	1.0
Total Oxidised Nitrogen (as N)	mg/L	-	0.33
Total Phosphorus (as P)	mg/L	-	0.12
Total Suspended Solids	mg/L	0.50	4.4
Turbidity	NTU	0.35	2.4
Microbiology			
Escherichia coli by MPN			
Escherichia coli	MPN/100 mL	-	1300
Faecal coliforms by MPN			
Faecal coliforms	MPN/100 mL	-	1300
Total coliforms by MPN			
Total Coliforms	MPN/100 mL	-	4900

*Results marked with * are not accredited to International Accreditation New Zealand*

Where samples have been supplied by the client they are tested as received. A dash indicates no test performed.

Reference Methods
The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Ammoniacal Nitrogen (as N) by Colorimetry/Discrete Analyser	HMSO (1981) ISBN 0117516139	0.005 mg/L	2	Auckland
Dissolved Reactive Phosphorus (as P) by Colorimetry/Discrete Analy	APHA (online edition) 4500-P F	0.002 mg/L	2	Auckland
Nitrate (as N) by Calculation	APHA (online edition) 4500-NO3 I	0.002 mg/L	2	Auckland
Nitrite (as N) by Flow Analysis (0.45 µm Filtered)	APHA (online edition) 4500-NO3 I	0.002 mg/L	2	Auckland
Total Kjeldahl Nitrogen (as N) by Sulphuric Acid Digestion (with merc	APHA (online edition) 4500-N org	0.1 mg/L	2	Auckland
Total Nitrogen (as N) by Persulphate Digestion and Flow Analysis	APHA (online edition) 4500-P J (modified), 4500-NO3 I	0.010 mg/L	2	Auckland
Total Oxidised Nitrogen (as N) by Automated Cadmium Reduction/Flo	APHA (online edition) 4500-NO3 I	0.002 mg/L	2	Auckland
Total Phosphorus (as P) by Persulphate Digestion and Colorimetry/Di	APHA (online edition) 4500-P J (modified)	0.004 mg/L	2	Auckland
Total Suspended Solids by Gravimetry	APHA (online edition) 2540 D	0.2 mg/L	All	Auckland
Turbidity by Nephelometry	APHA (online edition) 2130 B (modified)	0.05 NTU	All	Auckland
Microbiology				
Escherichia coli by MPN				
Escherichia coli	APHA (online edition) 9221 F	2 MPN/100 mL	2	Auckland

Preparations				
Faecal coliforms	APHA (online edition) 9221 E	2 MPN/100 mL	2	Auckland
Membrane Filtration (0.45 µm)	APHA (online edition) 4500-P B (preliminary filtration)		2	Auckland
Total Coliforms	APHA (online edition) 9221 B	2 MPN/100 mL	2	Auckland

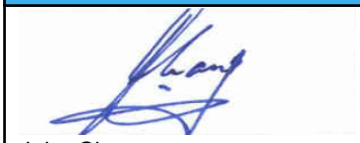
The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher. For more information please contact the Operations Manager.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

Watercare Laboratory Services is a division of Watercare Services Limited .

ACCREDITED LABORATORY

Report Signatory 06/09/2016



John Chang
KTP Signatory

Appendix B Marine Ecological Data

Table B1: PIT data

	1	2	3	4	5
0.5	CA	CB	RB	CA	SD
1	CA	CA	RB	CE	SD
1.5	CE	ZO	RB	CE	SD
2	SC	ZO	RB	CM	SD
2.5	CB	SP	AA	CM	SD
3	SC	ACE	AA	CE	SD
3.5	CE	CM	RC	CA	SD
4	ACB	CM	CM	CE	RC
4.5	CA	CM	CM	CE	RC
5	CE	SC	RB	CA	AA
5.5	CA	SC	RB	CA	RC
6	CA	SC	RC	AA	SD
6.5	CB	CB	RB	AA	SD
7	ACB	CA	CM	CA	SD
7.5	ACB	CA	CM	CF	RC
8	SC	CB	RB	ACE	SD
8.5	SC	ZO	RB	CB	SD
9	CE	ZO	RB	CA	RC
9.5	CA	SC	RB	CE	RC
10	CB	SC	RB	CM	SD
10.5	CB	SC	RB	CM	SD
11	ACB	CE	RB	CM	AA
11.5	CE	CB	RC	ACE	AA
12	CM	CB	RB	CM	AA
12.5	SC	ZO	RB	CM	AA
13	CE	CA	RB	CM	SD
13.5	SC	CA	RB	CA	SD
14	ZO	CB	RB	CA	SD
14.5	ZO	CM	RB	AA	RC
15	SC	CM	RB	AA	RC
15.5	ACE	CM	RB	CA	AA
16	CM	CM	RB	CA	SD
16.5	ZO	ZO	RB	CE	RC
17	ZO	ZO	RB	RC	RB
17.5	SC	CB	RB	RC	RB
18	CM	CM	RB	AA	RC
18.5	CA	CM	RB	AA	AA
19	CE	CE	RB	RB	SD
19.5	CM	CE	RB	RB	SD
20	ACB	CE	CB	RB	RC

20.5	CM	CM	RB	RB	RC
21	CM	ZO	RB	RB	RC
21.5	CM	SC	RB	CB	SD
22	RB	CA	RB	CB	SD
22.5	CA	CA	RB	CA	RB
23	SC	ZO	RB	CA	SD
23.5	RB	CA	RB	AA	RB
24	AA	CB	RB	AA	AA
24.5	AA	CA	RB	AA	AA
25	RB	CA	RB	RB	SD
25.5	AA	CB	RB	RB	SD
26	CA	ACE	AA	RB	SD
26.5	CA	CM	AA	RB	SD
27	RB	CM	RB	RB	SD
27.5	RB	CM	RB	RB	SD
28	AA	CM	RB	RB	SD
28.5	AA	CB	RB	RB	SD
29	AA	ACE	RB	RB	SD
29.5	RB	CA	RB	RB	SD
30	RB	CA	RB	RB	SD

Appendix 3: Initial Community Consultation – List of Attendees

Savusavu Cable Project – Initial Consultation

Hot Springs Hotel, Savusavu

20/09/2016

List of Participants

Name	**Organization**
1. Jayshree Lal	Digicel
2. Syneel Narayan	Vodafone
3. Arunesh Vishwa	Vodafone
4. Wendy	Hot Springs Hotel
5. Onorata Togaca	Hot Springs Hotel
6. Hemant Kumar	XPRO Electrical Works
7. Rizwan Ali	XPRO Electrical Works
8. Steven Yean	TFL