Environmental and Social Impact Assessment (ESIA) For the Caribbean Regional Communications Infrastructure Program (CARCIP)

Installation of a Subsea Fiber Optic Cable Between St. Vincent and The Grenadines and Grenada

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(CARCIP)

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Abbreviations

Term	Definition
ac.	acre = 43560 sq. ft. or 0.404 ha
BMH	Beach Man Hole
CARCIP	Caribbean Regional Communications Infrastructure Program
CLS	Cable Landing Station
CRS	Cable Route Study
CTU	Caribbean Telecommunications Union
DA	Double Armor
DCA	Development Control Authority
DGPS	Differential Global Positioning System
EA	Environmental Assessment
EN	Endangered
ECTEL	Eastern Caribbean Telecommunications Authority
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ft.	foot
GD	Grenada
GPS	Global Positioning System
GCM	General Circulation Model
GRM	Grievance Redress Mechanism
ha	hectare = 10000 sq. m
hr.	hour
HSE	Health Safety and Environment
ICT	Information and Communications Technologies
ICZM	Integrated Coastal Zone Management
ID	Inside Diameter
IFB	Invitation for Bid
in.	inch
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization of Standards
IUCN	International Union for Conservation of Nature
km	kilometer = 0.621 mi. = 0.540 NM
kt	knot = nautical miles per hour
LC	Least Concern
MCL	The Mustique Company Limited
MarSIS	Marine Resource Space-use Information System
MEA	Multilateral Environmental Agreement
mi.	statute mile = 1.609 km
mm	millimeter
MPA	Marine Protected Area
NT	Near Threatened

Term	Definition
nm.	nautical mile = 6076 ft
NTRC	National Telecommunications and Regulatory Commission
ºC	degrees Celsius
ºF	degrees Fahrenheit
OECS	Organization of the Eastern Caribbean States
OP	Operational Policy
PAI	Project Area of Influence
PPDB	Physical Planning and Development Board
PPU	Physical Planning Unit
SA	Single Armor
SDG	St. Georges Declaration of 2001
SLR	Sea Level Rise
SMS	Short Message Service
SFOC	Subsea Fiber Optic Cable
SIOBMPA	Sandy Island Oyster Bed Marine Protected Area
sq. ft.	square feet
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
UKHO	United Kingdom Hydrographic Office
VC	Saint Vincent and the Grenadines
VU	Vulnerable
WDPA	World Database on Protected Areas
WIDECAST	Wider Caribbean Sea Turtle Conservation Network
WB	World Bank
yd.	yard

1.0 EXECUTIVE SUMMARY

Digicel Group proposes to install and operate a modern subsea telecommunications cable between St. Vincent and the Grenadines (VC) and Grenada (GD) with cable landings on the Vincentian islands of Bequia, Mustique, Canouan, Union Island and the Grenadian island of Carriacou, a dependency of Grenada. An additional subsea cable link will be installed between Chateaubelair and Owia on St. Vincent.

The ESIA is developed for the Caribbean Regional Communications Infrastructure Program (CARCIP) project to install and operate fiber optic subsea cable connecting St. Vincent and the Grenadines with Grenada and including the Vincentian islands of Bequia, Mustique, Canouan and Union Island, and the Grenadian island of Carriacou. Currently the Vincentian and Grenadian Grenadines are only serviced by microwave links. The purpose of this project is to install fiber optic subsea cable and supporting beach connections from shore to shore for the listed islands. The project is needed because of a lack of modern Information and Communications Technologies (ICT) connections between the various islands in VC and GD. The primary result of this project will be to support the complete CARCIP vision of modernizing internet connections and service for government, schools and the public.

The basic infrastructural components of this project include approximately 139.8 mi. (225 km) of fiber optic cable, laid on the sea floor. A main trunk cable is proposed to run between St. Vincent and Grenada with branching cable segments at intervals to serve individual islands. In deep water, single armor (SA) cable is typically used. Near shore, both SA cable and double armor (DA) cable are used. An underground beach manhole (BMH) landing facility will be installed at each landing site location to anchor the subsea cable and house connections to cabling ashore which in turn connect to a Cable Landing Station (CLS).

The conduct of this project will be in compliance with the various Vincentian and Grenadian laws and regulations. Ministerial staff of the two countries have been collaboratively engaged in planning for the project, identifying beach cable landing sites and considering protected natural and social resources.

Landing sites were selected from several alternatives at each connecting island, with the exception of Arnos Vale, St. Vincent, where an existing BMH will be used. Some proposed landing sites were avoided because of environmental protection standards. Others were avoided because of lack of beach access, construction impracticability. The preferred landing sites are all feasible from a construction standpoint, access from inland to the site is available, and typically not used by the public or commerce.

Because of the minor disturbance caused by cable laying, no adverse effects to the physical resources of the project area of influence (PAI) are expected. The entire cable laying operation will take approximately one month. The cable is paid out by the cable ship at a speed and tension designed to lay the cable on the sea bed without suspended portions between bathymetric dips and rises. Currents in the deeper portions are less than that required to lift the cable. The cable lies on the seabed, eventually to be either covered by sediment action or overgrown in shallower areas by living organisms. This cause no effect on bathymetric contours or substrata.

The cable will cause an effect on a smaller scale. Lying on the seafloor, the potential disturbance caused by cables is restricted to a narrow strip of seabed, normally limited at most to an area 2-3 meters either side of the cable. The subsea cables will either be buried by normal sedimentary action, or will provide a solid substrate for a variety of invertebrate benthic species and associated vertebrates such as fish. This "reef effect" can lead to an increase in faunal diversity and a beneficial change in benthic community composition.

Subsea cables are encased in an inert plastic material; the entire cable has an expected life of around over 30 years. Installation is therefore considered a singular event that will not occur again unless maintenance is required, or if the removal of the cable is needed.

Cable routes have been selected to avoid coral as far as is practicable. In locations where the coral coverage is higher, divers will lay cables by hand and any live species can generally be avoided or moved to avoid being crushed, such as the West Indian sea egg. In areas such as Carriacou where the live coral coverage is higher, the presence of a marine biologist can be employed to reduce the risk of impacting any live corals.

Subsea cable deployment has the potential to affect various fish species but mobile fish and shellfish are expected to be able to move away during cable laying operations. Cable deployment has the potential to impact fishing activity temporarily during the laying operations similar to any other vessel on the open sea. As-laid information will be posted to the United Kingdom Hydrographic Office (UKHO) to warn navigators of the presence of a subsea cable.

Installation of the BMH and cable landing is anticipated to cause minor and short-lived impacts to habitats and species onshore. BMH installation sites were selected to minimize disruption of the land and include bare, disturbed or developed site areas. Important habitats such as mangroves and undeveloped forests have been avoided. The typical description of a BMH installation site can be described as on a sandy beach, adjacent to a roadway, in a parking area, or along a pedestrian beach access walkway. Landing site construction may temporarily displace species such as, rodents, mammals, and reptiles but there is no foreseeable adverse impact upon these species.

Articulated pipe weighted armor will keep the cable in place and prevent scouring of the sea floor in nearshore areas. Beach construction sites will be returned to pre-construction conditions with the exception of visible manhole covers and an occasional conduit/cable on the sea bottom in intertidal areas. Notification of impending construction will be provided locally and appropriate notices will be posted.

During offshore cable laying, threatened marine mammals and sea turtles will be avoided by Marine Mammal Observers onboard the vessel who are assigned watches to alert those in charge of ship/vessel control of potential collision. The slow speed of the cable laying vessel and the agility of smaller cable landing vessels will help to avoid collision with marine mammals and sea turtles.

Each beach landing site was selected, in part, to avoid existing land uses such as moorages, piers, parks, swimming beaches, etc. Landing site selection also avoids residences, forest, parks, marine protected areas, coral reefs and the like to minimize construction costs and avoid (mitigate) potential adverse effects to biological resources and existing land use. The selected location of each landing site strikes a balance between existing human use and environmental conservation.

Contacts and discussions with local residents, land managers and government officials have identified no sensitive social conditions that could be adversely affected by BMH construction or cable laying. To the contrary, contacts indicate the project is desirable overall. The installation of fiber optic connections to the various islands is viewed as a social benefit as it will improve internet connections for the individual, provide opportunity for improving education and improve government services conducted on the internet.

Installation of the cable will be positive for government, education, commerce and the public internet connections. On the other hand, installation of beach landings will temporarily exclude some activities such as fishing and small vessel navigation for the short duration of construction. Afterwards, installed components are inconspicuous, only to be seen by the occasional fisherman or beach pedestrian.

Mitigation measures have been developed to offset adverse environmental impacts. After analyzing the effect and applying mitigation to avoid, reduce or minimize adverse effects, remaining risk of effect was assessed. For this project residual risk is either absent, negligibly detrimental, or positively beneficial.

This Environmental and Social Impact Assessment (ESIA) contains an Environmental and Social Management Plan (ESMP). The ESMP is an instrument that details (a) the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts, or to reduce them to acceptable levels; and (b) the actions needed to implement these measures. The ESMP is an integral part of Category A EAs (irrespective of other instruments used). EAs for Category B projects may also result in an ESMP.

2.0 INTRODUCTION

The Caribbean Regional Communications Infrastructure Programme (CARCIP) is a communications improvement program initiated collaboratively by the Governments of St. Vincent and the Grenadines, St. Lucia and Grenada; and funded by the World Bank. CARCIP will modernize and fill gaps in regional Information and Communications Technologies (ICT) infrastructure by improving development opportunities and public service efficiency. Participating countries include St. Vincent and The Grenadines (VC), St. Lucia and Grenada (GD). Two letter country abbreviations are used throughout this document in accordance with the ISO Standard 3166 (2018).

> *CARCIP enhances networks and services among Government institutions, promotes small and medium enterprises to generate wealth and develops the skill sets of ICT professionals. The program's overarching goal is to encourage key stakeholders (which include citizens, government agencies, private agencies, telecommunications service providers, regulators, policy makers, ministers, and sponsors) to get involved in ICT in a productive manner, thereby improving economic development. (CTU 2018)*

The action addressed in this Environmental and Social Impact Assessment (ESIA) is known simply as "the project." The scope of the project is to install and operate fiber optic subsea cable connecting VC with Grenada and including the Vincentian islands of Bequia, Mustique, Canouan and Union Island, and the Grenadian island of Carriacou. An additional subsea cable link will be installed between Chateaubelair and Owia on St. Vincent.

This project has been procured by the Caribbean Regional Communications Infrastructure Program (CARCIP) under the CARCIP Invitation for Bids (IFB) of May 26, 2016, Lot 3, ID: SVG-CARCIP-G-ICB-2 (CARCIP 2016). According to the IFB, the installation and operation of the undersea cable system with landing stations comprises Lot 3, "Undersea Cable System." The scope of Lot 3 is: "Undersea Cable System connecting St. Vincent and Grenada islands with Bequia, Mustique, Canouan and Union Island (possessions of VC) and Carriacou (possession of GD)." The IFB further indicates that the governments of VC and GD will provide "potential Crown Lands for cable landing stations." (CARCIP 2016)

This ESIA follows guidance provided by World Bank Operations Manual OP 4.01 Environmental Assessment (EA) (World Bank 2013). The ESIA has been produced following an agreed Terms of Reference document prepared in collaboration with World Bank, VC and GD staff (APPENDIX I: TERMS OF REFERENCE). At the request of World Bank, this impact assessment has been titled an Environmental and Social Impact Assessment (ESIA). This ESIA evaluates social and environmental risks and impacts of the project; considers alternatives and identifies improvements to siting, planning, design and implementation by avoiding or minimizing potentially adverse social and environmental impacts. Further, the ESIA identifies ways to enhance positive impacts and methods to mitigate and manage adverse impacts during cable installation (World Bank 2013). Preparers and construction managers subscribe to professional codes of practice identified in APPENDIX II: CODES OF PRACTICE.

3.0 PROJECT DESCRIPTION

The project scope is to install and operate fiber optic subsea cable connecting VC with GD and including the Vincentian islands of Bequia, Mustique, Canouan and Union Island, and the Grenadian island of Carriacou. An additional subsea cable link called a festoon will be installed between Chateaubelair and Owia on St. Vincent (Figure 1). Throughout, the fiber optic subsea cable and shore landings will be connected to terrestrial infrastructure via terrestrial cables and the CLS's and routed to government offices, schools and the public.

The object of the CARCIP project is to provide the telecommunications infrastructure that will enable GD and VC to advance the development of Information and Communication Technologies (ICT) and to foster regional economic development and growth. The subsea cabling will "set the stage" for subsequent information systems.

3.1 Project Rationale

Currently St. Vincent Island and Grenada Island are connected to subsea cable internet services, while the smaller intervening islands of Bequia, Mustique, Canouan, Union and Carriacou are not so connected. These smaller islands need a high-speed internet cable connection to provide modern internet speeds and reliability. This project will also support expansion of modern-standard, high-bandwidth wireless services, High Definition Television, government internet services, and high-speed internet for local & tourism users to these islands.

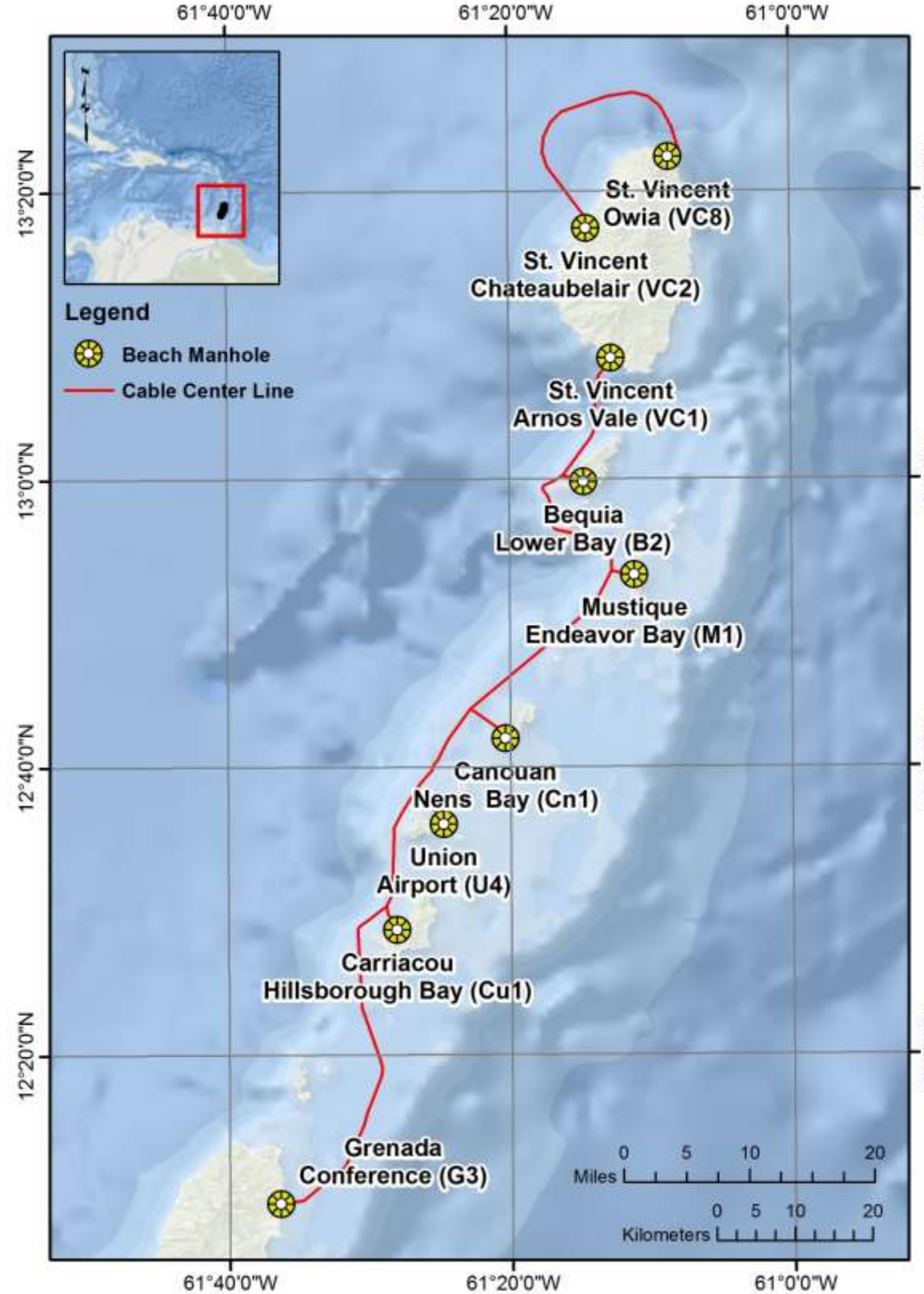
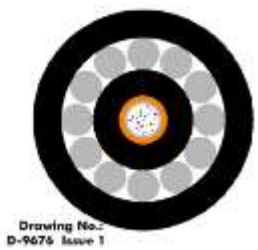


Figure 1. CARCIP cable route overview.

3.2 Project Components

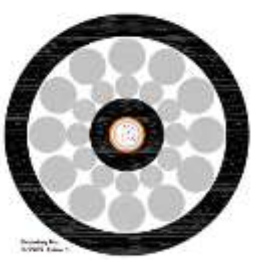
The basic infrastructure components of this project include approximately 139.8 mi. (225 km) of subsea fiber optic cable (Figure 1), laid on the sea floor. A main trunk cable is proposed to run between St. Vincent and Grenada with branching cable segments at intervals to serve individual islands. In deep water, SA cable is typically used (Figure 2). Near shore, both SA cable and DA cable (Figure 3) are used. A beach manhole (BMH) landing facility (Figure 4) will be installed at each landing site location.

The BMH serves to anchor subsea cables and house connections to existing cabling ashore (front haul) which in turn connect to a CLS. APPENDIX III: VESSEL AND CABLE SPECIFICATIONS provides further detail on the proposed terrestrial connections and CLS construction (where necessary) to include likely construction methods and mitigation measures, where appropriate.



Physical characteristics	Unit	Nominal value	±
Cable core diameter	mm	10	1
Cable outer diameter	mm	20/22	1.5
Weight in air, approx.	kg/m	1.1	0.2
Weight in seawater, approx.	kg/m	0.7	0.2

Figure 2. CARCIP SA cable type.



Physical characteristics	Unit	Nominal value	±
Cable core diameter	mm	10	1
Cable outer diameter	mm	33	1.5
Weight in air, approx.	kg/m	3.2	0.2
Weight in seawater, approx.	kg/m	2.3	0.2

Figure 3. CARCIP DA cable type.

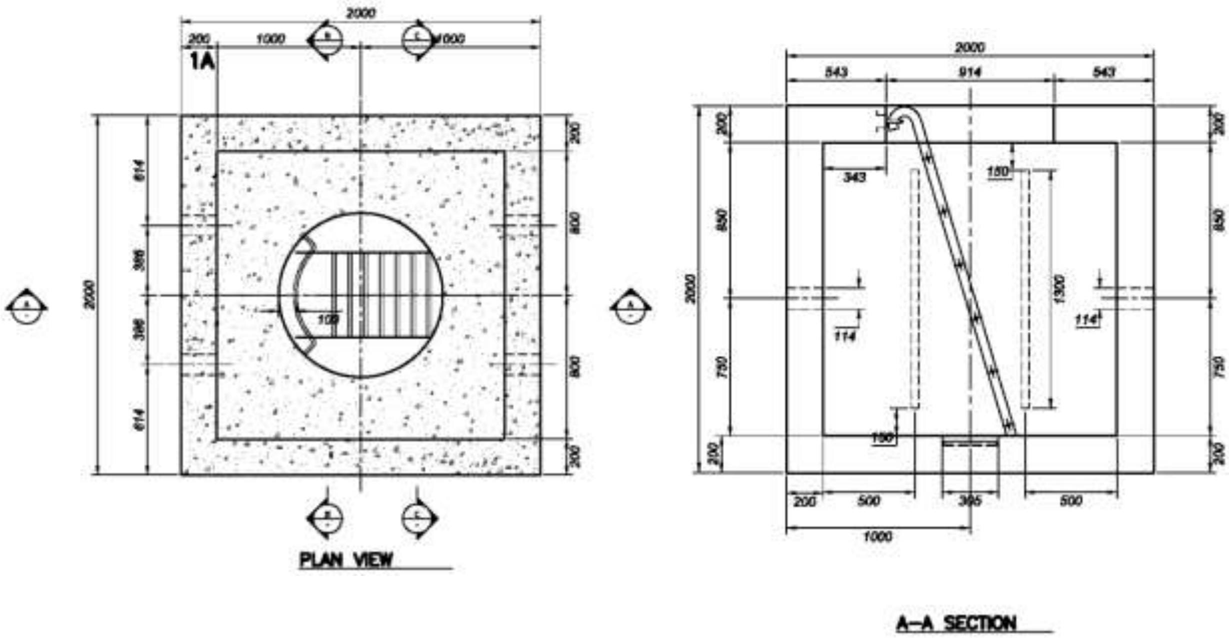


Figure 4. Beach manhole typical plan view and cross section (dimensions in mm).

3.3 Location

The preferred cable landing locations listed below have been selected from alternative landing sites on each island. Selection criteria have included environmental, social and execution aspects. Site selection and conclusions are discussed in detail in Section 5.0, Analysis of Alternatives. From this analysis, the preferred landing sites are listed in Table 1 and briefly described below.

Table 1. Preferred Landing Sites

Island	Landing Site Name	LATITUDE	LONGITUDE	IMPACT AFTER MITIGATION (See Section 7.7)
GD to ST. VINCENT	Conference (G3)	12° 9'40.38"N	61°36'23.34"W	Negligible
	Arnos Vale (VC1)	13° 8'26.15"N	61°12'42.24"W	Negligible
BEQUIA	Lower Bay (B2)	12°59'49.34"N	61°14'42.83"W	Negligible
MUSTIQUE	Endeavor Bay (M1)	12°53'21.24"N	61°11'7.50"W	Negligible
CANOUAN	Nens' Bay (Cn1)	12°42'0.18"N	61°20'20.76"W	Negligible
UNION	Airport (U4)	12°36'3.72"N	61°24'43.14"W	Negligible
CARRIACOU	Hillsborough Bay (Cu1)	12°28'43.14"N	61°28'4.98"W	Negligible
ST. VINCENT	Chateaubelair (VC2)	13°17'32.10"N	61°14'16.50"W	Negligible
	Owia (VC8)	13°22'23.16"N	61° 8'34.50"W	Negligible

On the northern end of Grenada, a main trunk cable is proposed to land at Conference, Grenada, in avoid to eastern side of Grenada and Kick 'em Jenny/Jack submarine volcanoes. The Conference landing site is an unimproved beach access road and the BMH will be installed in a grassy area on shore.

The main trunk cable will be routed around the north end of Grenada, crossing between Ronde Island and Carriacou, then to the southern end of St. Vincent (Figure 1). The landing site for the main trunk cable at St. Vincent is an existing beach manhole near the Arnos Vale Stadium. Branching cable segments are routed from the main trunk at intervals to the following island landing sites on Bequia, Mustique, Canouan, Union and Carriacou (Table 1).

A cable loop festoon will be routed around the northern end of St. Vincent to close the island-wide terrestrial ring due to the presence of the La Soufrière volcano in the northern mountainous areas. The festoon lands at Chateaubelair to the west and Owia to the east.

3.4 Installation

3.4.1 Cable Installation

The CARCIP subsea cable system comprises a main trunk line, six cable segments and associated BMH landings. The main trunk and cable segments will be laid on the ocean floor by the cable laying ship, the CS *IT Intrepid* (Figure 5 and APPENDIX III: VESSEL AND CABLE SPECIFICATIONS). The CS IT Intrepid is 377.3 ft. (115 m) in length and 20.7 ft. (6.3 m) in draft. The vessel is equipped with its own water making capabilities and will be independent from any on island resources. Cable dimensions and characteristics are discussed above in Section 3.2. At each of the cable landings, approximately 55 yd. (50 m) of the cable will be protected with cast iron articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS) to protect the cable and hold it steady in surf conditions. In some instances, the cable in shallow water may be buried by divers.

The prevailing winds and currents for the waters offshore St. Vincent, the Grenadines, and Grenada are from an easterly direction. Consequently, the preferred and most effective installation will follow these prevailing forces. To help maintain this alignment, the cable will be installed from southwest to northeast, starting in Grenada and ending in St. Vincent. As the trunk installation progresses, each branching cable segment will be installed. After the main system is installed, the festoon route along northern St. Vincent will be installed.

Figure 5. CS *IT Intrepid.*

3.4.2 Cable Lay

Proprietary navigation software (Figure 6) will be used to monitor, display and record ship's position throughout operations, on a 24-hour basis. Horizontal positioning will be achieved by a redundant primary system of two subscription-based Differential Global Positioning System (DGPS) receivers and two survey grade gyrocompasses. Position accuracy is within two meters at all times. Positions are logged and reported for record.

Throughout operations a secondary navigation system will provide full backup of the primary navigation system. The secondary system will be operational and fully maintained at all times to allow immediate cut over in the event of primary failure.

The cable deployment is modelled, controlled and recorded with proprietary software capable of a three-dimensional cable model for precise cable laying control. All significant factors influencing the position and control of the cable are monitored including complex cables and shapes that change with time, bottom terrain and complete water-column current profiles. Numerous cable types and cable bodies can be incorporated into a single cable lay or recovery with this system.

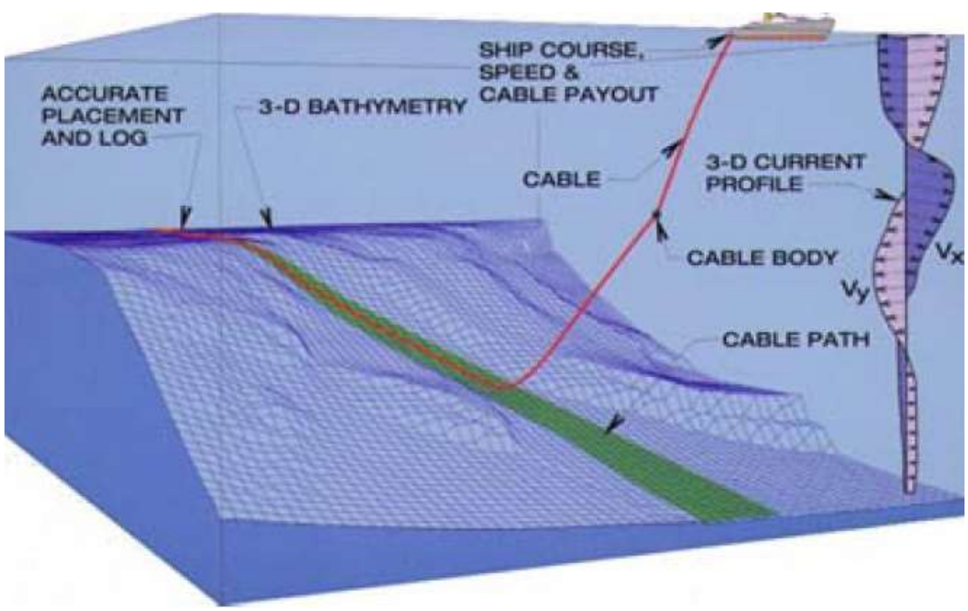


Figure 6. Three-dimensional cable laying model illustration.

The objective of subsea cable laying is to safely move the cable from the cable ship to the seabed and to place it there accurately. The cable aboard the ship is a complex assembly that has been designed and manufactured for placement at specific locations along the planned and surveyed cable route.

Not only is the cable to be laid on a specific route, but the cable must also be laid under specific conditions of slack or tension. Subsea fiber optic cable is generally laid on the bottom with a precise amount of slack to prevent spans and tensions that can shorten the cable's life, but not too much excess cable that can lead to hazardous loops and excessive costs. The ship speed and the cable pay out speed will depend on the seabed profile and cable type and is typically five knots or less.

The branching cable segments are generally installed as part of a single ship operation where one branch leg has been pre-laid and buoyed off, or simply streamed. The laying vessel lays the second branch leg up to the buoy and recovers the first leg. This is then jointed to the branching cable segment tail onboard and the branching cable segment released on the trunk cable.

Once the cable installation has been completed, the cable ship will return to the designated port for demobilization. If applicable, spare cable and related equipment will be offloaded and personnel disembarked.

3.4.3 Shore Ends

A Beach Man Hole (BMH) will be constructed at each landing site with the single exception of the Arnos Vale, St. Vincent, landing site where an existing BMH will to be used. BMHs will be constructed of a simple concrete box and will be constructed with local contractors onsite before cable installation begins. Due to the small size of the BMH, on-island resources will be used. Landing operations vary from short cable crossings where small craft can pull the end ashore, to heaving double armored cables across an open sea beach. Landing shore ends, by necessity, is a concerted team effort between the cable-ship crew and the Beachmaster, who supervises all beach activities. Consequently, communication between the vessel and beach rates high in priority.

On the day of cable transfer to shore, operators select one of three typical methods to land the cable. First, using a self-propelled barge where the cable is coiled onto the open deck then laid to the beach through the barge's smaller linear cable engine and counter. This technique is ideal when alter courses are planned between the cable ship's final holding position and long and shallow approaches. It is also typically the preferred method when landing on a smooth beach without heavy surf zone. It allows for minimal equipment requirements on the beach (Figure 7).

The barge is equipped with appropriate survey electronics and cable machinery to ensure cable slack management is maintained. The craft has the cable coiled onto her open deck directly from the cable ship's cable tank as the barge lays alongside. The barge will deliver the cable precisely to the landing spot with sufficient extra cable to satisfy beach manhole requirements.

Figure 7. Cable transfer from cable ship to barge

Second, the cable ship can also conduct her own cable haul with a small support craft to run messenger rope to/from the beach through a beach quadrant (Figure 8).

Figure 8. Cable pull from cable ship through beach quadrant

Third, workers on the beach can haul the cable directly from the cable ship with a winch or other similar machinery (Figure 9).

Figure 9. Floated cable pulled from the cable ship using a winch on the beach.

Once installed, as-laid information is provided to the UKHO charting agencies to allow placement on nautical charts while the local maritime authority is also advised to ensure that the location of the cables is well known to the local maritime community.

The section between the BMH and the CLS is referred to as the front haul infrastructure. This link will be installed by Digicel Group according to their standard operating procedures while adhering to all VC and GD legislation and regulation. Refer to APPENDIX IV: CABLE LANDING STATION SPECIFICATIONS for construction specifications for BMH, Front haul and CLS installation specifics on the CARCIP front haul and CLS installation.

3.4.4 Cable Repair Methodology

Cables breaks should be expected over the life of services. On average, every 10 years on average a repair will be expected. When a cable system is broken, tests are made from the CLS or suitable access points ashore to locate the trouble to an accurate geographical position derived from laying records. This localization will dictate the repair method to be selected, as follows:

<u>Shallow Water (less than 22 yd. [20 m] depth)</u>

When the interruption is located in shallow water, a diver inspection or an electronic probe will be used to locate the damaged area. The ends will be hauled (or floated) to the surface and secured at the repair vessel. After suitable electrical/optic tests have confirmed no other interruptions are present, a new spare piece is jointed/spliced in and the bight lowered, under controlled conditions, to the seabed. If appropriate, the exposed cable can be diver-jetted into the seabed. Alternatively, a new shore end may be installed on the same route and following the same methodology and installing a new cable. The full operation would be completed in approximately 2 days.

Deep Water (greater than 22 yd. [20 m] depth)

From a repair vessel, a grapnel is used to raise the cable to the surface. The bight of cable is hauled inboard on the grapnel and secured. After cutting the bight, the ends are opened and tested. In the ideal case testing in one direction will establish its mechanical/transmission integrity while testing in the other direction will indicate the break to be close to the ship.

After sealing and buoying off the good-end, the short stray end is recovered to a spare storage tank or coil space and the ship proceeds to grapple for the end on the far side of the break. Crew raise the bight of cable to the ship and splice the original cable to replacement cable. The repaired cable is then paid out while steaming back to the buoyed good-end.

When the cable buoy has been recovered and the first good end tested and confirmed to be still intact, the payout is terminated and the replacement cable is cut on the foredeck. Its end is joined to the recovered end and a final splice is made, whereupon the bight of cable is lowered to the seabed. After appropriate transmission tests have been made, the system can be returned to traffic. The full operation will take approximately 4 days.

4.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Both VC and GD have ratified several international environmental Agreements and Conventions and by their signature of the St. Georges Declaration of 2001(SDG) have committed themselves to the Principles for Environmental Sustainability in the Organization of the Eastern Caribbean States (OECS). They all have in place several pieces of legislation and institutions to protect their environments; some of which were originally enacted in the 1940's and amended in recent times.

The primary focus from environmental legislation in these countries has been on the protection of sensitive and important natural resources, protection of public health and safety, and the promotion of sound environmental and natural resource management principles and practices.

4.1 The ESIA Process and Approvals

The structure of the ESIA follows a combination of local and World Bank (WB) guidance. Preparation of the ESIA has included consultation with the WB, government officials and the public. The final document will be submitted to VC and GD governments for review and consent. The relevant planning units in each country will receive and distribute the ESIA among the appropriate ministries for additional review. This review and consent process ultimately support installation and operation of the subsea cable and shore landing infrastructure.

Local physical planning for infrastructural developments which provide for or improve upon communications do not necessarily always require an environmental impact assessment (EIA). In VC, the Town and Country Planning Act No. 45 of 1992, and Grenada's Physical Planning and Development Control Act, No. 25 of 2002 does not list cable laying or associated developments related to such activity as requiring an EIA.

However, permission for the implementation of the CARCIP project first requires a "No Objection" from the WB, as they are major funder of the project. In order to gain this approval, an Environmental and Social Impact Assessment (ESIA) must be carried out, reviewed and approved by the WB as well as respective governments.

The purpose of the ESIA is to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures. The ESIA also addresses community consultation following WB guidance.

Planning permission for the construction of BMHs must also be approved by the respective planning departments in both VC and GD as well as permission from the Mustique Company Ltd. since Mustique is privately owned. Applications for approval include the architectural BMH designs for each location and method statements for construction. Approval for constructing the BMHs may occur prior to the "No Objection" from the WB but does not grant permission to lay cables.

Ensuring the environmental and social sustainability of both countries is an integral part of this project. Extensive research has been carried out to avoid breaching existing frameworks and a thorough review of relevant policies, legislation and international conventions by which VC and GD are governed.

The following instruments are also discussed in the ESIA:

Environmental impact assessment (EIA): An instrument to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures. Projects and subprojects need EIA to address important issues not covered by any applicable regional or sectoral environmental assessment (EA).

Environmental and social management framework (ESMF): An instrument that examines the issues and impacts associated when a project consists of a program and/or series of sub-projects, and the impacts cannot be determined until the program or sub-project details have been identified. The ESMF sets out the principles, rules, guidelines and procedures to assess the environmental and social impacts. It contains measures and plans to reduce, mitigate and/or offset adverse impacts and enhance positive impacts, provisions for estimating and budgeting the costs of such measures, and information on the agency or agencies responsible for addressing project impacts. The term "Environmental Management Framework" or "EMF" may also be used.

4.2 World Bank Safeguard Policies Targeted

The WB environmental and social safeguards policies are triggered by this project, including the Operational Policy (OP) 4.01 for Environmental Assessment and the OP 4.12 for Involuntary Resettlement. The overall project must also comply with national laws and any applicable treaties concerning international waters.

The Safeguard Policy OP 4.01 requires that an Environmental and Social Management Framework (ESMF) be prepared for the overall program and is regarded here as the Environmental and Social Impact Assessment (ESIA) which also includes the WB requirement under OP 4.01 for an Environmental and Social Management Plan (ESMP).

The Involuntary Resettlement Considerations of Safeguard Policy OP 4.12 is triggered by land acquisition for the project. However, all land that will be affected by this project, is owned by the respective governments, therefore this safeguard policy will not be triggered. If private land had to be acquired, the preparation of a Resettlement Policy Framework and a Resettlement Action Plan would have been required.

The ESIA and ESMP will be disclosed to the WB, VC and GD governments and the public in order to receive a “No Objection” from the WB and approval from local governments prior to the commencement of project works.

4.3 Saint Vincent and the Grenadines

The Parliamentary Democracy of VC (Figure 10) is located towards the southern portion of the Windward Islands between St. Vincent to the north and Union Island to the south. It comprises approximately 32 Islands and Cays, eight of which are inhabited. Apart from mainland St. Vincent, the other inhabited Islands are: Bequia, Mustique, Union, Canouan, Prune (Palm), Mayreau and Petit St. Vincent. The total area is 150 square miles (388 sq. km), with St. Vincent (the main Island) being 133 sq. mi. (344 sq. km) (Niles 2011).

Figure 10. Flag of St. Vincent and The Grenadines.

In Saint Vincent and the Grenadines, the National Telecommunications and Regulatory Commission (NTRC) provides regulatory oversight of telecommunications development. The NTRC operates under the Treaty Establishing the Eastern Caribbean Telecommunications Authority (ECTEL) of 2000 and the Saint Vincent and the Grenadines Telecommunications Act No. 1 of 2001. This project will follow policies and procedures of the NTRC during environmental and permit review.

Physical planning in VC for this project will follow the Town and Country Planning Act, 1992, as amended. A Physical Planning and Development Board (PPDB) of 14 members are the executive of the Act. PPDB members are selected from various government ministries/departments, and other public offices.

The Physical Planning Unit (PPU) is responsible for the implementation of the Act and board directives. The PPU is responsible for development planning and development control as the regulatory body. Ministries represented on the PPDB include government officers (or their nominees) as officio members of the Board:

- Director of Planning
- Head of National Properties Ltd.
- Chief Engineer
- Chief Agricultural Officer
- Chief Surveyor
- Chief Environmental Health Officer
- General Manager of Housing and Land Development Corporation
- Manager of Central Water and Sewerage
- General Manager of St. Vincent Electricity Services Ltd
- Commissioner of Police
- Warden of Kingstown Town Board
- Additional members as appointed by the Cabinet

A number of Government and statutory agencies in Saint Vincent and the Grenadines have responsibility for environmental management in one form or another under various pieces of legislation. Table 2, below, provides an overview of the agencies, policy, legal and administrative considerations pertaining to environmental management relevant to this project.

Mustique Company Limited

The Mustique Company Ltd. (MCL) was formed to encourage tourism and building of private homes on the island (The Mustique Company Ltd. 2018). ‘The Mustique Company Limited Act 1989 (Act. No. 62) was passed into law appointing the Company as custodian of the island. This Act has since been repealed with the Mustique Company Limited Act, No. 48 of 2002 and amended with the Mustique Company Limited (Amendment) Act, No. 25 of 2004.

Although Mustique is part of the Grenadines Islands, this Act deals with matters relating to Mustique specifically. However, the Act ensures that the laws of VC apply to Mustique in the same manner that they apply to the other islands. This keeps Mustique under the ultimate jurisdiction of St. Vincent, but its individual Act allows for matters associated with a privately-owned island and conservation area to be addressed locally.

In the Act, the Mustique Company has the duty to manage, develop and maintain infrastructure and provide services that are normally the responsibility of public authorities. Infrastructure includes but is not limited to the airport, jetty, roads, and recreational as well as conservation areas.

The Company also has the duty to maintain and develop the Mustique Conservation Area. The conservation area encompasses the entire island and surrounding waters 1000 yards from shore. This includes but not limited to the conservation of its surroundings, such as beaches and landscape, as well as flora, fauna and aquatic life such as coral and fish. Other provisions deal with the management of various forms of pollution including air, noise and improper waste disposal.

Table 2. Policy, Legal and Administrative Considerations, VC

Agency	Legislation/Policy/MEAs	Scope and Relevance
Ministry of Health, Wellness and the Environment	Environmental Health Services Act (No. 14, 1991) Maritime Areas Act, 1981 Central Water & Sewage Act 1991	Make provision for the conservation and maintenance of the environment in the interest of health generally and in particularly in relation to place frequented by the public. Identifies the Territorial waters of St. Vincent and the Grenadines Provisions for the conservation, control, apportionment and use of water resources
Solid Waste Management Unit [Central Water and Sewerage Authority]	Waste Management Act (No. 31, 2000)	Executes the activities under the "Organization of Eastern Caribbean States (OECS) Solid and Ship-generated Waste Management Project" and is also currently responsible for the collection and disposal of Solid waste on St. Vincent.
Ministry of Agriculture, Rural Transformation, Forestry and Fisheries	Fisheries Act (No.8, 1986), & later amendments (No.32, 1986, and No.25, 1989) Forest Resource Conservation Act (No.47, 1992) Marine Parks Authority Act 1997(No.33, 2002) Natural Forest Resource Act (1947) Wildlife Protection Act (No.16, 1987) & later amendments (1988, 1991) Wildlife Conservation Act (1991) Beach Protection Act (1981)	Promotion and management of fisheries and related matters; To provide for the conservation, management and proper use of the forest and watersheds, declaration of forest reserves, cooperative forest and conservation areas; The establishment of marine parks and related areas; Providing for the protection of wildlife and any connected issues; The conservation and sustainable management of the Nation's forest, wildlife and national park resources. Prohibits the digging, taking or carrying away of almost any type of material from shores
Ministry of Tourism and Culture	National Parks Act (No.33, 2002) National Parks (Amendment) Act (No. 13, 2010) SVG National Parks and Protected Areas System Plan 2010 – 2014	To preserve, manage, protect and develop the natural and cultural heritage of VCG, including the historical and cultural heritage of the Island.
Ministry of Finance, National Security, Grenadines Affairs and Legal Affairs	Maritime Areas Act 1983 National Economic and Social Development Plan St. Georges Declaration of Principles for Sustainable Development (SGD) in the Organization of the Eastern Caribbean States (OECS) of 2001. [a]	Identifies the spatial extent of Territorial waters Plan applies strategic goals, objectives and targets so as to facilitate and guide the optimal improvement of the quality of life This sub-regional agreement is designed to support sustainable development and covers a wide range of environmental issues including the *Multilateral Environmental Agreements (MEAs)
Ministry of Housing, Informal Human Settlement, Physical Planning, Lands and Surveys	Town and Country Planning Act (No.45, 1992) Crown Lands Act Land Acquisition Act, Cap. 207 Land Surveyors Act, Cap. 266	-The PPU has the legal authority for environmental management in general, including the evaluation of the need for and level of EIA requirements. -The Governor-General may make regulations regarding the management, sale and letting of Crown Lands as well as occupation, allotment and survey of Crown lands and the issue of fees payable. Requires an acquisition be reported in the Gazette to become official Specifies only a surveyor can perform surveys which affects the definition of the boundaries, or the location of survey marks, of any holding or land registered, or to be registered

Agency	Legislation/Policy/MEAs	Scope and Relevance
The Ministry of Health, Wellness and the Environment	United Nations Conventions: Convention on Biodiversity FCCC Framework Convention on Climate Change Cartagena Convention – LBS protocol	- Convention for the protection of biological diversity. - Convention to reduce greenhouse gas emissions. - Convent against land-based sources of marine pollution.
[a] As a signatory to the MEAs and SGD, St. Vincent & the Grenadines has obligations to reduce its greenhouse gas emissions, protect and sustainably manage its biological diversity, prevent land degradation and ensure that livelihood issues are not threatened or compromised. The National Environmental Management Strategy and the National Economic and Social Development Plan 2013-2025 speaks to environmental sustainability; as a consequence, all activities that take place under the proposed project must respect and respond to these declarations and pronouncements (Murray, 2016).		

4.4 Grenada

Grenada is a Constitutional Monarchy and member of the Commonwealth of Nations (Figure 11). Grenada includes the Islands of Carriacou and Petit Martinique and some smaller uninhabited Islands between. It is located at the southern end of the Windward Islands approximately 45 miles (72.4 km) south of St. Vincent. The total area of these three inhabited Islands is 133 sq. mi. (344.5 sq. km), with Grenada (the main island) being 120 sq. mi. (310.8 sq. km); Carriacou 13 sq. mi. (33.7 sq. km); and Petit Martinique 0.9 sq. mi (2.3 sq. km).

Figure 11. Flag of Grenada

Grenada also has a National Telecommunications and Regulatory Commission (NTRC) which provides regulatory oversight of telecommunications development. The GD NTRC operates under operates under the Treaty Establishing the Eastern Caribbean Telecommunications Authority (ECTEL) of 2000 and the Telecommunications Act of 2000. This project will follow policies and procedures of the GD NTRC during environmental and permit review.

Physical planning in GD will follow the Physical Planning Development Control Act Number 23 of 2016. The Physical Planning Unit (PPU) is responsible for implementation of the Act. Environmental documentation submitted to the PPU is reviewed by the following ministries:

- Ministry of Health
- Ministry of Works
- Government Structural Engineer
- Government Architect

Table 3 provides an overview of agencies and their laws, policies and multilateral agreements relevant to this project.

Table 3. Policy, Legal and administrative Considerations for Grenada

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
Ministry of Agriculture; Ministry of Climate Resilience, the Environment, Forestry, Fisheries, Disaster Management & Information	Fisheries Act CAP. 108 (1990); Fisheries (Amendment) Regulations, SRO 2 of 2001; Fisheries (Amendment) Regulations, SRO 24 of 1996	Act does not allow a person to destroys any flora or fauna, dredge or extract sand or gravel, discharge or deposit waste or other pollutants or in any other way destroy, disturb or alter the natural environment. Offences also include the construction of any building or any other structure on or over any land or waters. Cables are laid directly on the seabed in locations identified as predominantly sand/seagrass with coral outcrops avoided using divers to hand lay cables in nearshore locations.
	Fisheries (Marine Protected Areas) Order, SRO 77 of 2001; Fisheries (Marine Protected Areas) Regulations, SRO 78 of 2001	Subsidiary legislation to the Fisheries Act that gives the Minister the power to declare an area to be a marine park, marine reserve, marine sanctuary or a marine historical site or any combination. Allows for zoning within the marine park or marine reserve and must be Gazetted. Although the Sandy Island Oyster Bed Marine Protected Area is proposed, it has not yet been gazetted. Cables do not cross through any MPA.
	National Parks and Protected Areas Act, No. 52 of 1991, NO. 42 of 1990; CAP. 206	Act provides for the designation and maintenance of national parks and protected areas. Subsea cables and all landing sites are located outside of any National Parks & Protected Areas
	Beach Protection Act, No. 67; CAP. 29 (1979); Beach Protection Amendment Act of 2009	Prohibits the unauthorized removal of sand. Sand will not be permanently removed from vicinity in which it is excavated and returned to pre-existing conditions
	Forest, Soil and Water Conservation Act Cap. 116 (1949); Forest, Soil and Water Conservation (Amendment) Ordinance No. 34 (1984)	Act provision for the conservation of forest, soil, water and other natural resource under the Forestry Department and may declare any Crown Land to be a forest reserve. Also does not allow persons to fell, cut, or cause damage to trees. Location of BMHs are not located in any forest reserves or forest protected areas and are located in open spaces, away from trees.
	Plant Protection Act, No 19 of 1986; Cap 242	Provides for the control of pests that are harmful to plants as well as prevent the importation of plants and materials that are harmful to agriculture. No species will be imported and the cable vessel will have recently had new antifouling bottom paint to ensure no organisms will be carried from foreign waters on the hull of the ship
	Crown Lands Rules (Amendments) SRO Nos. 3, 19, 39 (1965) Crown Lands Act; Crown Lands Ordinance Cap. 78 of 1990	Act relates only to Government lands, regulate the conduct and management of fisheries and makes provision for the protection of marine areas and the adjacent or surrounding land. These provisions are relevant to the management of the coastal zone with respect to coastal erosion, the protection of reefs, aquatic and marine plants and animals, oil pollution and mangrove forest on the near shore. Extensive efforts have been made to ensure cable routes and landing sites are located in areas with the least possible impact and an environmental & social management plan will be implemented.
	National Parks and Protected Areas Act, No. 52 of 1991, NO. 42 of 1990; CAP. 206	Act provides for the designation and maintenance of national parks and protected areas. Subsea cables and all landing sites are located outside of any National Parks & Protected Areas.

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
	Birds & Other Wildlife (Protection) Act; Cap 34	The Act preserves certain species that inhabit the islands of Grenada, Carriacou and Petit Martinique. The Act also makes special provision for the protection of turtles and turtle eggs by making a person who takes, destroys or possesses such turtles or turtle eggs, guilty of an offence. Cable laying activities have minimal impact on birds as they tend to avoid activity and no loud alarms will be used. Turtle specialists are included in the ESMP to ensure no turtles or eggs are impacted in any way.
Ministry of Agriculture; Ministry of Climate Resilience, the Environment, Forestry, Fisheries, Disaster Management & Information	Carriacou Land Settlement and Development Act Cap 42	The Act provides for the control and development for lands as may be vested in it with the economic and social requirements of the community, and with the need for conserving natural resources of soil, forest and water. Extensive efforts have been made to ensure cable routes and landing sites are located in areas with the least possible impact and an environmental & social management plan will be implemented.
	Tropical Forestry Action Plan (1985)	The Plan identifies long-term environmental impact of the ongoing global deforestation process. The project does not initiate deforestation and BMH will be restored to pre-existing conditions
	National Forest Policy (1999) and Strategy (2000)	Objectives of the Forest Policy are to conserve species, ecosystems, and genetic diversity; maintain, enhance and restore the ability of forests to provide goods and services on a sustainable basis; optimize the contribution of forest resources to social and economic development; maintain a positive relationship between the people and their forest environment. The project has little to no impact on any forested areas that would reduce goods and services.
	National Agricultural Plan	The Plan helps to increase agriculture contribution to national economic growth, employment creation, poverty reduction and rural development. The project does not lie within any areas used for agricultural.
	Land and Marine Management Strategy (2011)	The Strategy is a comprehensive and coherent plan for land and marine management through a participative process with relevant stakeholders. The project includes community consultations with comments addressed within this ESIA.
	National Environmental Policy and Management Strategy	The Strategy seeks to have full integration of environmental management into the development process. The project includes the ESIA (including this table reflecting legislative and policy framework) as well as an ESMP that must be approved prior to project implementation.
	Grenada Biodiversity Strategy and Action Plan 2016-2020	This Plan constitutes a revision and updating of Grenada's National Biodiversity Strategy and Action Plan pursuant to its obligations under the Convention on Biological diversity and is geared to facilitate the integration of biodiversity conservation and sustainable use into national decision making and mainstreaming across all sectors of the national economy and policy making framework. Approval and implementation of an ESMP is required prior to the commencement of works.
	National Climate Change Policy for Grenada, Carriacou and Petit Martinique 2017-2021	The Policy provides the framework for steering an efficient and effective integration of adaptation and mitigation in all climate relevant sectors. The ESIA includes climate adaptation measures within the project.
	Integrated Coastal Zone Management Policy for Grenada, Carriacou and Petit Martinique 2015	The Policy constitutes the ICZM Policy for the tri-island State of Grenada, Carriacou and Petit Martinique and provides a vision for the future use, development and protection of the nation's coastal zone by setting out policies to guide relationships among resource users, community facilities and activities, and physical development and infrastructure.

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
	Cartagena Convention (1983) and its Protocols concerning SPAW	The Convention provides measures to prevent, reduce and control: pollution from ships, pollution caused by dumping, pollution from sea-bed activities, airborne pollution, pollution from land-based sources and activities as well as protect and preserve rare or fragile ecosystems and habitats of depleted, threatened or endangered species; and develop technical and other guidelines for the planning and environmental impact assessments of important development projects.
Ministry of Agriculture; Ministry of Climate Resilience, the Environment, Forestry, Fisheries, Disaster Management & Information	United Nations Convention on the Law of the Sea (UNCLOS, 1982)	An international treaty that provides a regulatory framework for the use of the world's seas and oceans, inter alia, to ensure the conservation and equitable usage of resources and the marine environment and to ensure the protection and preservation of the living resources of the sea
	Convention on Wetlands of International Importance (RAMSAR, 1971)	The Convention is an international treaty for the conservation and sustainable use of wetlands. The Conference landing site is outside of the Levera RAMSAR site to the north.
	Convention on the Protection of Migratory Species of Wild Animals (1972)	The Convention aims to conserve terrestrial, marine and avian migratory species throughout their range by providing strict protection for the most endangered migratory species, by concluding regional multilateral agreements for the conservation and management of specific species or categories of species, and by undertaking co-operative research and conservation activities.
Ministry of Communications and Works; Physical Planning Unit (LDCA)	Physical Planning and Development Control Act, No. 25 of 2002; Physical Planning and Development Control Amendment Act, No. 30 of 2002; Land Development Control Regulations SRO No. 13 (1988)	The Act provision for the control of physical development, protection of natural and cultural heritage, ensures that appropriate and sustainable use is made of all publicly and privately owned land for the benefit of the public, to maintain and improve the quality of the physical environment and its amenity, and allows the Authority to compile and amend lists of places of natural beauty and interest, including submarine and subterranean areas, as well as their flora and fauna. The Act requires development works have written permission from the Authority. All planning permissions will be acquired prior to any cable laying and BMH construction.
	Grenada Building Codes and Standards (2000)	The Building Code establishes safety standards for building and building construction and addresses standards required for buildings which can effectively withstand the adverse effects of hurricanes, floods and heavy seas. BMH design will be approved by Planning prior to implementation.
	Town and Country Planning Act CAP. 293 (1958) and Amendments Act 3 (1963), CAP. 339 (1990	The Act makes provision for the preparation, approval and revocation of development plans, for the control of development and subdivision of land, and for matters connected with incidents arising from the development. All project works require full approval by the Government prior to the commencement of works.
	Roads Act Cap. 290 An Act relating to the	An Act relating to the construction and maintenance of roads and the regulation of traffic thereon. Minimal roadwork is required to reach the BMH in Carriacou and Bequia. Mitigation measures for traffic are implemented within the ESMP.

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
	National Water and Sewerage Authority Act CAP. 208 (1991); National Water and Sewerage Authority Regulations SRO 40 (1993)	This Act establishes an Authority with sole responsibility for the provision of water supplies, conservation, augmentation, distribution, preservation and protection of catchments. The Authority is also responsible the treatment and disposal of sewage and other effluents. The Act provides that the Minister can declare protected areas by notice in the Gazette where he is satisfied that special measures are necessary for the protection of public water resources in or derived from specified areas. Catchment areas on Crown land are to be reserved for the augmentation of water supply and the land on which they are located is not to be sold, leased or otherwise disposed of. Vessel used for cable laying will use onboard water makers and will not use local water supplies. Cable landing sites are not located in any major water catchment areas or protected areas.
	Bathing Places Act CAP. 28	The Act deals with the management of the coastline, complements the Beach Protection Act, Cap 29 and empowers the Minister to make rules for the development, regulation and control of public bathing places on and around the coastline. Engagement with the Government Departments has occurred throughout the planning process and notification of works has been incorporated into mitigation measures.
Ministry of Communications and Works; Physical Planning Unit (LDCA)	Integrated Watershed Management Policy	Policy strengthens the commitment and capacity to implement an integrated approach to the management of watersheds and coastal areas. The project has a short-lived impact on a very small footprint within the watershed where BMHs are located.
Ministry of Health; Grenada Solid Waste Management Authority	Waste Management Act No 16 of 2001; Solid waste management act No 11 of 1995	Act provides for the management of waste in conformity with the best environmental practices and is a significant step in the process of efficient waste management. Solid waste is defined “litter, garbage, refuse, organic waste, white goods, derelict vehicles, scrap metal and other solid materials but does not include solid or dissolved material in domestic sewage or other substances in water sources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation flows or other common water pollutants. The Solid Waste Management Authority is charged with the duty of developing the solid waste management facilities, and improving the coverage and effectiveness of solid waste storage, collection and disposal facilities of Grenada. Any waste generated onboard the vessel will be offloaded at port through the vessel's agent, if necessary.
	Abatement of Litter Act, No. 10 of 1990	Act controls depositing of litter and prohibits a person from throwing down, dropping, leaving, or depositing anything that will cause, contribute or lead to the littering of any open-air place where the public is allowed to make use of without payment, or on any premises or Government land. No litter will be left at landing sites, as required in the ESMP.
	Noise Control Act (2006)	Act controls the making or continuance of excessive noise for the erection, construction, alteration, repair or maintenance of buildings, structures or roads; including opening or boring under any road or adjacent land in connection with the construction, inspection, maintenance or removal of works. The project will provide a notice of construction during road works in Carriacou. Noise from cable laying and trenching activities is not expected to be over the limits to cause a nuisance.

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
	Public Health Act Cap. 263 (1925); Public Health Regulations Sec. 15 (1958); Public Health Ordinance CAP. 237 (1925) and Amendments SRO No. 218 (1957)	The Act operates with outdated legislation and regulations which hinder the achievement of the strategic goals of the Ministry and compliance to commitments as outlined in international conventions and agreements such as the International Health Regulations. Public consultations revealed concerns for the exposure to electromagnetic fields, however, there is little to no exposure to EMFs from fiber optic cables and ultimately, implementation of fiber optics will replace microwave technology where exposure is a concern.
	Grenada Poverty Reductions Strategy and Action Plan 2014-2018	The Strategy fosters economic growth, increased employment, and managing the high levels of debt and embodies a commitment on the part of Government to provide opportunities for all who desire a future where they can realize the opportunity for a fulfilling life, where they can achieve their full potential, and are prepared to work for it. The overall CARCIP project is expected to increase local employment opportunities.
	OECS/ESDU St. George's Declaration: Principles on Environmental Sustainability	The Declaration recognizes that environmentally sustainable development is essential for the creation of jobs, a stable society, a healthy economy and the of jobs, a stable society, a healthy economy and the natural systems on which this depends.
	International Convention for the Prevention of Marine Pollution MARPOL (ANNEX IV)	MARPOL is the main international convention aimed at the prevention of pollution from ships caused by operational or accidental causes, with ANNEX IV prohibits the discharge of sewage into the sea. The vessel used for cable laying is in compliance for all international regulations.
Ministry of Foreign Affairs; Ministry of Finance: Ports Authority; Economic Affairs Division,	Territorial Sea and Maritime Boundaries Act, No. 25 of 1989, CAP. 318	Act specific the 12 nautical mile jurisdiction in territorial seas of Grenada, declares sovereign rights over the territorial sea, internal waters, archipelagic waters as well as the airspace above and the seabed and subsoil below these waters. The project requires the approval from the Government of Grenada prior to implementation.
	Oil in Navigable Waters Act CAP. 218 (1928)	The Act primarily deals with preventative and mitigation measures for protecting the coastal and inland waters of Grenada. The project requires (and is included within this ESIA) mitigation measures to be in place prior to the implementation of the project as well as an ESMP.
	LDCA Act (1968) and Amendments (1983)	The Act controls and manages development and land use activities in conformity with approved environmental standards and determines where and what type of development could be carried out in Grenada. This Act also requires the prevention, mitigation, relocation and change in user activity. The project requires approval from the Government of Grenada prior to implementation and includes the implementation of an ESMP.
	Civil Liability for Oil Pollution Damage (International Convention) Act, No. 7 of 1998	The Act fulfils obligations under the International Convention on Civil Liability for Oil Pollution Damage and provides compensation for oil pollution damage. Mitigation measures and ESMP are included to be approved by the Government prior to implementation of the project.
	Grenada Ports Authority Act	An Act to establish the Grenada Ports Authority as a corporate body with all necessary powers to provide, manage and maintain efficient port services and facilities. All vessels entering and exiting the country are required to check in/out of from the Port. Full approval of the project is also required before implementation.
Ministry of Education: National Science and	National Heritage Protection Act, No. 18 of 1990 Cap 204:	The Act protects Amerindian art work and Pre-Columbian artefacts and archaeological remains. The ESMP includes in the event of finding artefacts during excavations, the Government will be notified.

Agency	Legislation, Policies & Multilateral Agreements	Scope and Relevance
Technology Council; National Trust	National Trust Act, No. 20 of 19667 Cap 207	The Act has some relevance to the management of the environment with specific reference to submarine areas and maintains Grenada's heritage by preserving places that are historically or architecturally valuable or areas that have national beauty. Submarine cable routes have been carefully selected based on extensive mapping using multibeam sonar and diver surveys. Additionally, all landing sites and BMHs are not located near any architecturally valuable areas or areas identified having 'natural beauty'.

5.0 ANALYSIS OF ALTERNATIVES

5.1 Nearshore Cable Routes & Landing Site Selection

The proposed nearshore cable route and landing site configuration is based on a consideration of alternative routes and landing sites. The following discussion summarizes the routing and selection process. Factors guiding route selection and landing sites include issues related to bathymetry, geography, environment, society and existing subsea cable locations.

Site visits were conducted from September 2 to September 10, 2018 to conduct ground truth assessment for alternative landing sites. Based on actual visits to candidate landing sites and other information, a total of 26 alternative sites were considered as suitable for cable landing (Table 4). One landing site on St. Vincent: Arnos Vale (VC1), uses an existing BMH structure so there was no need to evaluate alternative locations. The site visit team evaluated the landing site for safe, secure and environmentally responsible cable landings as well as the accessibility and the constructability of the site for both the BMH and the cable lay.

Nearshore cable routes were identified first through a desktop route engineering study and adjusted based on landing site visits (IT International Telecom 2018). Biologic data (such as percentage of existing live habitat coverage) was collected October 14 - 26, 2018, along sections of the proposed cable routes. Geophysical data (seafloor mapping and sediment samples) were collected from October 26 to November 9, 2018, for both nearshore cable routes and offshore cable routes (further detailed in 5.9 Offshore Marine Route). Diver and topographic surveys of nearshore cable routes were carried out November 16, 2018, to January 14, 2019. The purpose of all nearshore cable route surveys (biologic, geophysical, diver and topographic) was to ensure the best possible route configuration was selected to avoid any biologically sensitive areas or any unknown seafloor obstacles. All nearshore cable routes will be laid on benthic substrate composed of either sand, seagrass and/or areas of low biologic diversity, ultimately reducing the overall impacts on the seabed. Additionally, within the CRS (IT International Telecom 2018) and subsequent route engineering, potential conflict with known anchorages, fishing locales, MPAs, wrecks, dive sites and shipping routes were identified and avoided wherever possible.

Table 4. Alternative and Preferred Cable Landing Sites and Selection Pros and Cons Considered

Location	Latitude	Longitude	Pros	Cons
Grenada				
Bathway north (G1)	12°12'43.74"N	61°36'38.46"W	Best option from an engineering perspective	High density turtle nesting location (100-500 nestings per season), Some exposed beachrock; area of tourism would be temporarily disrupted during installation;
Bathway south (G2)	12°12'29.16"N	61°36'37.62"W	Second best option; Close proximity to the end of the beach where it is narrower and less likely for turtles to nest	Eroded shoreline and scarping would require trenching in the beachrock); area of tourism would be temporarily disrupted during installation
Conference (G3) Selected based on least environmental impact	12° 9'40.38"N	61°36'23.34"W	Very low levels of turtle nesting at this location; Within close proximity to the CLS Not an area used for tourism	Historical high-volume sand mining along the beach with illegal low-volume mining still occurring; Subsistence & commercial fishing occurs; Exposure to the Atlantic Ocean will have high sediments movement on the seabed
Carriacou				
Hillsborough Bay (Cu1) Selected based on the recommendation of Grenadian government	12°28'43.14"N	61°28'4.98"W	Located outside of the Sandy Island / Oyster Bed Marine Protected Area (SIOBMPA).	Cable requires additional armoring due to the nature of the hard bottom and will be visible on the seabed; Requires the only access road into the airport to be disrupted during BMH installation and cable laying to the CLS
Hillsborough Bay (Cu2)	Not applicable	Not applicable	Not Suitable - West of offshore riprap and cable route is partially within the boundaries of the SIOBMPA.	Cable would partially be within the SIOBMPA
L'Esterre Bay (Cu3)	12°28'33.48"N	61°28'38.16"W	Best option based on biotic habitat since it is dominated by sand and seagrass and would allow cables to self-bury Cable would not cross any public roads BMH would not be within close proximity to mangroves	Located within the SIOBMPA
St. Vincent				
Arnos Vale (VC1) Selected based on existing BMH	13° 8'26.15"N	61°12'42.24"W	Existing BMH does not require further construction.	Located on the water's edge
Chateaubelair (VC2) Selected due to ease of access and limited environmental impact	13°17'27.30"N	61°14'27.54"W	Sheltered site within a deep coastal embayment; BMH located on Government land (does not require land acquisition); Very short terrestrial connection; section of shoreline is not conducive for hawksbill turtle nesting.	No negative reasons for installation
Chateaubelair (VC3)	13°17'32.10"N	61°14'16.50"W	No positive reasons for selection	Impractical access from shore and sea

Location	Latitude	Longitude	Pros	Cons
Fancy west (VC4)	13°22'56.34"N	61°10'12.78"W	No positive reasons for selection	Impractical access from shore and sea; Exposed to high wave energy
Fancy east (VC5)	13°22'40.56"N	61° 9'14.52"W	No positive reasons for selection	Impractical access from shore and sea; Exposed to high wave energy
Owia town (VC6)	13°22'29.22"N	61° 8'42.12"W	No positive reasons for selection	Impractical access from shore and sea; Exposed to high wave energy
Owia town (VC7)	Not applicable	Not applicable	No positive reasons for selection	Impractical access from shore and sea; Exposed to high wave energy
Owia Bay (VC8) Selected based on ease of access and limited environmental impact	13°22'23.16"N	61° 8'34.50"W	Sheltered and accessible embayment	Major fish landing site will be disrupted briefly during installation; one to two days
Bequia				
Upper Bay (B1)	12°59'55.08"N	61°14'38.22"W	None - rejected	Impractical terrestrial connection; fish nursery grounds
Lower Bay (B2) Selected based on ease of access and limited environmental impact	12°59'49.34"N	61°14'42.83"W	Easy access to CLS	Located near a restaurant and will require crossing a road; located near pre-existing erosional gullying
Airport	12°59'31.17"N	61°16'33.36"W	Easy access to CLS	Impracticable sea connection and ongoing land reclamation (shoreline reconstruction) project.
Mustique				
Endeavor Bay (M1) Selected based on MCL preference	12°53'21.24"N	61°11'7.50"W	Little to no nesting or foraging sea turtles	No negative reasons for installation
Britannia Bay (M2)	12°52'42.18"N	61°11'14.10"W	No positive reasons for selection	Potential conflict with vessel traffic, fueling operations; foraging grounds for green sea turtles
Canouan				
Nens' Bay (Cn1) Selected location due to ease of connection and limited environmental impact due to pre-existing conditions	12°42'0.18"N	61°20'20.76"W	Practical terrestrial connection at the Airport (ease of connection)	degraded marine habitat from runoff/sedimentation.

Location	Latitude	Longitude	Pros	Cons
Grand Bay (Cn2)	12°42'13.74"N	61°19'41.64"W	No positive reasons for selection	Potential conflict with vessel traffic. Bedrock adds construction difficulty.
Glossy Point (Cn3)	12°42'17.70"N	61°21'13.86"W	No positive reasons for selection	Potential conflict with mining and existing shoreline revetments.
Union				
Belmont A (U1)	12°36'14.64"N	61°25'33.72"W	Practicable alternative	Lengthy connection to existing infrastructure.
Belmont/ Waterbreak B (U2)	12°36'13.86"N	61°25'37.56"W	Short distance to deeper depths	Lengthy connection to existing infrastructure; proposed protected area offshore
Bloody Bay (U3)	12°36'40.74"N	61°26'34.38"W	None	leatherback nesting beach; Impractical access from shore
Airport (U4) Selected due to limited environmental impact and ease of access	12°36'3.72"N	61°24'43.14"W	Practical terrestrial connection at the Airport; natural sand channel through the reef complex.	No negative reasons for installation

5.2 Grenada

The port island of Grenada has a large amount of boat traffic ranging from large commercial vessels and cruise ships to small pleasure boats. However, while any landing on the east side of Grenada is much less influenced by such movements, it is open to weather coming from the north, east and southeast. Three sites were examined in Grenada. Two on Bathway Beach, a northern (G1) and southern (G2) option, and one on Conference Beach (G3) (Figure 12). The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

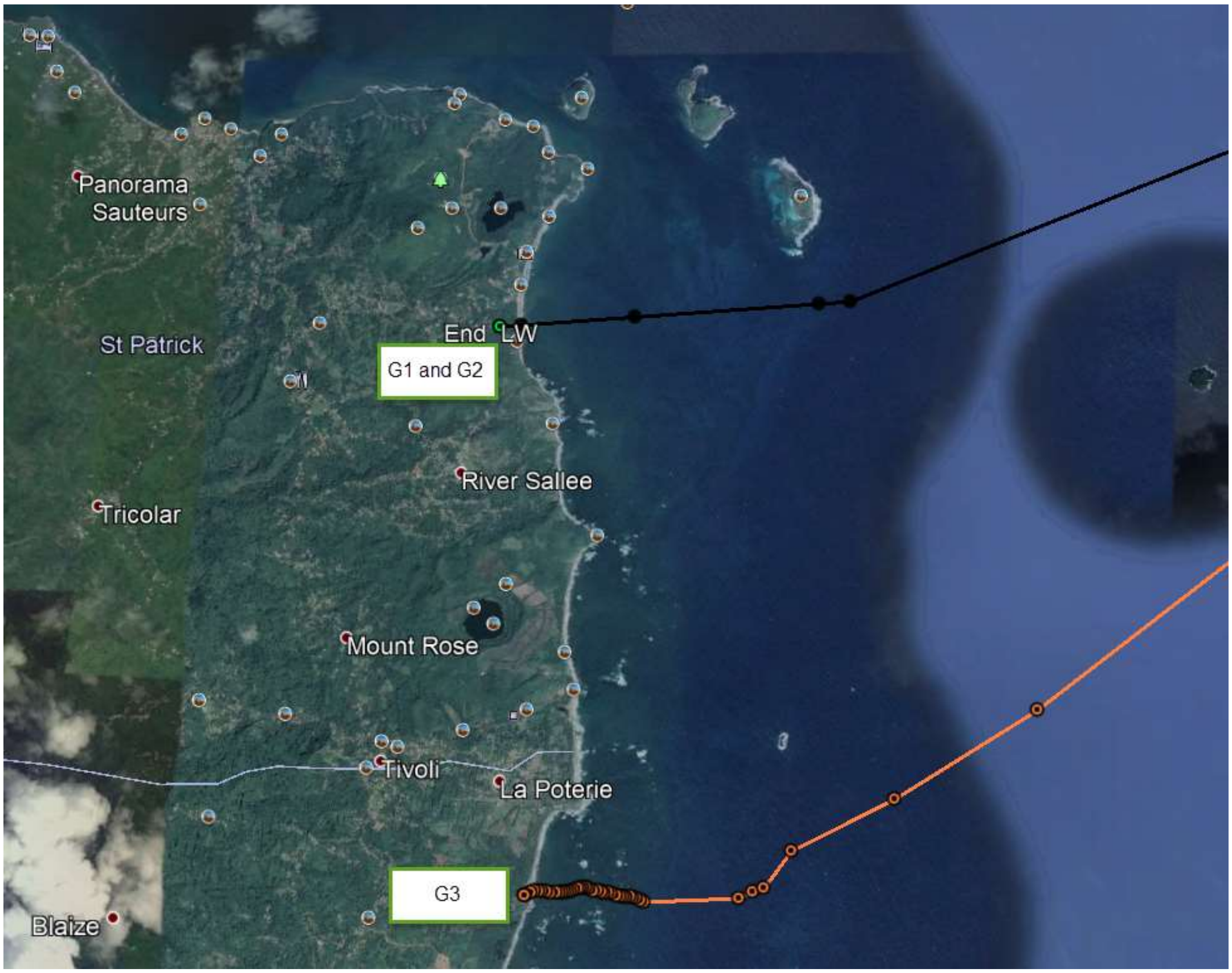


Figure 12. Overview of potential landing sites on the Island of Grenada

5.2.1 Bathway north (G1)

The Bathway north (G1) site is located at an existing parking area that is landscaped with shrubs, trees and grasses (Table 5). The site is clear of potential marine traffic conflict as no moorings or boat activity were seen during the site visit and no large-scale commercial fishing has been reported in the area. Bathway Beach is a tourist beach; it will be busy during tourist season and weekends and it has an exposed rock face that can add risk to cable landing. Finally, Bathway is noted for potential sea turtle nesting designations.

The beach manhole (BMH) will have to be installed in the southern corner of an existing parking area. Ideally, two 4.3 in. ID (110 mm) conduits will run from the BMH Seaward for approximately 33 yd. (30 m) and be secured there with a concrete head wall buried approximately 2 yd. (2 m) deep. This will allow the cable to be routed through existing gaps in the bedrock through the surf zone. From the headwall to the rock in the surf zone is approximately 55 yd. (50 m), this distance will need to be trenched but will most likely encounter bedrock. The cable will also need to be protected with articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS) from the headwall seaward past the inshore rocks.

Table 5. Bathway North (G1), Grenada, Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°12'43.74"N 61°36'38.46"W
Probable Land Owner	Government
Site description	Beach is sand with exposed bedrock at the water's edge
Distance to 11 yd. (10 m) water depth	≈654 yd. (600 m)
Distance to 22 yd. (20 m) water depth	≈3062 yd. (2800 m)
Distance from landing point to existing infrastructure	≈33 yd. (30 m) to the nearest pole
Ease of access to site for machinery	Fair. Roads leading to the site are very narrow with many sharp blind corners
Beach construction requirement	Installation of two 4.3 in. ID (110 mm) Conduits from the BMH seaward ≈33 yd. (30 m) seaward ends secured in a headwall.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Local Lodging	Bathway Cottages are closest to site.
Environmental Sensitivities	Major sea turtle (leatherback) nesting beach
Social Suitability	Beach used for tourism and by local residents

5.2.2 Bathway South (G2)

The Bathway south (G2) site is located at an open, grassy area near an unnamed road (Table 6). The BMH will be installed in the grassy area seaward of the roadside drainage ditch. Two, 4.3 in. ID (110 mm) conduits will run from the BMH seaward for approximately 11 yd. (10 m) and be secured there with a concrete head wall buried approximately 2 yd. (2 m) deep. This will allow the cable to be routed down the eroded slope in articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS), protecting the cable in the future if erosion is an issue after a major storm. From the headwall to the rock in the surf zone is approximately 77 yd. (70 m), this distance will need to be trenched but will most likely encounter bedrock. The cable will also need to be protected with articulated pipe from the headwall seaward past the inshore rocks. The slope at the edge of the grassy area and the beach will need to be stabilized where it is disturbed by excavation. This could take the form of a natural rock barrier with native plants reinstated on the disturbed area. The rock will protect the area while the plants take root.

Table 6. Bathway south (G2), Grenada, Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°12'29.16"N 61°36'37.62"W
Probable Land Owner	Government
Site description	Grassy area with cow grazing. Beach has a short steep eroded slope to a shallow sloping sand beach
Distance to 11 yd. (10 m) water depth	≈1312 yd. (1200 m)
Distance to 22 yd. (20 m) water depth	≈3062 yd. (2800 m)
Distance from landing point to existing infrastructure	≈164 yd. (150 m) to closest pole
Ease of access to site for machinery	Good, site is a wide fairly flat grassy area. Roads leading to the site are narrow with many sharp blind turns
Beach construction requirement	BMH, conduits and head wall. Articulated pipe from the headwall seaward. Some slope stabilization will be required after the cable landing.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull form ship if required.
Environmental Sensitivities	Major sea turtle (leatherback) nesting beach
Social Suitability	Beach used for tourism and by local residents

5.2.3 Conference (G3)

The landing at Conference (G3) is the preferred site as it has no turtle nesting designation nor any exposed rock. The only concern with the landing at Conference is the possibility of a construction conflict with evidence of localized, low-level (and possibly unregulated) sand extraction from the beach area.

The proposed BMH location at Conference (G3) (Table 7 and Figure 13) is approximately 33 yd. (30 m) back from the edge of the beach at the northern edge of the clearing. The beach and access route to the beach appear to be well travelled. The trail leading to the beach is heavily rutted from large vehicles. Evidence suggests this site might be used for sand mining. No heavy vehicles were present during the site visit but the shape of the beach and disturbed areas suggest it was a common occurrence. Two people were fishing with hand rods but no commercial or small boat activity. This beach does not appear to support tourism.

Garbage and other dumped items appear to have washed up from the ocean and/or been dumped on the beach. A pile of dumped garbage and car parts was located at the edge of the access trail to the beach to the south. This site is open to weather from north to south with a very limited amount of shelter from the north by the head of the bay approximately 0.62 mi. (1 km) to the north.

Table 7. Conference (G3), Grenada, Landing Site Features (IT International Telecom 2018)

Landing Coordinate	12° 9'40.38"N 61°36'23.34"W
Probable Land Owner	Government
Site description	Sandy beach. Signs of sand mining on the beach
Distance to 11 yd. (10 m) water depth	≈1531 yd. (1400 m)
Distance to 22 yd. (20 m) water depth	≈1859 yd. (1700 m)
Distance from landing point to existing infrastructure	≈981 yd. (900 m) to proposed CLS location
Ease of access to site for machinery	Poor. Trail has been used by heavy vehicles during rain so very badly rutted.
Beach construction requirement	Installation of conduits from BMH to top of the beach.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit.
Environmental Sensitivities	Extremely low to no sea turtle nesting activity
Social Suitability	Artisanal fishing

Figure 13. Conference (G3), Grenada, preferred landing site. Note that on this figure and following figures, the absence of a feature is identified by no icons or labels.

5.3 Carriacou

Three sites were examined in Carriacou: two in Hillsborough Bay: (Cu1) and (Cu2) and one in L'Esterre Bay (Cu3). The eastern most landing in Hillsborough Bay (Cu2) was immediately eliminated without further observation because of the proximity to marine traffic. The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

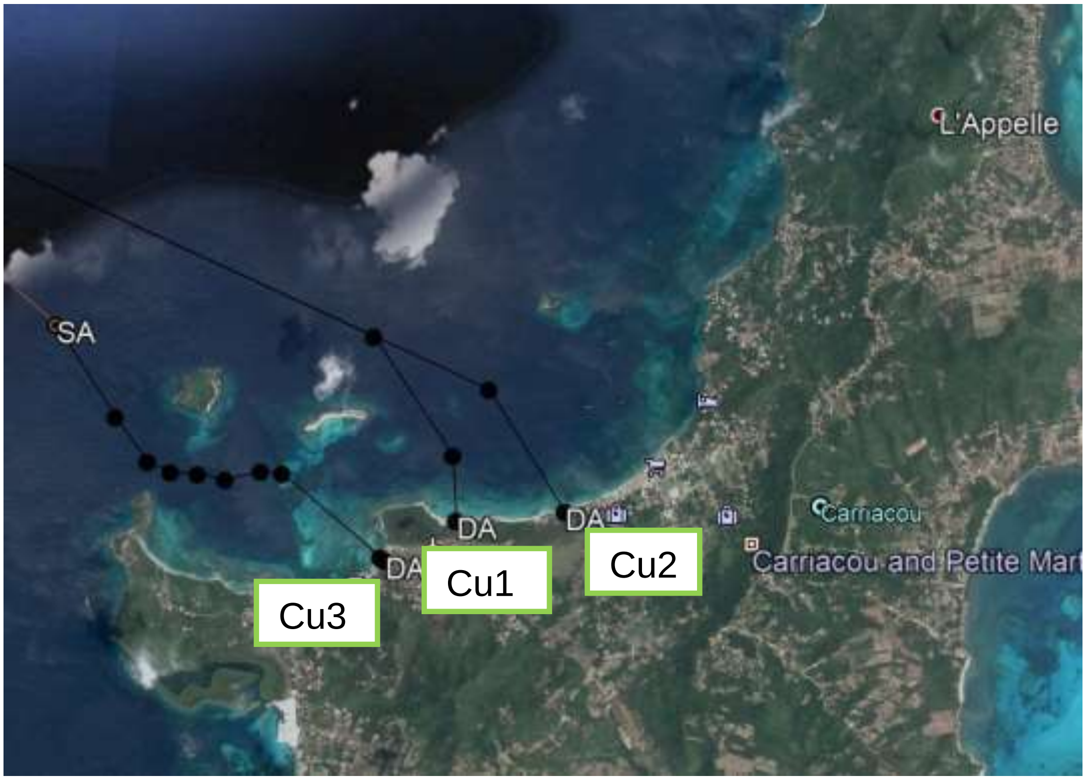


Figure 14. Overview of potential landing sites on the Island of Carriacou. Note Cu1 was shifted slightly to the east upon recommendation of the government.

5.3.1 Hillsborough Bay (Cu1)

Discussions with the GD government resulted in the Hillsborough Bay (Cu1) site to be the preferred site to entirely avoid the routing the cable through the Sandy Island Oyster Bed Marine Protected Area (SIOBMPA) and landing at Cu3. However, Cu1 was moved approximately 500 yd. (457 m) to the east to avoid cables crossing a small portion of the eastern boundary of the MPA.

The BMH will be located to the east of the eastern end of rip rap shoreline protection and on the landward side of the coastal road. Two conduits will run from the BMH seaward approximately 11 yd. (10 m) and a headwall installed. Articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS) will then be installed seaward and buried as deep as possible under the coastal road that leads to the airport. This site is on the leeward side of the island so storms will be of minimal concern, the site is well sheltered from any weather except for north (Table 8 and Figure 15).

Table 8. Hillsborough Bay (Cu1) Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°28'43.14"N 61°28'4.98"W
Probable Land Owner	Government
Site description	Sand. Bedrock visible along shore line
Distance to 11 yd. (10 m) water depth	≈436 yd. (400 m)
Distance to 22 yd. (20 m) water depth	≈545 yd. (500 m)
Distance from landing point to existing infrastructure	5 yd. (5 m)
Ease of access to site for machinery	Excellent.
Beach construction requirement	Installation of conduits from BMH to edge of beach.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit.
Environmental Sensitivities	Offshore rock revetment is used by resting sea birds; very low sea turtle nesting
Social Suitability	Beach used for local residents and tourism

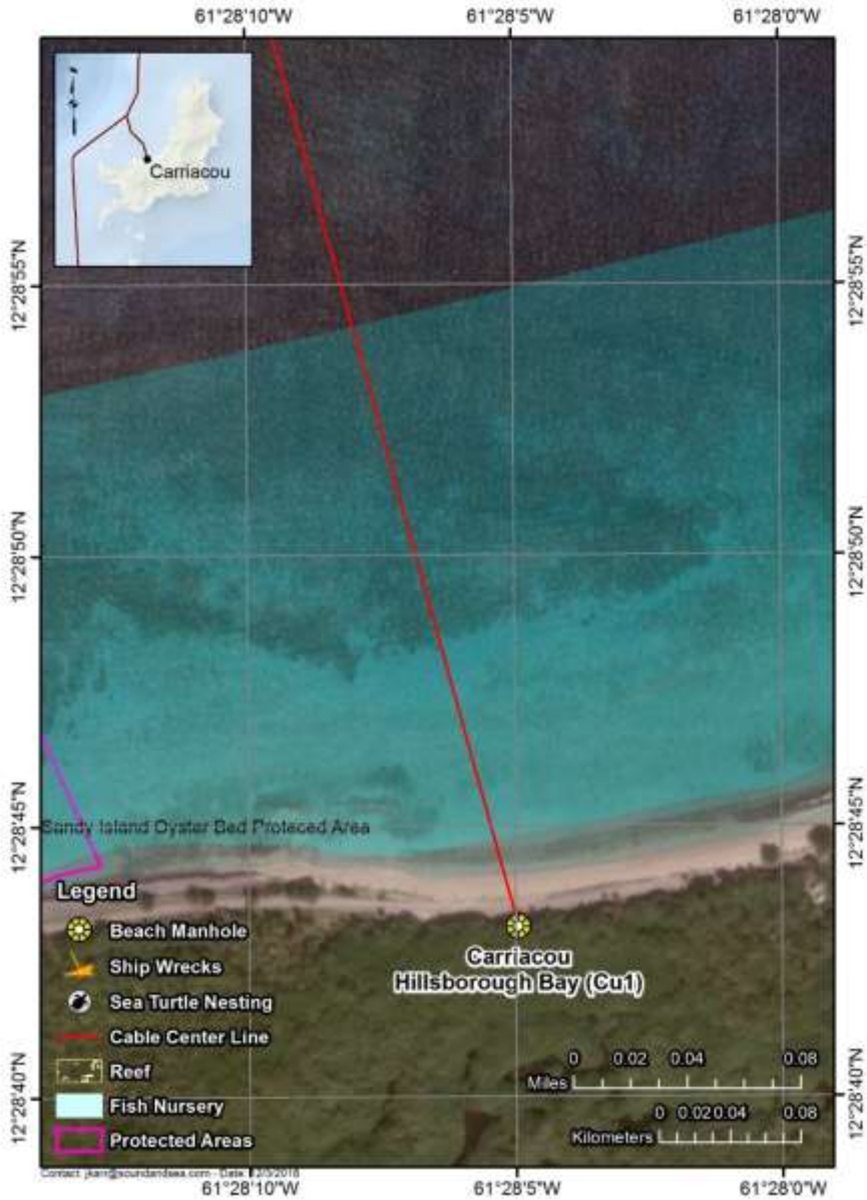


Figure 15. Hillsborough Bay (Cu1), Carriacou, preferred landing site.

5.3.2 L'Esterre Bay (Cu3)

A suitable landing area away from the public area of the beach was found at the end of the airport runway. The BMH will be installed seaward of the gate at the end of the runway with a ducted headwall installed 11 yd. (10 m) seaward (Table 9). From the headwall, articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS) with cable will be buried across the beach to an approximate 2 yd. (2 m) depth. Offshore of the site during the site visit, the team observed several small boats anchored in the bay and larger sailboats anchored between Sandy Island and Lauriston Point. The area offshore of the landing is an MPA, similar to Hillsborough Bay.

Table 9. L'Esterre Bay (Cu3), Carriacou, Landing Site Features (IT International Telecom 2018)

Landing Coordinate	12°28'33.48"N 61°28'38.16"W
Probable Land Owner	Government
Site description	Sand, no visible bedrock, offshore sea grass.
Distance to 11 yd. (10 m) water depth	≈981 yd. (900 m)
Distance to 22 yd. (20 m) water depth	≈1203 yd. (1100 m)
Distance from landing point to existing infrastructure	If CLS is built on airport grounds, furthest straight-line distance will be ≈1090 yd. (1 km)
Ease of access to site for machinery	Excellent. Narrow roads leading to the site may require some traffic control unless access through the airport is granted.
Beach construction requirement	BMH with conduit leading to the water. Concrete head wall to secure ends.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit.
Environmental Sensitivities	Located within the Sandy Island / Oyster Bed MPA; Extremely low to no sea turtle nesting activity
Social Suitability	One of the most popular beaches in Carriacou used by local residents and tourists, several vendors near BMH location

5.4 St. Vincent

Eight potential landing sites were considered for three landings on St. Vincent Island. The trunk cable will land at an existing BMH near Arnos Vale (VC1). The trunk cable runs southward through the Grenadines to Carriacou and Grenada. Two additional landings are required for the northern festoon between the Chateaubelair area and the Fancy/Owia area. Three sites were evaluated at Chateaubelair (VC2, VC3 and VC4) and four between Fancy and Owia (VC5, VC6, VC7 and VC8). The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

5.4.1 Arnos Vale (VC1)

The main trunk cable from Grenada will land at Arnos Vale (VC1). Because the existing BMH has capacity for additional cabling and avoids the need for additional construction of a BMH here, no other options were evaluated on the southern end of St. Vincent.

The BMH is located just outside the cricket stadium on a narrow rocky beach (Table 10 and Figure 16). The beach appears to be used by residents as evidenced by open fire sites. Because of such use, this site should include regular maintenance inspections to ensure no damage is done to the BMH. Further, flotsam in this protected area must be removed before construction. Also, this landing is adjacent to a fuel transfer area; the offshore moorings for the tankers are almost directly in front of the landing area. Notification to mariners and other cautions will have to be taken to avoid conflict with marine traffic during construction.

Table 10. Arnos Vale (VC1) Landing Site (IT International Telecom 2018)

Landing Coordinate	13° 8'26.15"N 61°12'42.24"W
Probable Land Owner	Government
Site description	Narrow cobble beach. Very limited access for machinery. Machines must travel along the beach from the east.
Distance to 11 yd. (10 m) water depth	≈327 yd. (300 m)
Distance to 22 yd. (20 m) water depth	≈654 yd. (600 m)
Distance from landing point to existing infrastructure	Existing BMH and duct route back to CLS
Ease of access to site for machinery	Poor. Access through stadium grounds is by foot along narrow rocky beach or heavy equipment access from the east along the beach
Beach construction requirement	N/A
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	None
Social Suitability	Fuel transfer area within vicinity will require coordination

Figure 16. Arnos Vale (VC1), St. Vincent, preferred landing site.

5.4.2 Chateaubelair (VC2)

For the leeward northern St. Vincent landing, three sites were considered in the Chateaubelair area: VC2, VC3, and VC4 (Figure 17). All of these except VC2 were not suitable because of impracticable access from land. The preferred site in Chateaubelair (VC2) provides adequate shore access. The BMH will be built next to the eastern wall of the customs house next to the existing utility pole line (Figure 18 and Table 11). Conduits will be run from the BMH seaward under the concrete walk way and a headwall installed on the beach. The beach is a shallow sloped fine sand beach with some small boats moored just offshore. The site is approximately 55 yd. (50 m) from a commercial dock. No vessel was at the dock during the site visit, but it is possibly used as a landing for small freighters and ferries.

Figure 17. Chateaubelair sites overview

Table 11. Chateaubelair (VC2) Overview (Source: IT, 2018)

Landing Coordinate	13°17'27.30"N 61°14'27.54"W
Probable Land Owner	Government
Site description	Sand, concrete walk way, small construction area with existing pole line on site.
Distance to 11 yd. (10 m) water depth	≈218 yd. (200 m)
Distance to 22 yd. (20 m) water depth	≈327 yd. (300 m)
Distance from landing point to existing infrastructure	Existing pole line is less than 11 yd. (10 m) from proposed BMH position
Ease of access to site for machinery	Fair. Narrow roads with many twists, narrow track to the BMH location or along pedestrian walk way.

Beach construction requirement	From BMH, install conduits under the concrete walk way and build headwall on the beach.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	Hawksbill turtle nesting occurs further to the east
Social Suitability	Small fishing boats along the beach further to the west

Figure 18. Chateaubelair (VC2), St. Vincent, preferred leeward landing site for the northern festoon.

5.4.3 Owia (VC8)

For the windward northern St. Vincent landing, four sites were considered between Fancy and Owia: VC5, VC6, VC7 and VC8. Route engineers considered and rejected sites at Fancy (VC5) and two sites on the western side of Owia town (VC6 and VC7) because of the lack of land access (Figure 19), vulnerability to storms and erosion. The only viable option remaining is the site in protected Owia Bay (VC8) (Figure 20).

The BMH at Owia Bay (VC8) is to the east of Owia town center, just north of the breakwater pier (Table 12 and Figure 20). The shoreline is armored by rocks for beach stabilization and protection.

Ideally the BMH will be installed in this protected area but if this proves difficult it could be moved slightly to the north along the same axis into an area that appears to be constructed of soil and rock fill. The cable will be direct trenched through the rocks and articulated pipe (APPENDIX III: VESSEL AND CABLE SPECIFICATIONS) added from the BMH seaward to protect the cable.

Table 12. Owia Bay (VC8) Landing Site Features (Source: IT, 2018)

Landing Coordinate	13°22'23.16"N 61° 8'34.50"W
Probable Land Owner	Government
Site description	Placed rock.
Distance to 11 yd. (10 m) water depth	≈545 yd. (500 m)
Distance to 22 yd. (20 m) water depth	≈654 yd. (600 m)
Distance from landing point to existing infrastructure	Existing pole line is on main road about 77 yd. (70 m) beyond.
Ease of access to site for machinery	Fair. Narrow roads with many twists, access to the foreshore is limited and may require soil to be brought in to make a ramp over a small concrete wall.
Beach construction requirement	From BMH, direct bury cable in articulated pipe to landing point and then seaward as determined by Ecological Resources Assessment.
Shore End installation proposed procedure	Small landing craft or direct pull from ship
Environmental Sensitivities	None
Social Suitability	Within close proximity to a major fish landing site

Figure 19. Owia potential sites investigated

Figure 20. Owia (VC8), St. Vincent, preferred windward landing site for the northern festoon.

5.5 Union

Cable engineers considered three options on Union island: Bloody Bay (U1), Waterbreak (U2&3) and the Airport (U4) (Figure 21). Bloody Bay (U1) was unsuitable because of extensive construction work required to gain access and turtle nesting on this beach. The following discussion addresses further investigation of U2, U3 and U4. See Table 4, above, for site selection summary and logic.

5.5.1 Waterbreak (U2 and U3)

The landing in the Waterbreak area considered two potential BMH locations: U2 and U3. The westward site, U2, has a shore line that is armored, a quick drop off to deep water, is government owned, and is well protected from erosion (Table 13 and Figure 21). The eastward site, U3, was rejected because the location of the landing site is privately owned and near a public beach. The BMH site for U2 is just west of the public beach beyond the armored highway right of way. The land is government owned and will have minimal amounts of public use.

Table 13. Waterbreak (U2), Union, Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°36'13.86"N 61°25'37.56"W
Probable Land Owner	Government
Site description	Sand grass shrubs. Rip rap remains along shoreline
Distance to 11 yd. (10 m) water depth	≈327 yd. (300 m)
Distance to 22 yd. (20 m) water depth	≈436 yd. (400 m)
Distance from landing point to existing infrastructure	Closest pole is ≈11 yd. (10 m) from BMH location
Ease of access to site for machinery	Excellent. Narrow roads
Beach construction requirement	From BMH install conduits past rip rap. Reinstate rip rap over conduits and cap. ≈33 yd. (30 m) of conduit. Improvements will also be made to the drainage ditch near the BMH location both as a goodwill gesture and to prevent future damage to the cable when the ditch is repaired or upgraded
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	Short distance between road and shoreline
Social Suitability	Minimal amount of public use

5.5.2 Union Airport (U4)

The airport site U4 was selected as the preferred site because it is very near the CLS and has excellent shore access for construction. This site will require more marine cable and has a longer shallow water section with reefs visible from the shore line. The proximity to existing infrastructure connections offset the subsea cable requirement. This site does have limitations offshore because of the longer shallow water distance and reefs that is considered further in Section 6.3.6.

The BMH will be located in a small grassy area slightly to the south of the main beach access (Table 14 and Figure 22). The conduits will be run from the BMH seaward approximately 11 yd. (10 m) and end at a head wall in the grassy area before the beach begins. The beach is fine sand and gently sloping.

Table 14. Union Airport (U4) Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°36'3.72"N 61°24'43.14"W
Probable Land Owner	Government
Site description	Sand, trees at top of bank
Distance to 11 yd. (10 m) water depth	≈763 yd. (700 m)
Distance to 22 yd. (20 m) water depth	≈1750 yd. (1600 m)
Distance from landing point to existing infrastructure	CLS could be built at the airport. If the route was forced to go around the airport distance will be ≈436 yd. (400 m)
Ease of access to site for machinery	Excellent. Narrow roads around airport. Dirt/gravel track to the landing site
Beach construction requirement	From BMH, install conduits ≈11 yd. (10 m) to the top of the bank and secure with a headwall.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	Pre-existing erosional gullying to the south of landing site
Social Suitability	Limited beach use due to proximity to the airport

Figure 21. Union Island potential sites investigated

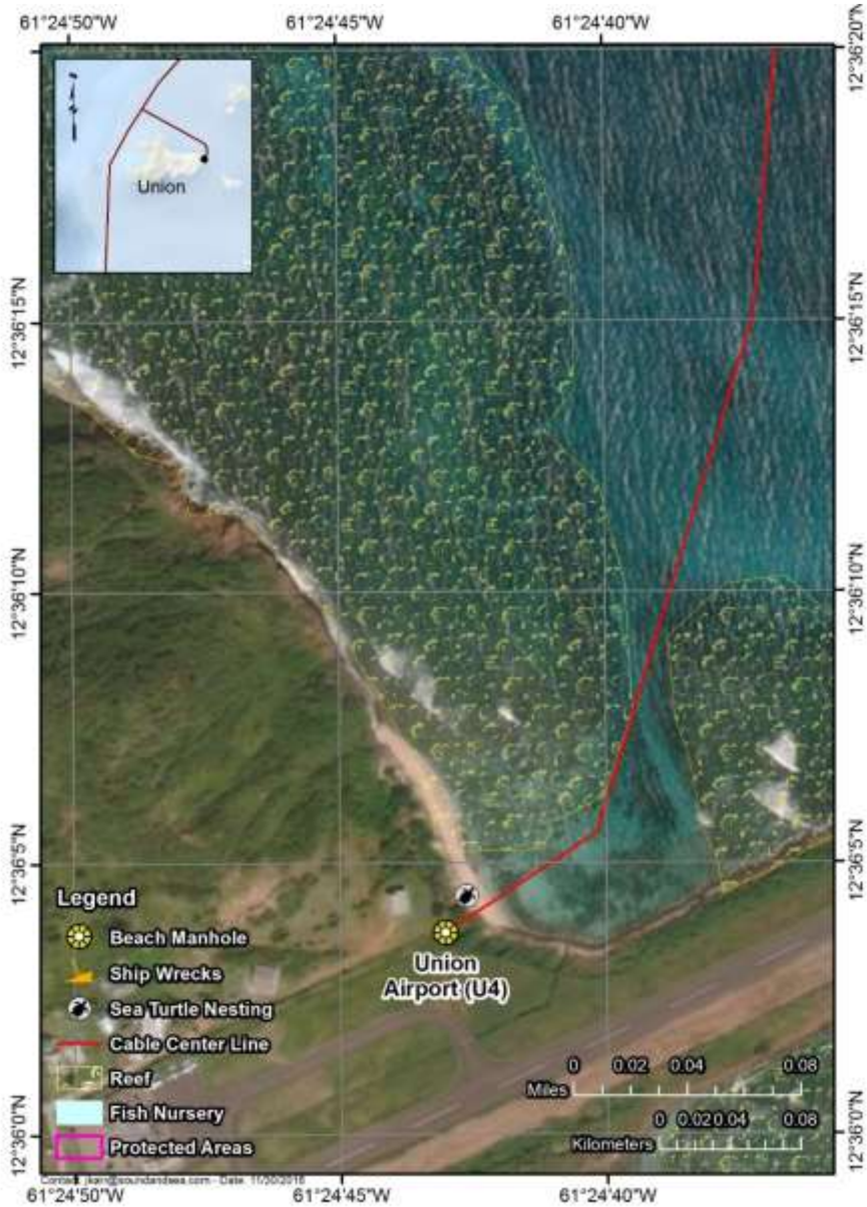


Figure 22. Union Airport (U4), Union, preferred landing site.

5.6 Canouan

Three potential landings were considered at Canouan: Nen's Bay (Cn1), Grand Bay (Cn2) and Glossy Bay (Cn3) (Figure 23). The landing point at the headland of Glossy Bay (Cn3) was not suitable because of the unprotected and armored beach and proximity to excavations (presumably for fill nearby). The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

Figure 23. Canouan potential sites investigated

5.6.1 Grand Bay (Cn2)

The potential landing point at Grand Bay (Cn2) is to the east of the government wharf on a public beach (Table 15). The BMH will be located either in or adjacent to a construction company lay down yard. There are many small boat moorings to the north and the east of the landing point. To the west of the landing point is the government wharf where local shipments and the ferry arrives. Further offshore appears to be a sandy seabed. The landing point is in an area where no bedrock is visible but there is rock visible to the east. Inshore of the landing is an area of trees and shrubs. Because of the potential conflict from marine traffic, this site is not preferred.

Table 15. Grand Bay (Cn2), Canouan, Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°42'13.74"N 61°19'41.64"W
Probable Land Owner	Government or private depending on final location
Site description	Sand, trees at top of bank
Distance to 11 yd. (10 m) water depth	≈1203 yd. (1100 m)
Distance to 22 yd. (20 m) water depth	≈1312 yd. (1200 m)
Distance from landing point to existing infrastructure	≈175 yd. (160 m) to nearest pole line
Ease of access to site for machinery	Fair unless access is arranged through the construction yard then travel down the beach and over the edge of the wharf. Alternatively, access can be made along the fence line but this route is partly obstructed by refuse material.
Beach construction requirement	From BMH, install conduits to the top of the bank and secure with a headwall. ≈13 yd. (12 m)
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship but limited space and need to block off public beach
Environmental Sensitivities	Possible beachrock below sandy surface
Social Suitability	Potential conflict with marine traffic

5.6.2 Nen's Bay (Cn1)

The Nen's Bay (Cn1) site is situated on the east side of a government owned area used as an undifferentiated landfill. Although development is proposed for this site, the existing conditions present less potential marine traffic conflict than Grand Bay (Cn2). Future development at this site includes closure and sanitizing of the landfill, constructing a new solid waste facility between the landfill and the airport to the west, and building out the shoreline with fill to create a new docking area for commercial ships (DICAM 2014). Although no timeframe for development has been announced, some initial development for waste disposal already has been installed at this site. The proposed solid waste treatment facility at this site (DICAM 2014) indicates the BMH location will be clear of the proposed landfill and additional development to the east.

The BMH location is just inshore of a stand of trees along the shoreline (Table 16 and Figure 24). The beach area is a shallow slope of fine sand to the water. Some bedrock is visible near the landing area but there is a roughly 5 yd. (5 m) space in line with the landing. Further offshore there are three moorings that appear to be for small boats.

Table 16. Nen's Bay (Cn1), Canouan Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°42'0.18"N 61°20'20.76"W
Probable Land Owner	Government
Site description	Sand, trees at top of bank
Distance to 11 yd. (10 m) water depth	≈763 yd. (700 m)
Distance to 22 yd. (20 m) water depth	≈872 yd. (800 m)
Distance from landing point to existing infrastructure	CLS could be built at the airport. If the route was forced to go around the airport distance will be ≈1531 yd. (1.4 km).
Ease of access to site for machinery	Excellent. Narrow roads around airport. Dirt/gravel track to the landing site
Beach construction requirement	From BMH, install conduits ≈11 yd. (10 m) to the top of the bank and secure with a headwall.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	Beach shows signs of erosion on the eastern end
Social Suitability	Some fishing within the bay

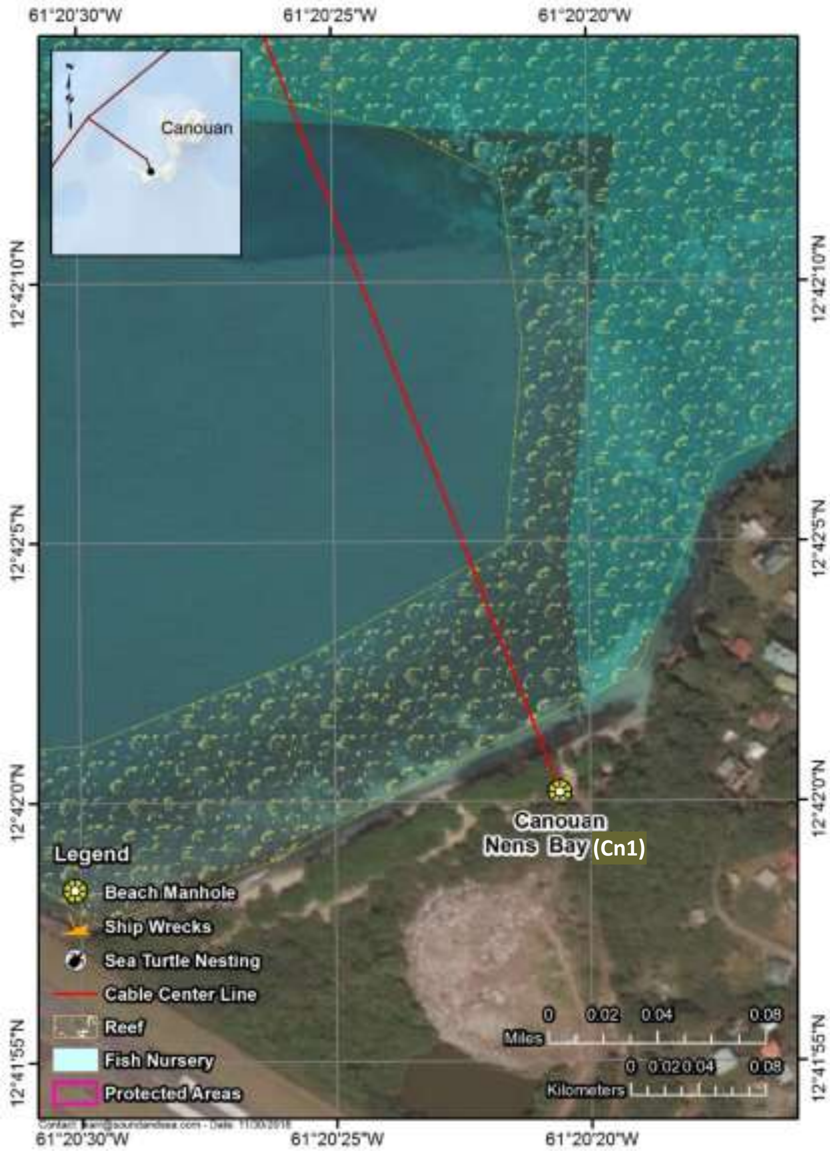


Figure 24. Nen's Bay (Cn1), Canouan, preferred landing site.

5.6.3 Canouan Summary

Table 4 summarizes the landing sites and the logic behind the selection.

5.7 Mustique

Two landings were evaluated at Mustique: Endeavor Bay (M1) and Britannia Bay (M2), both of which are within the Mustique Conservation Area that encompasses the entire island and surrounding waters 1000 yards from shore (Figure 25). The Conservation Area is in the jurisdiction of the MCL administration. Britannia Bay was not suitable as impracticable for both MCL and the site survey team. The bay has many moorings, is used as a fueling station for the island and has many super yachts that anchor offshore of the site. The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

With the collaboration of MCL, Endeavor Bay (M1) was selected as the preferred landing site. Endeavor Bay is a suitable landing (Table 17 and Figure 26). It has fewer moorings and is already the site of some infrastructure (water intake pipes) and a coral nursery. The landing point is a shallow sloped sandy beach with bedrock visible at the shore line. Offshore appears to be sandy with few outcrops of rock. The BMH will be constructed near the parking area with two conduits running to a head wall near the top of the bank to the beach.

Figure 25. Mustique potential landing sites investigated

Table 17. Endeavor Bay (M1), Mustique, Landing Site Features (IT International Telecom 2018)

Landing Coordinate	12°53'21.24"N 61°11'7.50"W
Probable Land Owner	Government or private depending on final location
Site description	Sand, grass and shrubs at top of bank
Distance to 11 yd. (10 m) water depth	≈218 yd. (200 m)
Distance to 22 yd. (20 m) water depth	≈327 yd. (300 m)
Distance from landing point to existing infrastructure	N/A new duct work to be built
Ease of access to site for machinery	Excellent. Excavation on the beach and for the conduits will require nothing bigger than a mid-size machine because of tail swing and not wanting to damage trees and shrubs.

Beach construction requirement	From BMH, install conduits to the top of the bank and secure with a headwall, about 11 yd. (10 m) beyond.
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship but public beach and direction of pull limited to north by water intake pipes. This will mean pulling in front of the restaurant and towards the more public area of the beach
Environmental Sensitivities	None
Social Suitability	Minimal beach use of resort guests

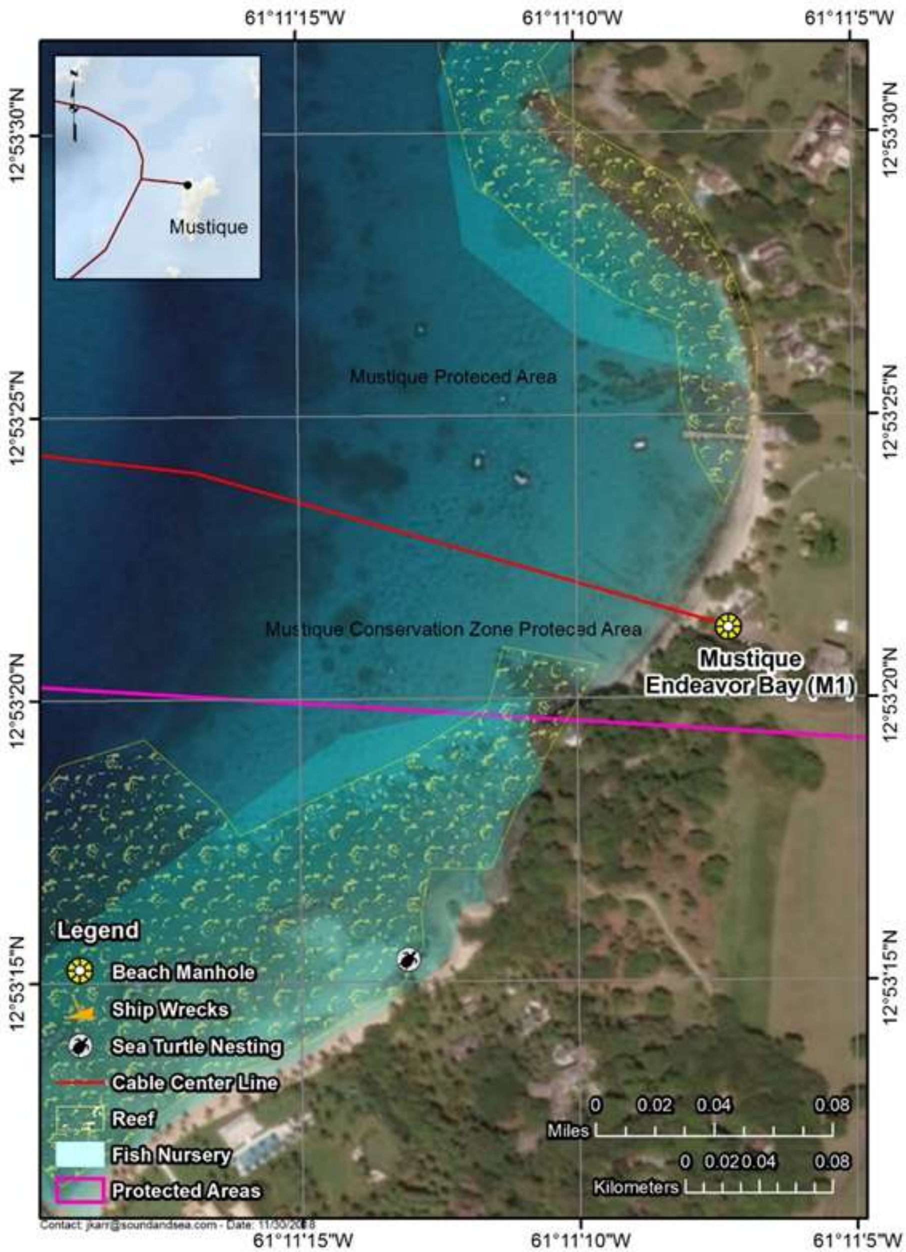


Figure 26. Endeavor Bay (M1), Mustique, preferred landing site.

5.8 Bequia

Three landing sites were examined at Bequia: two facing the west in Lower Bay (B1 and B2) (Figure 27) and one facing the south to the west of the airport (B3). The northern Lower Bay site (B1) was not suitable because of excessive construction requirements needed on shore and an offshore fish nursery area. The airport site (B3) was not suitable because of ongoing land reclamation and an impracticable distance to the nearest terrestrial connection.

The southern Lower Bay site, (B2), is preferred because of limited terrestrial construction required. It is also directly in line with the road that leads to Digicel Group's cell tower and the planned location for the CLS (Table 18 and Figure 28).

The BMH will be placed at the edge of the road leading to the cell tower. The main beach road will need to be cut and conduits installed under the road to a headwall at the bottom of the bank on the beach. Care will be taken to reinstate the bank of the beach to prevent erosion. The following discussion addresses potential sites investigated. See Table 4, above, for site selection summary and logic.

Figure 27. Bequia potential landing sites investigated

Table 18. Lower Bay (B2), Bequia, Landing Site Features (Source: IT, 2018)

Landing Coordinate	12°59'49.34"N 61°14'42.83"W
Probable Land Owner	Government
Site description	Sand, trees at top of bank
Distance to 11 yd. (10 m) water depth	≈545 yd. (500 m)
Distance to 22 yd. (20 m) water depth	≈763 yd. (700 m)
Distance from landing point to existing infrastructure	N/A new duct work to be built
Ease of access to site for machinery	Excellent. Narrow roads with many twists.
Beach construction requirement	From BMH, install conduits to the bottom of the bank and secure with a headwall. ≈27 yd. (25 m)
Shore End installation proposed procedure	Small landing craft. Back feed through conduit. Or direct pull from ship
Environmental Sensitivities	Pre-existing erosional gullying to the east
Social Suitability	Within close proximity to a restaurant

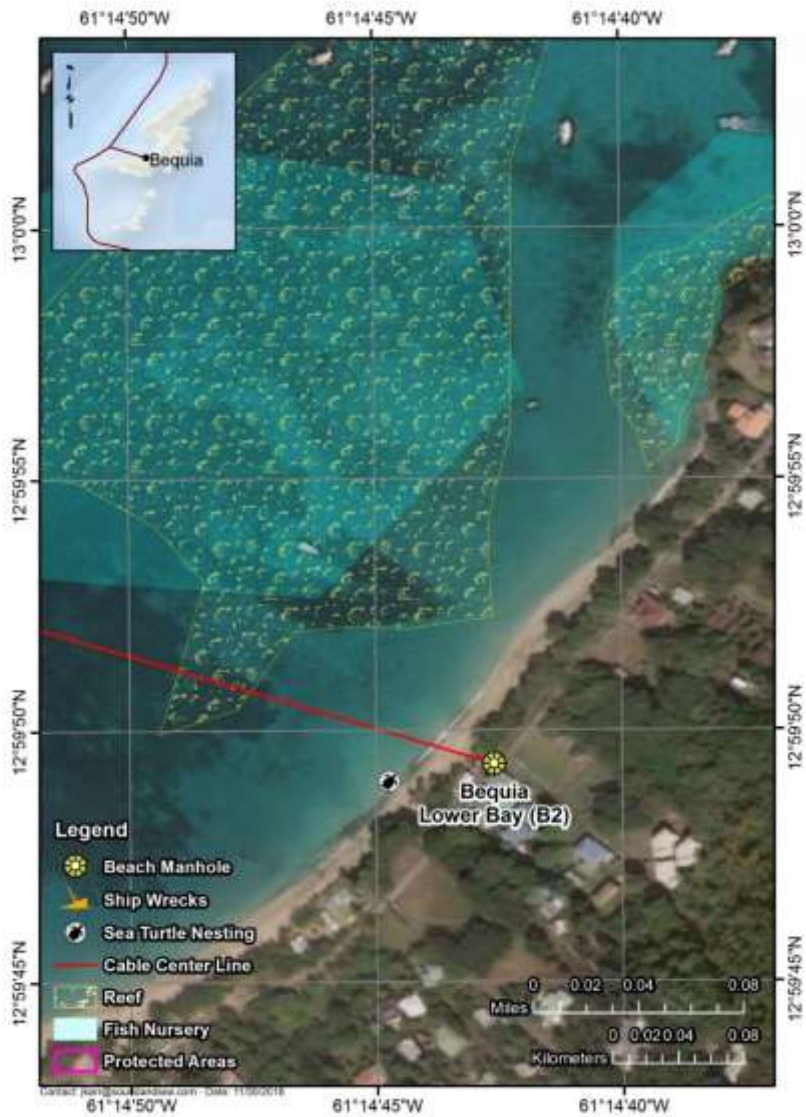


Figure 28. Lower Bay (B2), Bequia, preferred landing site.

5.9 Offshore Marine Route Selection

Offshore marine routes were also first identified through a detailed desktop route engineering study and included avoiding pre-existing cables, using the more sheltered side of the Grenadines for route and landings and avoidance of the active Kick-'em-Jenny submarine volcano just to the north west of Grenada. Desktop routes were determined by available bathymetric data. However, the paucity of data defining the shelf edge and available charts north of St. Vincent simply marked as “inadequately surveyed” did not ensure the cable route was viable. Accurately defining the continental shelf, and its edge, continental slopes and base was key for the CARCIP final route engineering, therefore, deep-water surveys were subsequently conducted September 9 to September 14, 2018.

The offshore marine route surveys (and nearshore cable routes) included surveying and mapping all routes using a multi-beam echo sounder, side-scan sonar and a sub bottom profiler to accurately identify all seafloor features. During the offshore surveys, it was quickly determined the deep-water route first identified compromised cable security and was rendered unacceptable due to an almost vertical drop off from 50m to 200m along the continental shelf edge. Additionally, surveys in northern SV revealed the marine extension of the La Soufrière volcano in which two survey swaths were required to locate slope angles suitable enough for cables (i.e. no more than around 5°). Avoidances of these features were designed into the final route (Figure 29).

All marine routes were identified as having the least impact on the marine environment, while considering cable integrity to ensure longevity to maximize the social impacts. The cable will be laid on the surface of the seabed. It is approximately 30 mm in diameter, affecting a minimal area of the seabed. After the cable is installed, the route will be placed on nautical charts to notify navigators to avoid the cable should marine use involve direct contact with the seabed.

The cable itself is benign and does not deteriorate or leech any substances into the environment, making it harmless to fish, cetacean’s and the marine environment. In the future, should the cable become obsolete and selected for decommissioning, Digicel Group would apply a risk assessment process to determine whether or not and how decommissioning should be accomplished (Emu Ltd. 2004).

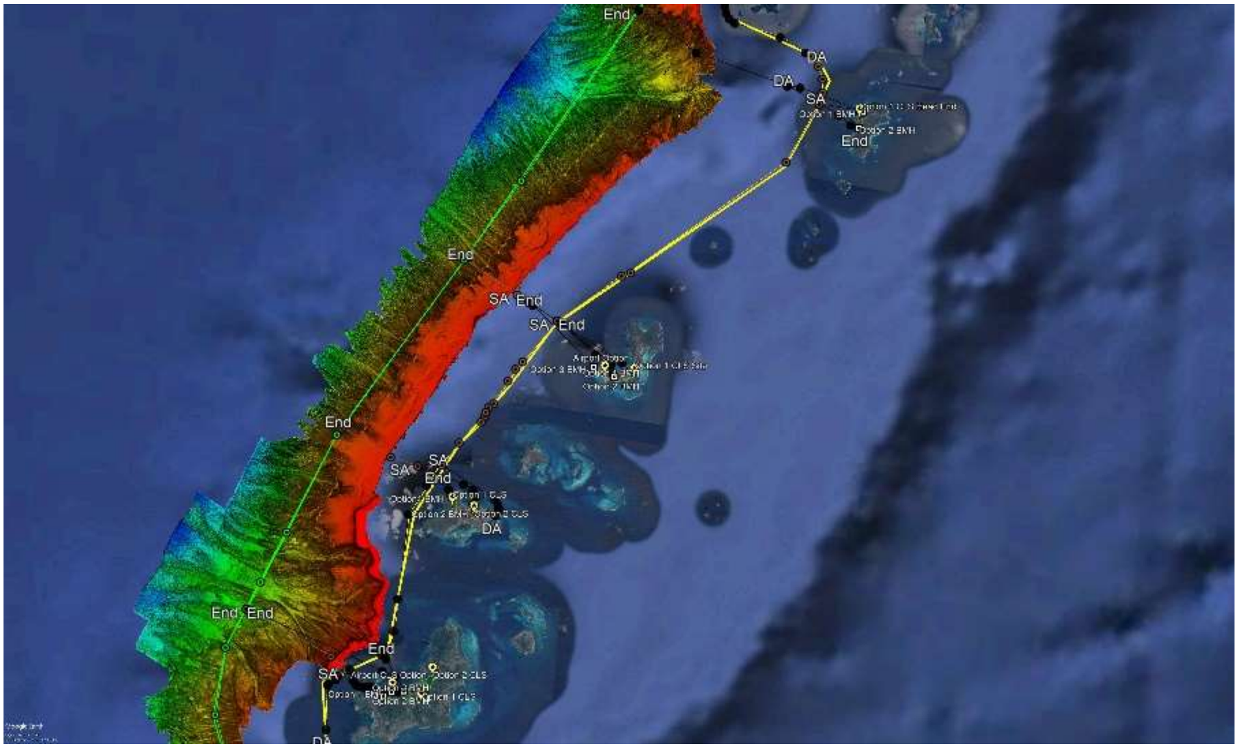


Figure 29. Offshore marine routes. Note green line depicts original cable route north west along a deep water drop off. Yellow line (cable route) along shallower depths.

6.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

6.1 Project Area of Influence

The PAI is located within the Windward Islands of the Lesser Antilles, in the Eastern Caribbean, west of Barbados. VC is an archipelago state consisting of more than 32 islands. The main islands of the Grenadines affected by this project include Bequia, Mustique, Canouan, and Union Island. Grenada and Carriacou make up the southern portion of the study area. The PAI includes both shallow nearshore and marine ocean waters over a 218 yd. (200 m) wide corridor surrounding the proposed centerline for the subsea cable. BMH locations, the cable route and front haul are the focus of this ESIA.

In this ESIA, the existing environment in the PAI is described generally, with characteristics applicable to the entire PAI. Each landing site is described at a finer scale to address the specific characteristics of each landing site and the nearshore marine environment. The information presented here has been adapted from general literature reviews, the CARCIP Environmental and Social Framework (Niles 2011), and the CARCIP Ecological Resources Assessment (APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT), site visits and resource assessments conducted between September 3 - 9 and October 14 - 26, 2018; and the CARCIP Cable Route Study (CRS) (IT International Telecom 2018) prepared as a design front-end study and available separately from the Digicel Group.

6.2 General Existing Conditions Across the Entire PAI

6.2.1 Existing Climate & Predicted Climate Change

The normal climate at the latitude of St. Vincent, the Grenadines and Grenada is a humid tropical marine type, with little seasonal or diurnal variation and a fairly constant, strong wind out of the east. This regional climate is affected mainly by the subtropical cyclone belt and the intertropical convergence zone. The location of these two meteorological systems varies in a cyclical pattern, and their movement gives a marked seasonal character to the weather. Rain tends to be showery and is distributed roughly into a drier season from January to May and a wetter season from June to December. There is some risk of hurricanes from June to November, with Grenada just south of the path of most tropical storms (IRF and CCA 1991a; IRF and CCA 1991b).

According to the Climate Change Risk Profile for both GD (Simpson, Clarke et al. 2012a) and VC (Simpson, Clarke et al. 2012b), climate projections are similar. Regional Climate Model projections indicate an increase ranging from 2.4˚C to 3.2˚C in GD, and 2.4-3.1˚C in VC, mean annual temperatures by the 2080’s in the higher emissions scenario. The General Circulation Model (GCM) projections of rainfall span both overall increases and decreases, ranging from -40 to +7 mm per month (GD) and -34 to +6 mm (VC) by 2080 across three scenarios. Most projections tend toward decreases with the RCM projections indicate -29% decreases in annual rainfall in GD and -30% in VC.

The GCM projections for sea surface temperatures (SST) indicate increases in SST throughout the year. Projected increases range from +0.9˚C and +3.1˚C (GD) and +0.9˚C and +3.0˚C (St. Vincent) by the 2080s across all three emissions scenarios. With warming oceans, North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in SSTs indicate potential for continuing increases in hurricane activity and model projections indicate that this may occur through increases in intensity of events but not necessarily through increases in frequency of storms. Hurricane incidence and paths through the area over the past 50 years are shown in Figure 30.

Over the past century, the rate of sea level rise (SLR) has roughly tripled in response to 0.8°C global warming (Rahmstorf, 2010). The Intergovernmental Panel on Climate Change (IPCC), a United Nations body for assessing the science related to climate change, reported that the mean global sea surface rose by 1.8±0.5mm/year over the period 1961 – 1993, and by 3.1±0.7mm/year between 1993 and 2003 (Solomon, Qin et al. 2007). Updated measurements using only the period when satellite measurements have been available indicate the rate of SLR has now reached 3.4±0.7mm/ year, or about 80% faster than the average IPCC model projection of 1.9mm /year (Rahmstorf 2010). Available information suggests that SLR trends in the Caribbean have been broadly similar to global trends (Nicholls and Cazenave 2010).

There are few records of sea level change at the present time in the Caribbean (detailed information from tide gauges are lacking), but it is likely that a similar rate of rise to that estimated for 1961 – 1993 occurred in the area at the end of the last century, and if sea level in the region generally tracked global changes, there is no reason to suppose that the greater rate of rise for 1993 – 2003 did not take place. This is in agreement with observed trends in SLR from 1950 to 2000, when the rise in the Caribbean appeared to be near the global mean (Church, White et al. 2004). Land movement is only imperfectly known in the Caribbean, and it is therefore assumed that about 3.1mm/year applies to all areas.

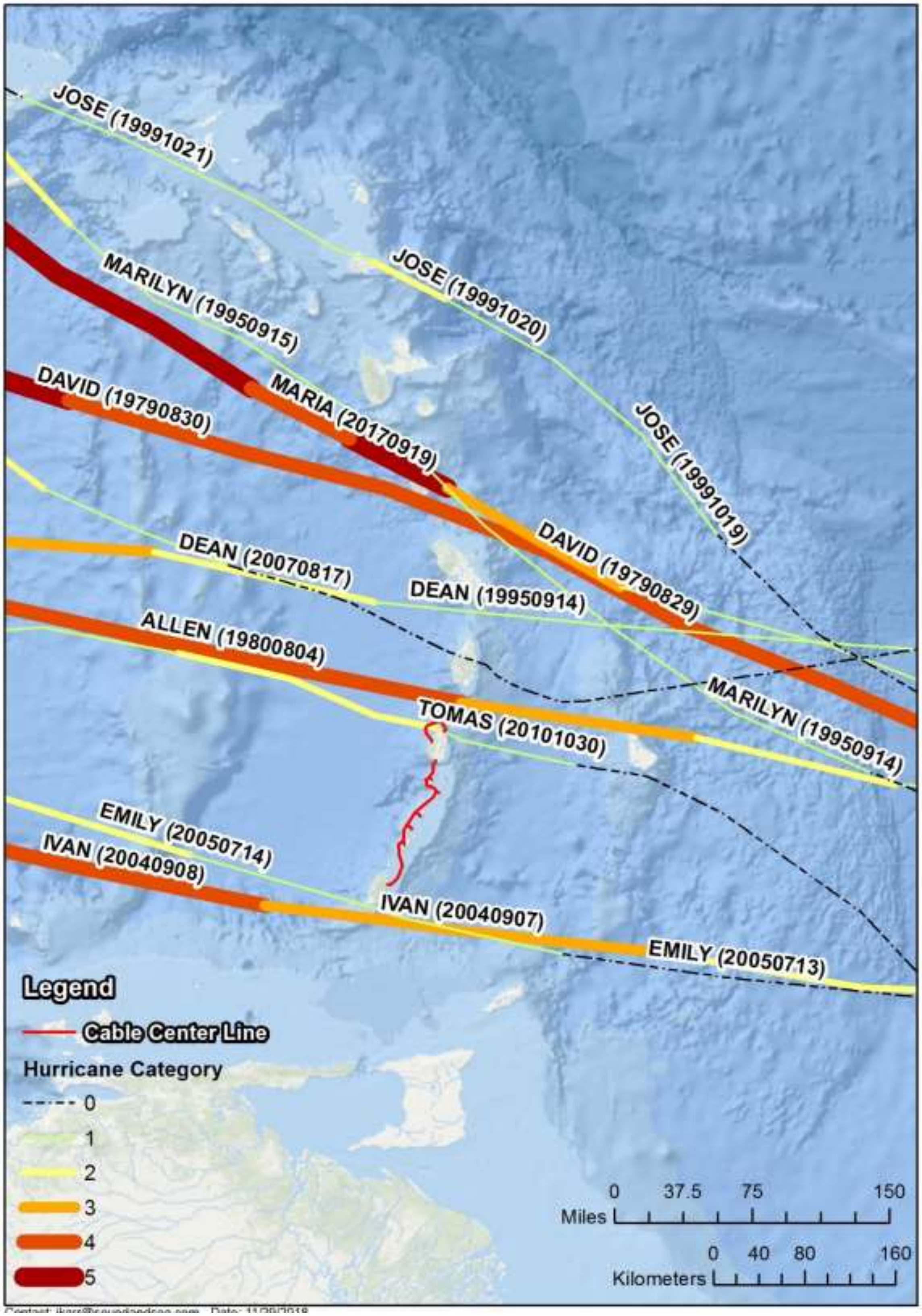


Figure 30. Hurricane incidence over the past 50 years across the PAI.

6.2.2 Physiography

St Vincent is volcanic in origin; a rugged mountain range runs from La Soufrière in the north to Mt St Andrew (2461 ft. [750 m]) above the Kingstown Valley in the south. This mountainous backbone sends off lateral spurs which are intersected by wooded valleys and numerous streams. Many of the beaches of St Vincent are of black volcanic sand; there are some white-sand beaches. The Grenadines have been much celebrated for their beaches of fine white sand and clear waters. The topography of Granada, St. Vincent and intervening islands is rugged with high aspect sloping lands, high ridges and mountains occupying over 80% of each them. The smaller islands are not as rugged, the peaks are lower and some are flatter. The gently sloping/flat lands are ideal for development, but are limited.

The drainage pattern of each main island follows the natural land form into gullies, ravines and rivers which flow directly into the sea. Most of the smaller islands do not have perennial streams. The main concern here is about potential effects of soil erosion, landslides and flooding that may quite possibly be created by the implementation of the project (Niles 2011).

The geology of the Islands within the study area from St. Vincent to GD are all of volcanic origin consisting mainly of volcanic remnants and other sedimentary rocks. A common feature on the slopes in many parts is huge boulders formed from volcanic blasts.

The Grenada Basin was formed by seafloor spreading in the early Cenozoic. The Basin is bounded to the north by the Saba Bank and to the south by the continental rise of northern Venezuela. The Aves Swell and Lesser Antilles Arc form the western and eastern limits of the basin. The shape is arcuate and has an approximate north/south dimension of 398 mi. (640 km), an east/west dimension of 87 mi. (140 km), and an average water depth of about 9022 ft. (2750 m). Sediment thickness ranges from 6562 ft. (2000 m) in the north to 29,528 ft. (9000 m) in the south. Morphologically the ocean floor of the Grenada Basin falls into northern and southern parts. The bathymetry of the northern part has been described as "rugged with a system of spurs and valleys running down from the Lesser Antilles Volcanic Arc" (Bouysse 1988; Wikipedia 2018) The southern part of the basin is characterized by a near-horizontal, smooth seafloor. The nature of the deep sediments of the Grenada Basin is not known.

St. Vincent includes an active volcano and the remains of two or more extinct subaerial volcanic cones. Volcanic breccias and lavas, weathered and deeply dissected by erosion, form the southern half of the island. An active volcano, La Soufrière, takes up the majority of the northern third of the island (University of the West Indies 2018). La Soufrière erupted in 1812, 1902 and 1971–72 (Commonwealth Secretariat 2018). The presence of this volcano and the risk of eruption is the basis for selecting the Owia to Chateaubelair cable festoon to avoid risk of damage by geologic forces and the difficulty of traversing the mountainous terrain. The country includes 32 of the northern Grenadines that lie southwest of St. Vincent. The islands affected by this project are Bequia, Canouan, Mustique, and Union Island. The Grenadine chain includes several smaller submerged and re-emerged volcanic formations and reef structures in shallow water (Mills, 2001).

Grenada is made up of volcanic basaltic rock in a rugged topography, rising to a maximum height of 840 m (Mount St. Catherine). A chain of mountains strikes almost the length of the island but is offset toward the western coast. No historical volcanic eruptions are known from GD. However, a submerged volcano "Kick 'em Jenny" lies 7 km north of GD. The top of Kick 'em Jenny lies about 187 m beneath sea level (White, Copeland et al. 2017). A restricted area, radius 0.8 mi (1.3 km), has been established around this volcano. The restricted area is expanded to 2.7 mi (4.3 km) at times of increased or dangerous volcanic activity. Volcanic activity is not visible or audible until the volcano is in full eruption. Such activity may occur with little or no warning.

6.2.3 Terrestrial Environment

The PAI includes many of the same habitats and species. The current vegetative cover in both GD and VC is the result of natural and man-made activities that have occurred over centuries, and correlates highly with its topography, elevation, geology and rainfall, resulting in a nearly concentric zonation of vegetation types. These diverse physical features and climatic conditions of the islands have developed into a variety of ecosystems such as forests, grasslands, and wetlands which harbor and sustain high biodiversity but are increasingly under threat from a variety of natural and anthropogenic sources.

The coastal terrestrial habitats, include dry scrub woodland and mangroves but the narrow strip of dry evergreen littoral woodlands (including seagrape, manchineel, buttonwood) are the primary habitats most likely to be affected by the CARCIP project with construction of the BMH, cable installation and front haul/CLS installation. Landing site selection considered existing development within the area and include pre-existing roadways, beach access trails and parking lots as primary BMH locations, eliminating the need to develop access pathways. All front haul installations are kept to as short as practicable.

Grenada's threatened plant species identified under the IUCN include the endangered Spanish Cedar (*Cedrela odorata*) and the Big Leaf or West Indian Mahogany (*Swietenia mahagoni*). The Spanish Cedar (*Cedrela odorata*) is listed as "vulnerable" with the Big Pine Key Prickly Pear (*Opuntia tricantha),* the Turk's Cap (*Melocactus broadwayi*) and the Bloodwood (*Pterocarpus officinalis*) listed as "near threatened".

Additional plants of importance in GD according the Grenada Forestry Department (Anthony Jeremiah, Forestry Wildlife Conservation Officer, pers. Comm) include those species found in wetland areasRed mangrove (*Rhizophora mangle*), White Mangroves (*Lauguncularia racemosa*), Black Mangroves (*Avicennia germinans*), and Button Wood Mangrove (*Conocarpus erectus*). Other locally important species identified include White cedar (*Tabebnia heterophylla*), Tantacayo (*Albizia niopoides*), Sea Grape (*Coccoloba uvifera*), Indian Almond (*Terminalia catappa*).

In VC, endangered species include *Guaiacm officinale* (no common name) and *Swietenia mahagoni* (no common name given). Vulnerable species include the Big Leaf or West Indian Mahogany (*Swietenia mahagoni*), *Pouteria semecarpifolia* (no common name given) and the *Magnolia dodecapetala* (no common name given). Those listed as near threatened include Big Pine Key Prickly Pear (*Opuntia tricantha),* Turk's Cap (*Melocactus broadwayi*), Bloodwood (*Pterocarpus officinalis*) and *Bois faire* (no common name given). No threatened species listed under the IUCN are found within the vicinity of the cable landing or BMHs.

St. Vincent, the Grenadines and GD have recorded over 200 bird species (Table 19) according to Avibase, the World Bird Database (Lepage, 2019). St. Vincent holds regionally and globally important populations and includes 14 of the Caribbean's 38 Lesser Antilles Endemic Bird Area Restricted-Range birds. Two of the 14 restricted-range birds, the national bird of St. Vincent, the St. Vincent Parrot (*Amazona guildingii)* and the Whistling Warbler (*Catharopeza bishopi)* are endemic to the island of St. Vincent. Grenada's resident bird populations include two endemics, the critically endangered Grenada Dove (*Leptotilla wellsi*) and the Grenada Hook-billed Kite (*Chondrohierax uncinatus murus*) listed as endangered in the IUCN Red List. Four species of birds which are endemic to the Lesser Antilles are also found in GD: the Grenada flycatcher (*Myiarchus nugatory*), the Scaly-breasted Thrasher (*Margarops fuscus*), the Lesser Antillian Bullfinch (*Loxigilla noctis*), and the Lesser Antillian Tanager (*Tangara cucullata*).

There are approximately 15 species of breeding seabirds that range across the two countries, (Bradley & Norton, 2009) (Table 19). with a majority of seabird nesting sites are located in the Grenadine islands (Lowery *et al*., 2009), with the most important island for breeding birds, based on diversity of species and the number of large colonies, is Battowia Island, outside of the PAI.

Table 19. Avifauna in the CARCIP PAI, breeding seabirds highlighted in blue. Available online at: https://avibase.bsc-eoc.org/avibase.jsp

Common Name	Genus species	Classification	Location (GD, VC or Both)
Spotted Sandpiper	*Actitis macularius*	Rare/Accidental	BOTH
Scaly-breasted Thrasher	*Allenia fusca*	Rare/Accidental	BOTH
St. Vincent Parrot	*Amazona guildingii*	Endemic Vulnerable	VC
Northern Pintail	*Anas acuta*	No concern	BOTH
Common or Green Winged Teal	*Anas crecca*	Least concern	BOTH
Mallard	*Anas platyrhynchos*	Rare/Accidental	VC
Anhinga	*Anhinga*	Rare/Accidental	GD
Brown Noddy	*Anous stolidus*	Least concern	BOTH
Great Egret	*Ardea alba*	Least concern	BOTH
Cocoi Heron	*Ardea cocoi*	Rare/Accidental	VC
Great Blue Heron	*Ardea herodias*	Rare/Accidental	BOTH
Ruddy Turnstone	*Arenaria interpres*	Rare/Accidental	BOTH
Lesser Scaup	*Aythya affinis*	Least concern	BOTH
Ring-necked Duck	*Aythya collaris*	Least concern	BOTH
Upland Sandpiper	*Bartramia longicauda*	Rare/Accidental	BOTH
Cattle Egret	*Bubulcus ibis*	Least concern	BOTH
Broad-winged Hawk	*Buteo platypterus*	Least concern	BOTH
Common Black Hawk	*Buteogallus anthracinus*	Least concern	BOTH
Striated Heron	*Butorides striata*	Rare/Accidental	BOTH
Green Heron	*Butorides virescens*	Least concern	BOTH
Sanderling	*Calidris alba*	Rare/Accidental	BOTH
Baird's Sandpiper	*Calidris bairdii*	Rare/Accidental	BOTH
Red Knot	*Calidris canutus*	Rare/Accidental Near-threatened	BOTH
Curlew Sandpiper	*Calidris ferruginea*	Rare/Accidental Near-threatened	BOTH
White-rumped Sandpiper	*Calidris fuscicollis*	Rare/Accidental	BOTH
Stilt Sandpiper	*Calidris himantopus*	Rare/Accidental	BOTH
Western Sandpiper	*Calidris mauri*	Rare/Accidental	BOTH
Pectoral Sandpiper	*Calidris melanotos*	Rare/Accidental	BOTH
Least Sandpiper	*Calidris minutilla*	Rare/Accidental	BOTH
Ruff	*Calidris pugnax*	Rare/Accidental	BOTH
Semipalmated Sandpiper	*Calidris pusilla*	Rare/Accidental Near-threatened	BOTH
Buff-breasted Sandpiper	*Calidris subruficollis*	Rare/Accidental Near-threatened	BOTH
Whistling Warbler	*Catharopeza bishopi*	Endemic Endangered	VC
Gray-cheeked Thrush	*Catharus minimus*	Least concern	GD
Short-tailed Swift	*Chaetura brachyura*	Least concern	BOTH
Gray-rumped Swift	*Chaetura cinereiventris*	Least concern	GD
Lesser Antillean Swift	*Chaetura martinica*	Least concern	VC
Collared Plover	*Charadrius collaris*	Rare/Accidental	BOTH
Snowy Plover	*Charadrius nivosus*	Rare/Accidental Near-threatened	VC
Semipalmated Plover	*Charadrius semipalmatus*	Rare/Accidental	BOTH
Killdeer	*Charadrius vociferus*	Rare/Accidental	BOTH
Wilson's Plover	*Charadrius wilsonia*	Rare/Accidental	BOTH
Black Tern	*Chlidonias niger*	Rare/Accidental	BOTH
Hook-billed Kite	*Chondrohierax uncinatus*	Least concern	GD
Black-headed Gull	*Chroicocephalus ridibundus*	Rare/Accidental	BOTH

Common Name	Genus species	Classification	Location (GD, VC or Both)
Brown Trembler	*Cinclocerthia ruficauda*	Rare/Accidental	BOTH
Hen Harrier	*Circus cyaneus*	Least concern	GD
Northern Harrier	*Circus hudsonius*	Least concern	VC
Yellow-billed Cuckoo	*Coccyzus americanus*	Rare/Accidental	VC
Dark-billed Cuckoo	*Coccyzus melacoryphus*	Rare/Accidental	GD
Mangrove Cuckoo	*Coccyzus minor*	Least concern	BOTH
Bananaquit	*Coereba flaveola*	Least concern	BOTH
Crested Bobwhite	*Colinus cristatus*	Least concern	VC
Rock Dove	*Columba livia*	Introduced species	BOTH
Rock Pigeon	*Columba livia*	Introduced species	BOTH
Common Ground Dove	*Columbina passerina*	Least concern	BOTH
Common Ground-Dove	*Columbina passerina*	Least concern	BOTH
Black Vulture	*Coragyps atratus*	Rare/Accidental	GD
Smooth-billed Ani	*Crotophaga ani*	Least concern	BOTH
Black Swift	*Cypseloides niger*	Rare/Accidental Vulnerable	BOTH
West Indian Whistling Duck	*Dendrocygna arborea*	Rare/Accidental Vulnerable	BOTH
West Indian Whistling-Duck	*Dendrocygna arborea*	Rare/Accidental Vulnerable	BOTH
Black-bellied Whistling Duck	*Dendrocygna autumnalis*	Rare/Accidental	BOTH
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	Rare/Accidental	BOTH
Fulvous Whistling Duck	*Dendrocygna bicolor*	Rare/Accidental	BOTH
Fulvous Whistling-Duck	*Dendrocygna bicolor*	Rare/Accidental	BOTH
Bobolink	*Dolichonyx oryzivorus*	Rare/Accidental	BOTH
Little Blue Heron	*Egretta caerulea*	Rare/Accidental	BOTH
Little Egret	*Egretta garzetta*	Rare/Accidental	BOTH
Western Reef-Heron	*Egretta gularis*	Rare/Accidental	VC
Snowy Egret	*Egretta thula*	Rare/Accidental	BOTH
Tricolored Heron	*Egretta tricolor*	Rare/Accidental	BOTH
Yellow-bellied Elaenia	*Elaenia flavogaster*	Least concern	BOTH
Caribbean Elaenia	*Elaenia martinica*	Least concern	BOTH
Scarlet Ibis	*Eudocimus ruber*	Rare/Accidental	GD
Green-throated Carib	*Eulampis holosericeus*	Least concern	BOTH
Purple-throated Carib	*Eulampis jugularis*	Least concern	BOTH
Antillean Euphonia	*Euphonia musica*	Rare/Accidental	BOTH
Merlin	*Falco columbarius*	Rare/Accidental	BOTH
Peregrine Falcon	*Falco peregrinus*	Least concern	BOTH
American Kestrel	*Falco sparverius*	Rare/Accidental	BOTH
Magnificent Frigatebird	*Fregata magnificens*	Least concern	BOTH
American Coot	*Fulica americana*	Rare/Accidental	BOTH
Caribbean Coot	*Fulica caribaea*	Rare/Accidental	GD
Wilson's Snipe	*Gallinago delicata*	Rare/Accidental	BOTH
Common Gallinule	*Gallinula galeata*	Rare/Accidental	BOTH
Red Junglefowl	*Gallus*	Least concern	BOTH
Gull-billed Tern	*Gelochelidon nilotica*	Rare/Accidental	VC
Ruddy Quail Dove	*Geotrygon montana*	Least concern	BOTH
Ruddy Quail-Dove	*Geotrygon montana*	Least concern	BOTH
Bridled Quail-Dove	*Geotrygon mystacea*	Rare/Accidental	VC
Rufous-breasted Hermit	*Glaucis hirsutus*	Least concern	GD
American Oystercatcher	*Haematopus palliatus*	Rare/Accidental	BOTH
Black-winged Stilt	*Himantopus*	Rare/Accidental	GD
Black-necked Stilt	*Himantopus mexicanus*	Rare/Accidental	VC

Common Name	Genus species	Classification	Location (GD, VC or Both)
Barn Swallow	*Hirundo rustica*	Least concern	BOTH
Baltimore Oriole	*Icterus galbula*	Rare/Accidental	BOTH
Venezuelan Troupial	*Icterus*	Rare/Accidental	GD
Yellow Oriole	*Icterus nigrogularis*	Rare/Accidental	GD
Jabiru	*Jabiru mycteria*	Rare/Accidental	GD
Herring Gull	*Larus argentatus*	Least concern	VC
Ring-billed Gull	*Larus delawarensis*	Rare/Accidental	VC
American Herring Gull	*Larus smithsonianus*	Least concern	GD
Euler's Flycatcher	*Lathrotriccus euleri*	Extirpated	GD
Grenada Dove	*Leptotila wellsi*	Endemic Critically endangered	GD
Laughing Gull	*Leucophaeus atricilla*	Least concern	BOTH
Short-billed Dowitcher	*Limnodromus griseus*	Rare/Accidental	BOTH
Marbled Godwit	*Limosa fedoa*	Rare/Accidental	BOTH
Hudsonian Godwit	*Limosa haemastica*	Rare/Accidental	VC
Lesser Antillean Bullfinch	*Loxigilla noctis*	Least concern	BOTH
American Wigeon	*Mareca americana*	Least concern	BOTH
Pearly-eyed Thrasher	*Margarops fuscatus*	Least concern	BOTH
Belted Kingfisher	*Megaceryle alcyon*	Rare/Accidental	BOTH
Ringed Kingfisher	*Megaceryle torquata*	Least concern	GD
Black-faced Grassquit	*Melanospiza bicolor*	Least concern	GD
Tropical Mockingbird	*Mimus gilvus*	Least concern	BOTH
Black-and-white Warbler	*Mniotilta varia*	Least concern	BOTH
Shiny Cowbird	*Molothrus bonariensis*	Least concern	BOTH
Rufous-throated Solitaire	*Myadestes genibarbis*	Least concern	VC
Grenada Flycatcher	*Myiarchus nugator*	Endemic (country/region)	BOTH
Masked Duck	*Nomonyx dominicus*	Rare/Accidental	BOTH
Eskimo Curlew	*Numenius borealis*	Rare/Accidental Critically endangered (possibly extinct)	BOTH
Whimbrel	*Numenius phaeopus*	Least concern	BOTH
Yellow-crowned Night Heron	*Nyctanassa violacea*	Rare/Accidental	BOTH
Yellow-crowned Night-Heron	*Nyctanassa violacea*	Least concern	BOTH
Black-crowned Night Heron	*Nycticorax*	Rare/Accidental	BOTH
Black-crowned Night-Heron	*Nycticorax*	Rare/Accidental	BOTH
Wilson's Storm-petrel	*Oceanites oceanicus*	Rare/Accidental	BOTH
Bridled Tern	*Onychoprion anaethetus*	Rare/Accidental	BOTH
Sooty Tern	*Onychoprion fuscatus*	Rare/Accidental	BOTH
Rufous-vented Chachalaca	*Ortalis ruficauda*	Least concern	BOTH
Antillean Crested Hummingbird	*Orthorhyncus cristatus*	Least concern	BOTH
Ruddy Duck	*Oxyura jamaicensis*	Least concern	BOTH
Osprey	*Pandion haliaetus*	Rare/Accidental	BOTH
Louisiana Waterthrush	*Parkesia motacilla*	Least concern	BOTH
Northern Waterthrush	*Parkesia noveboracensis*	Rare/Accidental	BOTH
House Sparrow	*Passer domesticus*	Introduced species	VC
White-crowned Pigeon	*Patagioenas leucocephala*	Rare/Accidental Near-threatened	VC
Scaly-naped Pigeon	*Patagioenas squamosa*	Least concern	BOTH
Brown Pelican	*Pelecanus occidentalis*	Rare/Accidental	BOTH
Cave Swallow	*Petrochelidon fulva*	Rare/Accidental	VC
Cliff Swallow	*Petrochelidon pyrrhonota*	Rare/Accidental	BOTH
Red-billed Tropicbird	*Phaethon aethereus*	Rare/Accidental	BOTH

Common Name	Genus species	Classification	Location (GD, VC or Both)
White-tailed Tropicbird	*Phaethon lepturus*	Rare/Accidental	BOTH
Large-billed Tern	*Phaetusa simplex*	Rare/Accidental	GD
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Least concern	BOTH
American Flamingo	*Phoenicopterus ruber*	Rare/Accidental	GD
Scarlet Tanager	*Piranga olivacea*	Rare/Accidental	BOTH
Summer Tanager	*Piranga rubra*	Rare/Accidental	BOTH
Roseate Spoonbill	*Platalea ajaja*	Least concern	BOTH
Glossy Ibis	*Plegadis falcinellus*	Least concern	BOTH
American Golden Plover	*Pluvialis dominica*	Rare/Accidental	BOTH
American Golden-Plover	*Pluvialis dominica*	Rare/Accidental	BOTH
Grey Plover	*Pluvialis squatarola*	Rare/Accidental	BOTH
Black-bellied Plover	*Pluvialis squatarola*	Rare/Accidental	BOTH
Pied-billed Grebe	*Podilymbus podiceps*	Rare/Accidental	BOTH
Purple Gallinule	*Porphyrio martinica*	Rare/Accidental	VC
Sora	*Porzana carolina*	Rare/Accidental	BOTH
Caribbean Martin	*Progne dominicensis*	Least concern	BOTH
Prothonotary Warbler	*Protonotaria citrea*	Rare/Accidental	BOTH
Audubon's Shearwater	*Puffinus lherminieri*	Rare/Accidental	BOTH
Manx Shearwater	*Puffinus*	Rare/Accidental	BOTH
Carib Grackle	*Quiscalus lugubris*	Least concern	BOTH
Channel-billed Toucan	*Ramphastos vitellinus*	Introduced species	GD
Sand Martin	*Riparia*	Rare/Accidental	BOTH
Bank Swallow	*Riparia*	Rare/Accidental	BOTH
Black Skimmer	*Rynchops niger*	Rare/Accidental	GD
Ovenbird	*Seiurus aurocapilla*	Rare/Accidental	VC
Northern Parula	*Setophaga americana*	Rare/Accidental	BOTH
Black-throated Blue Warbler	*Setophaga caerulescens*	Rare/Accidental	VC
Bay-breasted Warbler	*Setophaga castanea*	Rare/Accidental	VC
Hooded Warbler	*Setophaga citrina*	Rare/Accidental	VC
Yellow-rumped Warbler	*Setophaga coronata*	Rare/Accidental	VC
Prairie Warbler	*Setophaga discolor*	Rare/Accidental	BOTH
Blackburnian Warbler	*Setophaga fusca*	Rare/Accidental	GD
Chestnut-sided Warbler	*Setophaga pensylvanica*	Rare/Accidental	VC
Yellow Warbler	*Setophaga petechia*	Least concern	BOTH
American Redstart	*Setophaga ruticilla*	Rare/Accidental	BOTH
Blackpoll Warbler	*Setophaga striata*	Rare/Accidental Near-threatened	BOTH
Cape May Warbler	*Setophaga tigrina*	Rare/Accidental	BOTH
Grassland Yellow Finch	*Sicalis luteola*	Rare/Accidental	BOTH
Grassland Yellow-Finch	*Sicalis luteola*	Rare/Accidental	BOTH
Northern Shoveler	*Spatula clypeata*	Least concern	BOTH
Blue-winged Teal	*Spatula discors*	Rare/Accidental	BOTH
Yellow-bellied Seedeater	*Sporophila nigricollis*	Rare/Accidental	BOTH
Wilson's Phalarope	*Steganopus tricolor*	Rare/Accidental	GD
Arctic Skua	*Stercorarius parasiticus*	Rare/Accidental	BOTH
Parasitic Jaeger	*Stercorarius parasiticus*	Rare/Accidental	BOTH
Pomarine Jaeger	*Stercorarius pomarinus*	Rare/Accidental	VC
Roseate Tern	*Sterna dougallii*	Rare/Accidental	BOTH
Forster's Tern	*Sterna forsteri*	Rare/Accidental	VC
Common Tern	*Sterna hirundo*	Rare/Accidental	BOTH
Least Tern	*Sternula antillarum*	Rare/Accidental	BOTH

Common Name	Genus species	Classification	Location (GD, VC or Both)
Eurasian Collared Dove	*Streptopelia decaocto*	Rare/Accidental	BOTH
Eurasian Collared-Dove	*Streptopelia decaocto*	Introduced species	BOTH
White-collared Swift	*Streptoprocne zonaris*	Rare/Accidental	BOTH
Masked Booby	*Sula dactylatra*	Rare/Accidental	BOTH
Brown Booby	*Sula leucogaster*	Least concern	BOTH
Red-footed Booby	*Sula sula*	Rare/Accidental	BOTH
Least Grebe	*Tachybaptus dominicus*	Rare/Accidental	GD
White-winged Swallow	*Tachycineta albiventer*	Rare/Accidental	GD
Lesser Antillean Tanager	*Tangara cucullata*	Endemic (country/region)	BOTH
Royal Tern	*Thalasseus maximus*	Least concern	BOTH
Sandwich Tern	*Thalasseus sandvicensis*	Rare/Accidental	BOTH
Lesser Yellowlegs	*Tringa flavipes*	Rare/Accidental	BOTH
Greater Yellowlegs	*Tringa melanoleuca*	Rare/Accidental	BOTH
Willet	*Tringa semipalmata*	Rare/Accidental	BOTH
Solitary Sandpiper	*Tringa solitaria*	Rare/Accidental	BOTH
House Wren	*Troglodytes aedon*	Least concern	BOTH
Cocoa Thrush	*Turdus fumigatus*	Least concern	BOTH
Spectacled Thrush	*Turdus nudigenis*	Least concern	BOTH
Gray Kingbird	*Tyrannus dominicensis*	Least concern	BOTH
Tropical Kingbird	*Tyrannus melancholicus*	Rare/Accidental	GD
Fork-tailed Flycatcher	*Tyrannus savana*	Rare/Accidental	BOTH
Common Barn Owl	*Tyto alba*	Least concern	BOTH
Barn Owl	*Tyto alba*	Rare/Accidental	BOTH
Southern Lapwing	*Vanellus chilensis*	Least concern	GD
Black-whiskered Vireo	*Vireo altiloquus*	Least concern	BOTH
Yellow-throated Vireo	*Vireo flavifrons*	Rare/Accidental	BOTH
Red-eyed Vireo	*Vireo olivaceus*	Least concern	VC
Blue-black Grassquit	*Volatinia jacarina*	Least concern	GD
Eared Dove	*Zenaida auriculata*	Least concern	BOTH
Zenaida Dove	*Zenaida aurita*	Least concern	BOTH

6.2.4 Marine Environment

Much of the marine environment between Grenada and St. Vincent is shallower than 164 ft. (50 m), supporting extensive coral reefs and related habitats in the southeastern Caribbean. Marine habitats in the PAI include seagrass; mangroves; and a variety of patch, fringing and bank barrier reefs. The area also supports economic activities including commercial and substantive fishing and recreational diving. Section 6.3 describes these conditions in greater detail for each landing site.

The coastal regions of the PAI consist of islands and their respective shorelines linked with a variety of coral reef, seagrass and mangrove ecosystems. Where these ecosystems meet are important nursery areas for resident and transient marine species. In turn, the organisms supported are generally valuable for the host nations' economic and social health. The primary threats to these ecosystems include pollution from runoff, sedimentation from uncontrolled development on and offshore, and direct removal for development.

Key indicators of coastal health in the coastal regions of the PAI include a particular "balance" of species, populations, and assemblages. Changes in diversity and abundance can also signal ecosystem degradation or growth. The following indicators are specific to VC (Kramer, Roth et al. 2016):

- Coral types, abundance and recruitment
- Fleshy macroalgae
- Herbivorous fish
- Commercial fish

According to Kramer, Roth et al., (2016), Grenada possesses 30 sq. mi. (78 km^2) of patch and fringing reefs predominantly on the eastern coast of Grenada as well as the west coast at Grand Anse and Moliniere and around the islands of Carriacou and Petite Martinique. Grenada also has 11 sq. mi. (29 km^2) of seagrass beds. Coastal development during the 1980s along with sewerage, agrochemical pollution and sedimentation may be responsible for much of the shallow reef degradation in Grenada and the Grenadines (IRF, 1991; Bouchon, et al., 2008). Additionally, a series of hurricanes – Ivan in 2004 followed by Emily in 2005 – have all contributed to physical damage, especially to stands of the elkhorn coral *Acropora palmata* (Burke, et al., 2011).

Based on the results of the 2016 Coral Reef Report Card (Kramer, Roth et al. 2016), a total of 33 species of hard coral have been recorded in Grenada with live coral coverage averaging 22% with fleshy macroalgae coverage averaging 20%. Herbivorous fish species are most abundant but generally small in size while commercial fish species (groupers and snappers) are rare as well as smaller in size with few mature adults.

On the main island of St. Vincent, volcanic sediments resulting from the active La Soufrière volcano in the north of the island has prevented the development of extensive coral reefs around the island and only a narrow shelf with patch and fringing reefs exists. In contrast, the Grenadine islands possess considerable areas of fringing reef with the best developed on the windward coasts of the Tobago Cays, Mayreau and Union Island.

Based on the results of the 2016 St. Vincent Coral Reef Report Card (Kramer, Roth et al. 2016), live coral coverage averaged 21% but lower than historic levels with fleshy algae coverage averaging 16%. A higher percentage of coral coverage exists on western coasts compared to those on the eastern side of the islands with all reefs at risk from high sedimentation, storms and bleaching events. Surveys in 2004 indicated that the reefs have minimal disease present, and at some sites the branching coral *Madracis mirabilis* covers areas hundreds of meters in size. There was a healthy population of *Diadema* sea urchins in 2004 as well as the West Indian sea egg (*Tripneustes ventricosus*). The presence of *Diadema* and the relatively healthy population of parrotfish appear to be keeping macroalgal growth in check.

Indicator fish species, particularly herbivorous fish such as parrotfish are common on reefs but size classes are small (0-5 cm), possibly an indicator they are overfished. Additionally, commercial fish species such as groupers and snappers are also considerably small (most within the 6-10 cm size class). In contrast, no-take protected areas such as the Tobago Cays, exhibit higher fish populations and size classes.

Marine Mammals that frequent the offshore waters of VC and GD include humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter catodon*), blackfish or pilot whales (*Globicephala macrorhynchus*), killer whales (*Orcinus orca*), bottlenose dolphins (*Tursiops truncatus*), spinner dolphins (*Stenella longirostris*), and several other species of dolphins (Boisseau, et al., 2006). Humpback Whales migrate from northern waters to calving grounds in the Grenadines during January to April each year, Blackfish migrate through the area between July to November or mid-December, and a wide variety of dolphins are present year-round. Other cetacean species are less commonly encountered.

Artisanal whalers are permitted by the International Whaling Commission to take a maximum of four humpback whales per year. This quota was reached only once since it was introduced (2013), due largely to the weather conditions and the use of traditional open boats (almost identical to the original boats from the 1860s) and hunting equipment, also almost identical to those used over 140 years ago. Most years, one to two whales are killed. The 2018 season resulted in zero catch due to severe weather conditions. However, species such as blackfish are commonly hunted by fishers, particularly those from the Central Leeward town of Barrouallie.

The PAI is home to four species of turtles, all internationally qualified under the IUCN. The most common is the critically endangered hawksbill (*Eretmochelys imbricata*), with smaller numbers of endangered green turtles (*Chelonia mydas*) and leatherbacks (*Dermochelys coriacea*) and, less frequently, loggerheads (*Caretta caretta*). Both leatherbacks and loggerheads in the NW Atlantic subpopulation are listed as species of least concern (Ceriani and Meylan 2017) and (Tiwari, Wallace et al. 2013) respectively, while on a global level they are both listed as vulnerable. Juvenile green turtles, hawksbill and occasionally loggerhead turtles can be seen around the islands year-round, non-nesting adults are rare. Green turtles are abundant around the Grenadines due to the seagrass and algae bed habitats and hawksbills are more frequent around St. Vincent. Hawksbill turtles nest all year round, however, peak season is between September through October, while green and leatherbacks nest March through August.

6.2.5 Fisheries

The fishing industry in VC is predominantly small-scale and artisanal with most fishermen operating from small boats close to shore. Traditional gear, methods and vessels are predominantly used. In 2014, the industry included 1900 people who engaged in the marine coastal fisheries and 900 people engaged in deep-sea fisheries.

In 2014, the fleet consisted of 839 registered vessels operating from 36 landing sites, of which 20 are located on the mainland and 16 in the Grenadines (FAO, 2014). Most of these landing sites lack modern infrastructure and in reality, are just designated points where fishers pull up their boats to serve the villages.

Fishers in VC harvest a variety of demersal finfish and shellfish, large offshore and small coastal pelagic, turtles, mammals and crustaceans. Balahoo (*Hemiramphus balao*), Jacks (*Selan crumenophthalmus*) and Robin (*Decapterus macarellus*) are the most common in the coastal waters, while Dolphin (*Coryphaena hippurus*)), Snapper (*Lutjannus buccanella*), Tuna (*Thunnus abesus*) and Cavallie (*Caranx* spp.) are most abundant among the deep-water species (FAO, 2014). Deep sea fishers use hooks and lines, the near-shore fishers use nets, fish pots and some divers use spear guns. Small scale and longline fishery make up most of the catch; no bottom trawling is conducted.

Much of the marine resource information was obtained from the Marine Resources Space-use Information System (MarSIS) (Baldwin 2018). The background and purpose of MarSIS is explained thusly:

> *"The Grenadines Marine Resource Space-use Information System (MarSIS) brings together a variety of social, economic and environmental information drawn from both scientific and local knowledge into a single information system. Therefore, areas important for livelihoods and conservation can be better identified and this information used to assist the management and planning of sustainable development across the Grenadine island chain."*

Preferred fishing grounds (Figure 31) were identified in the MarSIS study. Within the Grenadines, it was apparent that the fishers prefer to fish close to shore in shallower water. This is likely because of a number of factors, such as cost of fuel and time to travel to offshore sites and depth limitation of gear. Due to the nature of the fishing activities in the region, the cable installation will have little or no adverse effect on the fishing fleets.

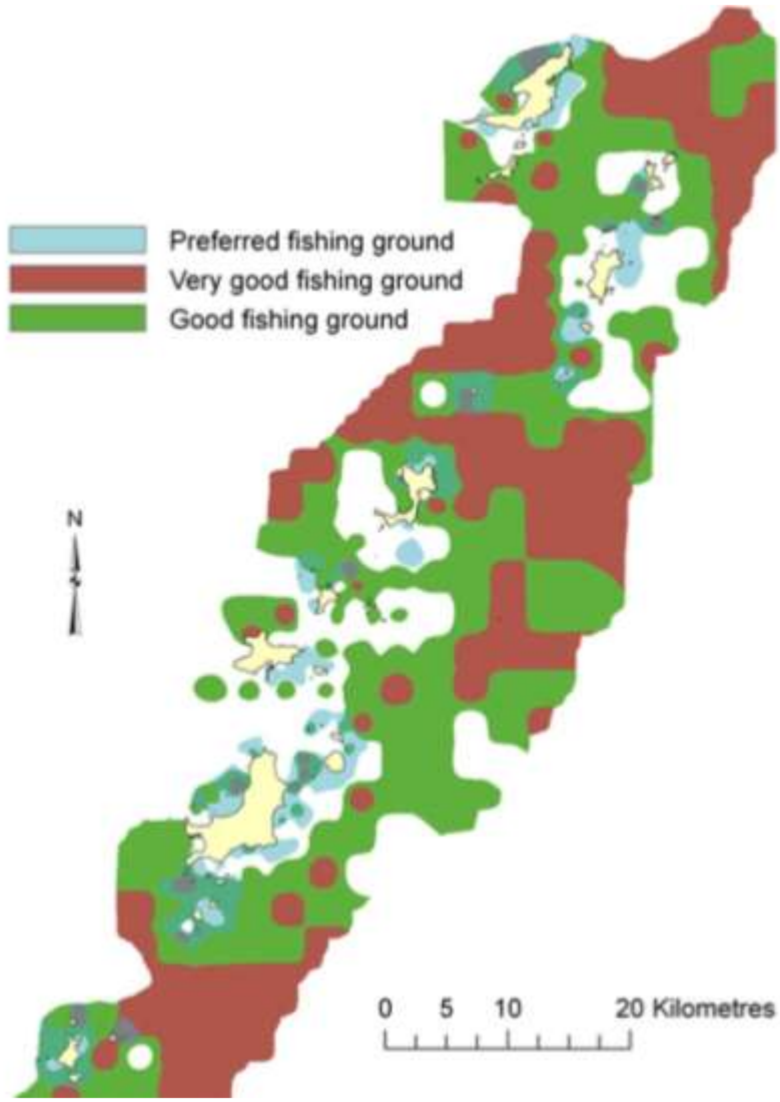


Figure 31. Preferred, good and very good fishing grounds in the Grenadines.

Traditional methods of hunting, killing and processing of humpback whales are continued today from the people of Bequia. The annual quota is four whales per year. The whaling station where the whale is processed is on Port Nevis. Whaling Season for the people of Bequia is February through April.

Grenada has a complex multi-species fishery, with a mix of large and small pelagic species, a wide spread of demersal species (reef fish and deep-water snapper) and some high value vulnerable fisheries (lobster, conch and turtle) (Finlay, 1996).

The GD fishing fleet includes a mixture of relatively advanced and well-equipped larger vessels with inboard diesel engines (longliners), outboard powered open boats and small subsistence inshore boats, with a total of 800 Grenadian fishing boats and 1,500 fishers have been identified within the GD fisheries, of that 75% work full time (Baldeo, 2011).

Longline fishing is the most popular fishing method in GD. In the western areas, large fishing boats with inboard engines are mainly used for longline fishing to catch tuna for about three days in offshore and high sea areas (Baldeo, 2011). In eastern areas, such as Grenville, most fishing boats are smaller than those of the western areas. These smaller boats operate trolling, hand-line, or diving fishing on day trips to coastal and offshore areas. Most fishers target offshore pelagic fish, such as dolphin fish and kingfish, and demersal fish, such as snappers.

Tuna fishing is not popular in the eastern areas, because there is no large adult tuna on the Atlantic Ocean side. In the Grenadines' areas, large longline fishing boats operate in the high seas to catch tuna on trips lasting seven to ten days, and unload the captured tuna to the fish-processing factories at Grand Mal Bay (JICA, 2009). Small fishing boats operate trolling, handlines or diving fishing on day trips to catch offshore pelagic or demersal fish.

The high season for offshore pelagic fish, including tuna, skip jack, dolphin fish and kingfish, is from February/March to May/June. Coastal pelagic fish, including robin and jack, are mainly caught in beach seine nets in coastal areas of the island all year round (Finlay, 1996). Diving fishing with scuba is also popular around the island; mainly to catch lobster and conch shellfish.

6.2.6 Historical and Archaeological

There has been a growing interest among the population, in the preservation of buildings and sites of cultural value and places of interest to the people of that region. This has resulted in several conservation related initiatives lead by local community organizations, Government and Non-Governmental Organizations. The National Parks and Protected Areas are widely considered to be one of the most important of those initiatives. Petroglyphs on St. Vincent Island are well removed from the construction areas and will not be affected.

Wrecks and obstructions are found in the PAI. These have been identified and will be avoided during cable installation. These obstructions are identified in detail in the CRS (IT International Telecom 2018).

6.2.7 Social Context

The population of each of the islands within the PAI is concentrated on the coast with inland distributions along lowlands. The topography and limited amount of ideal development lands in GD and VC have resulted in mixed land use concentrated near the coasts and ports. Urban centers and settlements are located along the coast with some settlements extending inland in a linear land use pattern along flatlands extending inland and on both sides of roadways.

St Vincent and The Grenadines' population is approximately 109,897 persons and ranks 45th in population out of all commonwealth of nations member states (Figure 32) (Commonwealth Secretariat 2018). Population density has stabilized to approximately 282 individuals per square kilometer as of 2017 (Figure 33). Gender distribution is even across all age groups younger than about 70 years. The older population (> 70 years) consists of slightly more males than females (Figure 34 and Table 20). The population pyramid for VC suggest a future decrease in population because of an apparent decrease in younger-aged individuals (< 20 years) over the past ten years. This feature of the population might be offset by immigration, however.

Grenada's population is approximately 107,825 persons and ranks 46th in population out of all commonwealth of nations member states (Figure 32) (Commonwealth Secretariat 2018). Population density continues to grow in GD; as of 2017 the density was 317 individuals per square kilometer (Figure 33). Gender distribution is even across all age groups younger than about 70 years. The older population (> 70 years) consists of slightly more males than females (Figure 34 and Table 20). The population pyramid for GD suggests a stabilizing population growth because of relative level numbers of younger-aged individuals (< 20 years) over the past ten years (Figure 34).

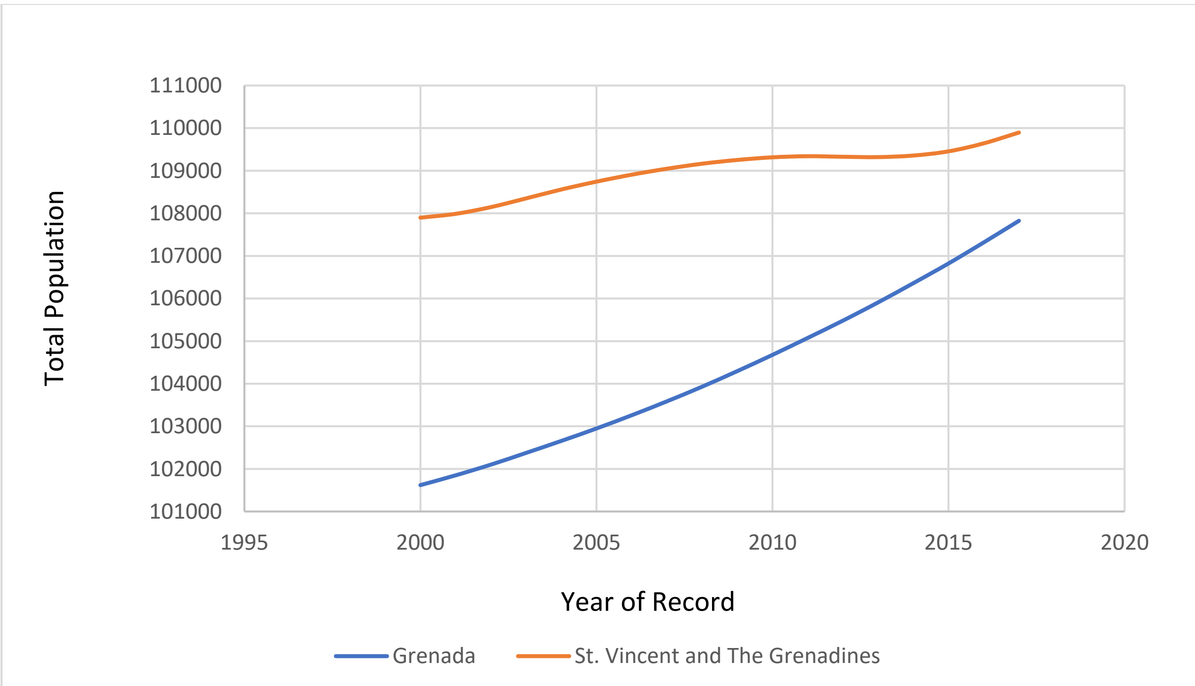


Figure 32. Total population between years 2000 and 2017 in VC and GD (World Bank 2018).

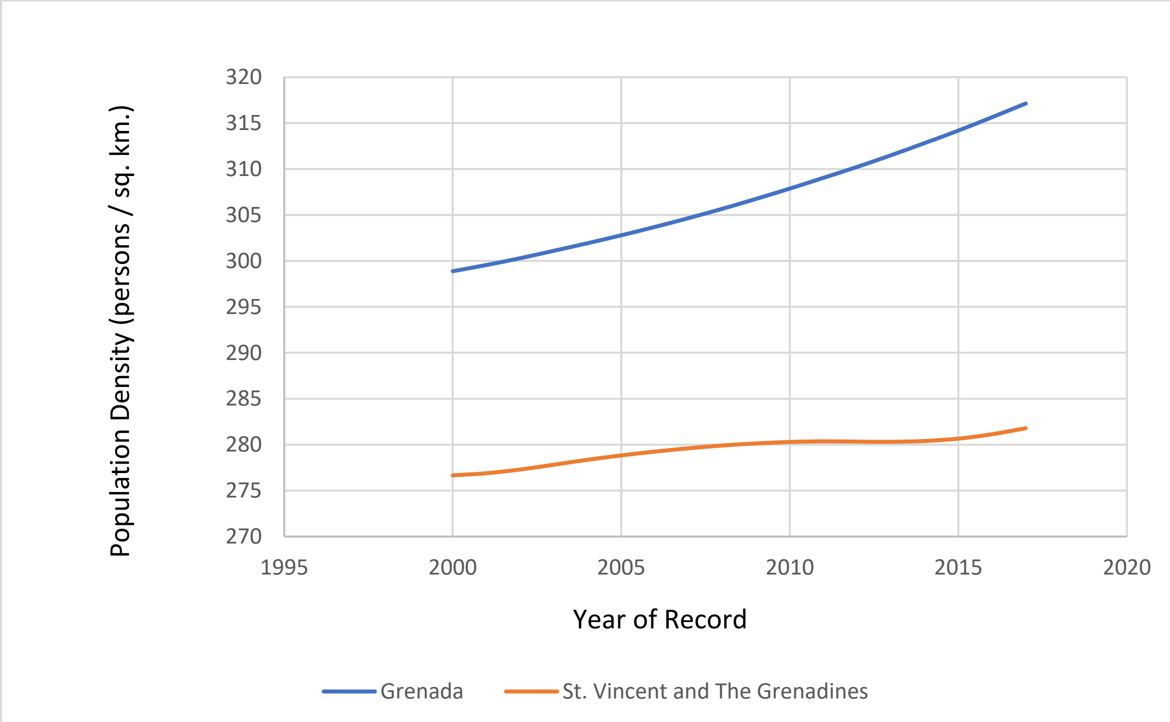


Figure 33. Population density between years 2000 and 2017 in VC and GD (World Bank 2018).

Table 20. Gender Distribution in 2017 in GD and VC (World Bank 2018)

Statistic	**GD**	**VC**
Population, female	53677	54480
Population, female (% of total)	49.8	49.5
Population, male	54148	55417
Population, male (% of total)	50.2	50.4
Population, total	107825	109897

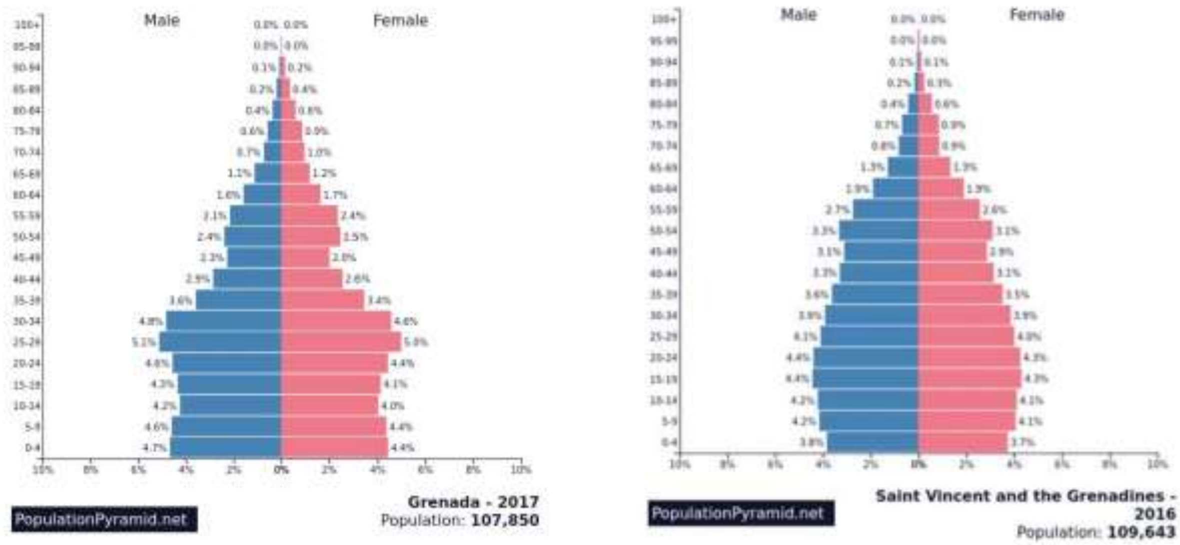


Figure 34. Gender distribution in GD and VC in 2017 and 2016 respectively. Graphs illustrate population growth trends in each country (Population Pyramid.Net 2018).

Tourism, agriculture and marine related activities are the main sources of livelihood for the people of GD and VC. None of those islands in the PAI has regarded any part of their population as vulnerable to the extent that it is necessary to make special provisions for them. Less fortunate/Vulnerable communities and individuals usually benefit from various social programs implemented by Government, religious and other organizations (Niles 2011)

The Blue Growth Coastal Master Plan proposed a number of coastal projects for GD (Government of Grenada 2016). On the island of Carriacou, the proposed projects include the Windward Boat Yard Marina & Village in Windward, Carriacou, the Hillsborough Fishing Village and Marina Resort in Hillsborough, Carriacou and the Lauriston Resort in Lauriston, Carriacou. On the main island of Grenada, the Levera Beach Resort. These projects have been identified as strategic development projects for GD and have been avoided in the landing site selection. The selected landing site at Carriacou has been located in collaboration with the Grenadian government. In addition, local qualified labor, heavy equipment and material resources will be used during construction of the BMH facilities at the landing sites; only the cable pull will require outside expertise.

Much of the shipping activity in VC and GD is inter-island ferry, cruise and cargo vessels (Figure 35). Ferry traffic runs daily to and from St. Vincent and Bequia. Other ferry service to Canouan, Mayreau, Mustique and Union Island runs three times a week. Grenadian ferries also run from Grenada to Carriacou and Petite Martinique through Osprey Lines Ltd.

Within the PAI there are eleven ports, they range from small ports that service yachts and ferries to larger ports that handle cargo and cruise ships. These ports are:

- Port of Kingstown, St. Vincent
- Chateaubelair, St. Vincent
- Port Elizabeth, Bequia, The Grenadines

- Mustique, The Grenadines
- Canouan, The Grenadines
- Mayreau, The Grenadines
- Union Island, The Grenadines
- Port of St. Georges, Grenada
- Port of Lance aux Épines (Prickly Bay), Grenada
- Port of Grenville, Grenada
- Tyrell Bay, Grenada

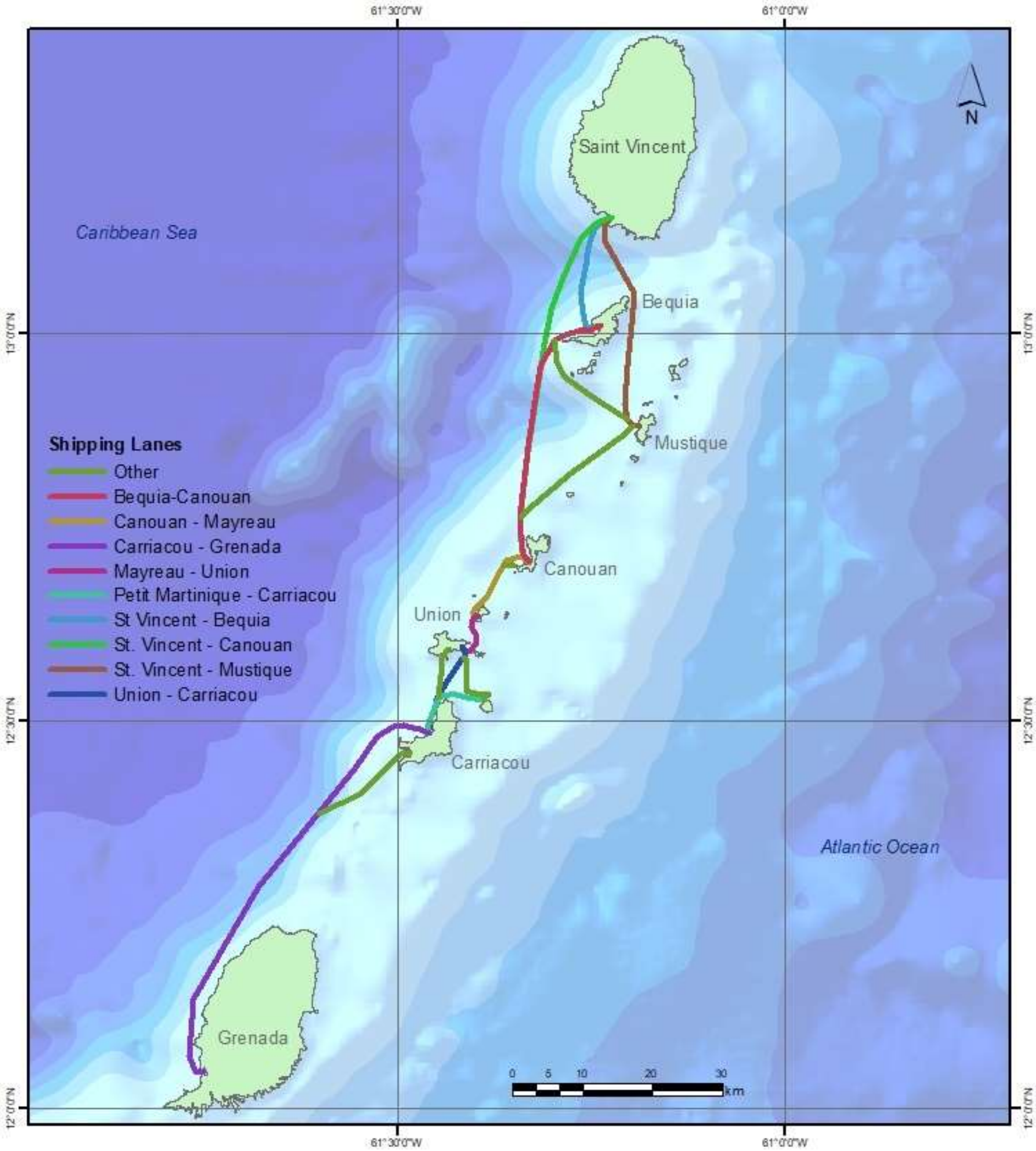


Figure 35. Generalized shipping lanes between the various islands in the PAI.

Anchorages exist in the PAI; the foremost of these were taken from the nautical charts and anchorage areas were established as a part of the multi-zone plan conducted in the Grenadines in 2012. These known anchorages have been considered during the cable route planning and BMH siting. The proposed project avoids the following known anchorages:

- On St. Vincent, Chateaubelair Bay, northeast of the concrete pier at the head of the bay is a major anchorage.
- On Bequia, Admiralty Bay is the principle anchorage. The town of Port Elizabeth stands at the head of the bay. Both the inner and outer part of the bay are used for anchorage, however, only small vessels are recommended to anchor within the inner portion. Yachts are recommended to anchor near the concrete jetty.
- On Mustique, large vessels can find anchorage, in depths of 66 to 89 ft. (20.1 to 27.1 m), about one mile west southwest of Montezuma Shoal, good holding ground.
- On Mustique, Grand Bay, on the west side of the island, provides anchorage, in depths of 72 ft. (21.9 m). A pier, 39 yd. (36 m) long, with a depth of 3.3 ft. (3 m) alongside, lies on the north side of the bay.
- On Canouan, Charleston Bay provides anchorage for large vessels off the entrance with the northwest extremity of the island in a depth of about 102 ft. (31.1 m). Small vessels can anchor closer inshore, but inside the 90 ft. (27.4 m) anchorages are limited due to a rapidly decreasing depth.
- On Carriacou, a number of anchorages have been identified in Hillsborough Bay.
- On Grenada, there are a few areas restricted to anchoring: Three are located on the south side of island, Grand Anse Bay, Prickly Bay and Pingouin Beach (Point Salines). Additionally, Tyrell Bay, both the inner and outer lagoon, located on the southeast of the island of Carriacou is prohibited to yachts and vessels used for residential purposes anchoring.

The Grenadines island chain is on the tentative list to become a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site because of the local indigenous people’s culture and history, maritime history (Indigenous Whaling, boat building and sailing), the island’s pre-Columbian history, diverse marine habitats and a rich marine habitat and biodiversity.

Both VC and GD rely heavily on tourism. There are a number of tourist sites and attractions throughout the study area. Holidays and special events are detailed in If possible, these dates should be avoided for shore end operations at the specified island. Difficulty retaining hotels and conducting the work could result in delays during these times. Holiday and special event dates to be planned around are included as reference in Table 21 and Table 22.

Table 21. GD Holidays & Special Events

Holiday	Date 2019
New Year	Jan 1
50th Spice Island Billfish Tournament	Jan. 23
Grenada Sailing Week	Jan. 27-Feb. 1
Grenada Sailing Festival Work Boat Regatta	Feb. 2
Independence Day	Feb.7
Carriacou Carnival	Feb. 11
National Heroes Day	Mar 14
Grenada International Triathlon	April (TBD)
Good Friday	Apr 19
Easter Monday	Apr 22
Labor Day	May 1
Grenada Chocolate Festival	May 31-June 7
Whit Monday	Jun 10
Fisherman’s Birthday	June 29
Carnival Monday	Jul 8
Carnival Tuesday	Jul 9
Emancipation Day	Aug 1
Carnival ‘Spicemas Festival’	Aug. 4-Aug. 14
Independence Day	Oct 27
Independence Day Holiday	Oct 28
Christmas Day	Dec 25
Boxing Day	Dec 26

Table 22. VC Holidays & Special Events

Holiday	Date 2019
New Year	Jan 1
Independence Day	Feb 7
Good Friday	Apr 19
Easter Monday	Apr 22
Bequia Easter Regatta	April 19 - 22
May Day	May 1
Canouan Regatta	Late May to early June
Whit Monday	Jun 10
Corpus Christi	Jun 20
Bequia Carnival	June (end of month)
Vincy Mass	End of June – Beginning of July
Bequia Fisherman's Day	July (the first Saturday after Vincy Mas)
Emancipation Day	Aug 5
Carnival (First Day)	Aug 12
Carnival (Second Day)	Aug 12
Thanksgiving	Oct 25
Nine Mornings (St. Vincent)	Dec 16 - 24
Christmas Day	Dec 25
Boxing Day	Dec 26

6.2.8 Social Survey

6.2.8.1 Summary and Conclusions

Respondents were randomly selected in several locations in VC and GD who now subscribe to internet services (Table 23). A description of the project was read to each respondent. The respondent was then asked to answer ten questions representing issues of interest to the respondents (APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS). The questions had between three and six multiple choice selections. Some respondents selected more than one interest item for some questions. Also, some selections were not tallied for unknown reasons. Thus, the total number of selections for each question vary. For example, some respondents had concerns about all environmental concern responses listed.

Table 23. Locations and number of responses for the CARCIP Social Survey.

Location	Total	Male	Female
Grenada			
Hillsborough – Carriacou, Grenada	25	16	9
Conference – Grenville, Grenada	52	26	26
St. George's (East), Grenada	26	16	10
St. George's (True Blue), Grenada	26	16	10
St. George's (West), Grenada	25	13	12
St. Vincent and the Grenadines			
Bequia Lower Bay	25	16	9
Canouan	25	15	10
St. Vincent, Arnos Vale	24	15	9
St. Vincent, Calliaqua	25	15	10
St. Vincent, Campden Park	25	14	11
St. Vincent, Chateaubelair	25	13	12
St. Vincent, Owia	25	14	11
Union Clifton	25	15	10

A total of 353 individuals were interviewed and a total of 4030 responses tallied. Gender distribution remained about 60% male / 40% female in both countries and throughout the responses (Table 23), with some exceptions noted in the discussion below.

Table 24. Gender and Country Breakdown of Survey Respondents.

Gender	St. Vincent and the Grenadines	Grenada	Combined
Male	1385 / 60%	1043 / 58%	2428 / 59%
Female	933 / 40%	769 /42%	1702 / 41%
Total	2318 / 100%	1812 / 100%	4130 / 100%

All responses to all ten questions were tallied. Each respondent had the option of selecting more than one response. The data were analyzed by collecting the responses by country and question and then calculating the percentage of the total gender selecting the response item. Thus, the percentage-based analysis normalizes the 60/40 split between respondent gender. The percentage data were evaluated for differences relative to the question, gender and country. These data are displayed in the next section (Section 6.2.8.2) with regard to each question.

A second evaluation considered the most popular selections identified. Those selections from more than half of the respondents were ranked accordingly and presented in Table 25 as “simple majority” preferences.

Table 25. Simple majority preferences (> 50%) over all questions in the CARCIP Social Survey. Parenthetical Information Includes the Question Number and Choice selected.

Preferred or Desired Issue (Question response ID)	**Total selections**	**Selections out of total respondents n=354**
Lower internet service price (2c)	349	99%
Other/None (7d)	327	92%
Other/None (10d)	283	80%
Coral protection (3b)	278	79%
Small fiber optic cable buried on the beach (6c)	273	77%
Yes, probably for the better (4b)	253	71%
Fewer interruptions / less down time (2b)	247	70%
Improved internet speed (2a)	237	67%
I am not satisfied (1b)	220	62%
Nearshore sea floor habitats (3d)	186	53%
No (8b)	178	50%

The simple majority evaluation suggests two conclusions:

1. There is a broad dissatisfaction with existing internet services and hope for future improvements with the CARCIP project. A large majority (40%) of respondents desire lower internet pricing. Others desire improved speed and fewer interruptions. A majority of respondents have experienced a general dissatisfaction with existing internet service (62%) and thought the project would improve their lives in general (71%). Racial, religious or gender discrimination with internet services does not appear to be a problem for any respondent answering Question 10 (Section 2.10). Eighty percent of the total respondents answered this question and all of them selected 10d, Other, indicating no experience with the listed discrimination issues.

2. The environmental focus of about half of the population is the nearshore marine and beach terrestrial environments; what can be seen and experienced on and near the beach. Coral protection is the main interest item.

    a. Coral protection (66%) and nearshore sea floor habitats (55%) were primary environmental concerns.

    b. There is some concern about the construction of the beach landing and beach manhole on the beach. Respondents were also concerned about the post-construction presence of a fiber optic cable and beach manhole buried on the beach; the source of this concern is unknown. While 77% of respondents were concerned about the presence of the cable, fewer than half reported their fears were put to rest by an explanation of the size and shape of the cable. Most of the respondents (64%) reported a change of mind after hearing the cable description.

Other issues were also identified as important when considering each question independently. When asked what the ESIA should study, about half of the question respondents indicated nearshore habitats, while the other half were satisfied with what the authors of the ESIA will do.

No respondents were interested in seeing analysis of social issues, air/water quality, or deep ocean sea floor habitats. Regarding potential conflict with ongoing human activities, respondents were broadly of the same mind with a minor country variation regarding recreation (listed below).

No additional mitigation was repeatedly indicated, either from selections or "write in" suggestions.

Overall, there were few gender or country variations. Most males and females selected options similarly and there were few variations between respondents from either country. The following list identifies other, less dramatic but notable differences by gender or country:

- Question 1: Existing Services ....Males are more dissatisfied than females.
- Question 2: Improvement.............Females wish a lower price more than males.
- Question 4: Expectations..............Females expect no change more than males and males expect change for the better more than females.
- Question 8: Cable understanding ..Grenadians reported less concern than Vincentians after understanding the cable size.
- Question 9: Potential conflict........Grenadians are slightly more concerned about recreation than Vincentians.

6.2.8.2 Interview Question Results

Question 1 - Existing Services

Most responses to this question, about 65%, expressed dissatisfaction with the existing internet services, but only about 34% expressed satisfaction. Several respondents had no opinion (Table 26 and APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS). We conclude the existing internet services are falling short of expectations. In general, men appear to be more dissatisfied than women; this discrepancy being more pronounced in GD than VC. The underlying cause of gender variation is not clear from the data at hand.

Table 26. Opinion of existing internet services.

Question and Response Choice	Selection	Percentage of total selections
What is your opinion of the current internet services you have now?		
a. I am satisfied	131	37
b. I am not satisfied	220	62
c. I have no opinion	3	1
Total	354	100

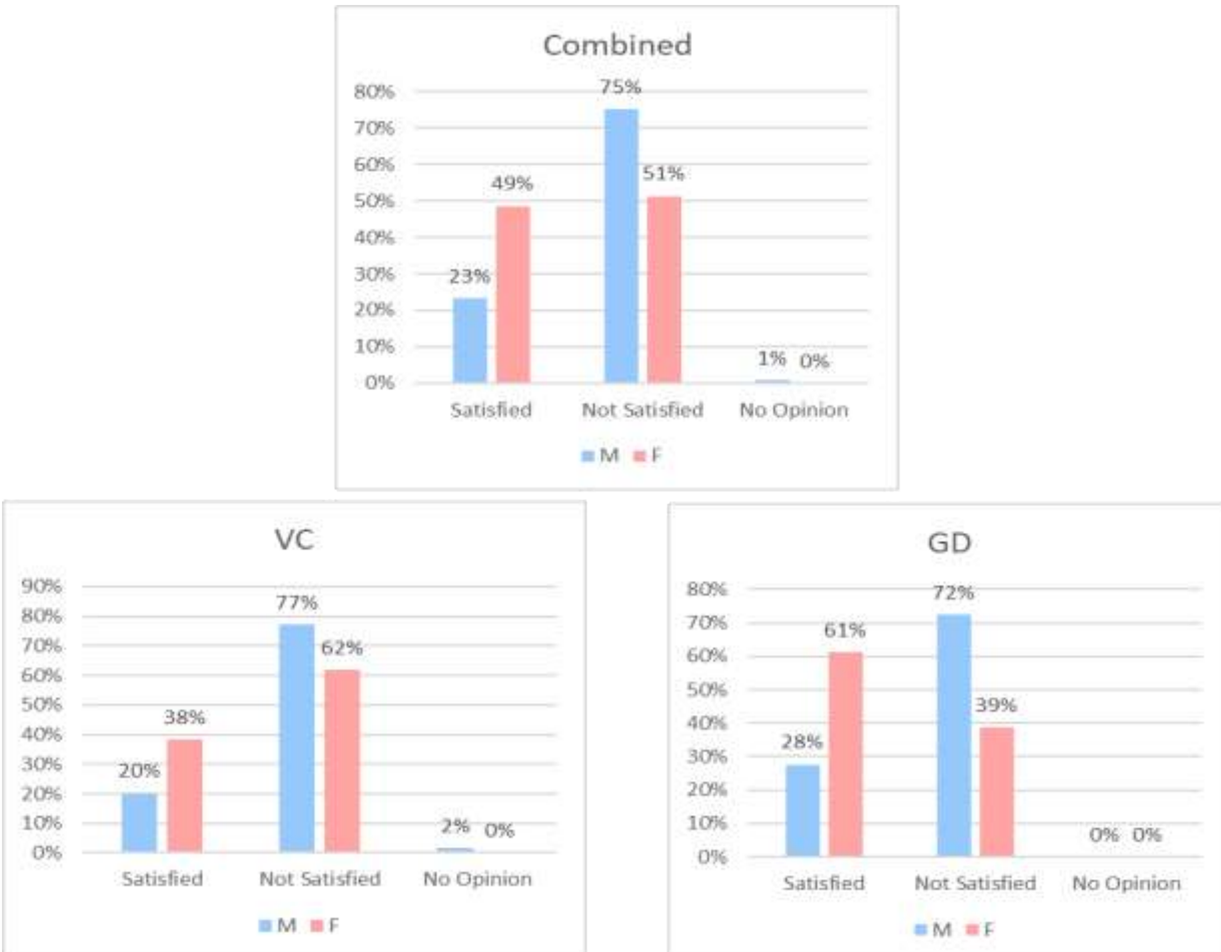


Figure 36. Opinion of existing internet services by country group and gender

Question 2 - Desirable Improvement

Perhaps the most important question, all but three respondents desire improvement to existing internet services. The most popular improvements were lower internet service price (40%), followed by fewer interruptions (30%) and, finally, improved speed (29%). Responses were statistically similar for the selections for fewer interruptions and improved speed and are equally desirable (Table 25, Table 27, and Figure 37). Internet speed is likely to be important to those who are familiar with computer operations because they would have experienced more modern cable internet speeds. Men appear to be more interested in lower pricing than women, but relatively more women appear to prefer improved speed and fewer interruptions.

Table 27. Desired internet services improvements.

Question and Response Choice	Selection	Percentage of total selections
What would you like to see improved in your current internet services		
a. Improved internet speed	251	29
b. Fewer interruptions and less down time	261	30
c. Lower internet service price	349	40
d. I have no opinion	3	0
Total	864	100

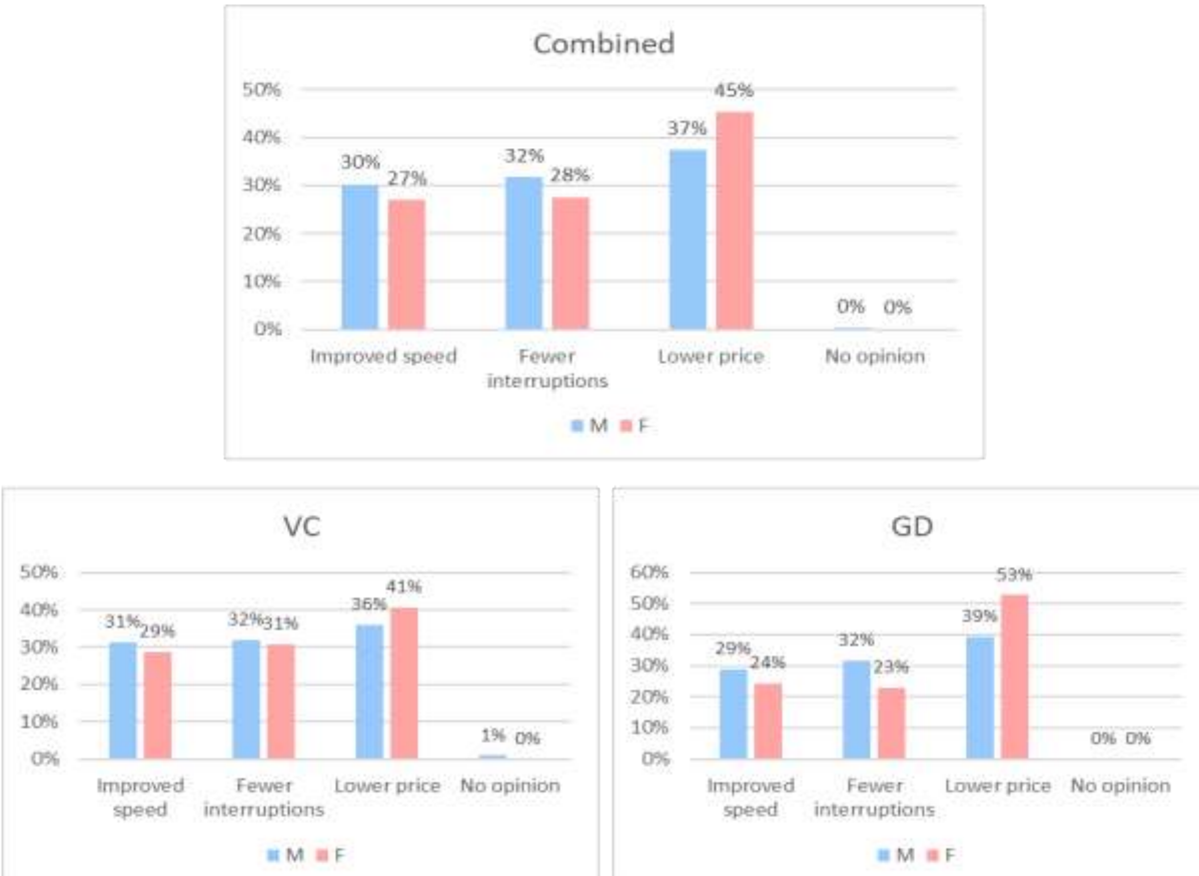


Figure 37. Desired internet services improvements by country group and gender

Question 3 - Environmental Concerns

Coral protection is the primary environmental concern at construction sites because the majority of respondents selected this option (66%). Sea turtle conservation is also important, but for a minority of the population because a minority of respondents selected this option (23%). Water quality, hazardous material spills and other issues appear to be not important because they were selected very little (Table 28 and Figure 38). Men and women selected responses similarly.

Table 28. Primary Environmental Concerns at Construction Sites

Question and Response Choice	Selection	Percentage of total selections
What are your primary environmental concerns at the construction sites, if any?		
a. Turtle conservation	101	23
b. Coral protection	285	66
c. Water quality	30	7
d. Hazardous material spills	2	0
e. Other/None	13	3
Total	431	100

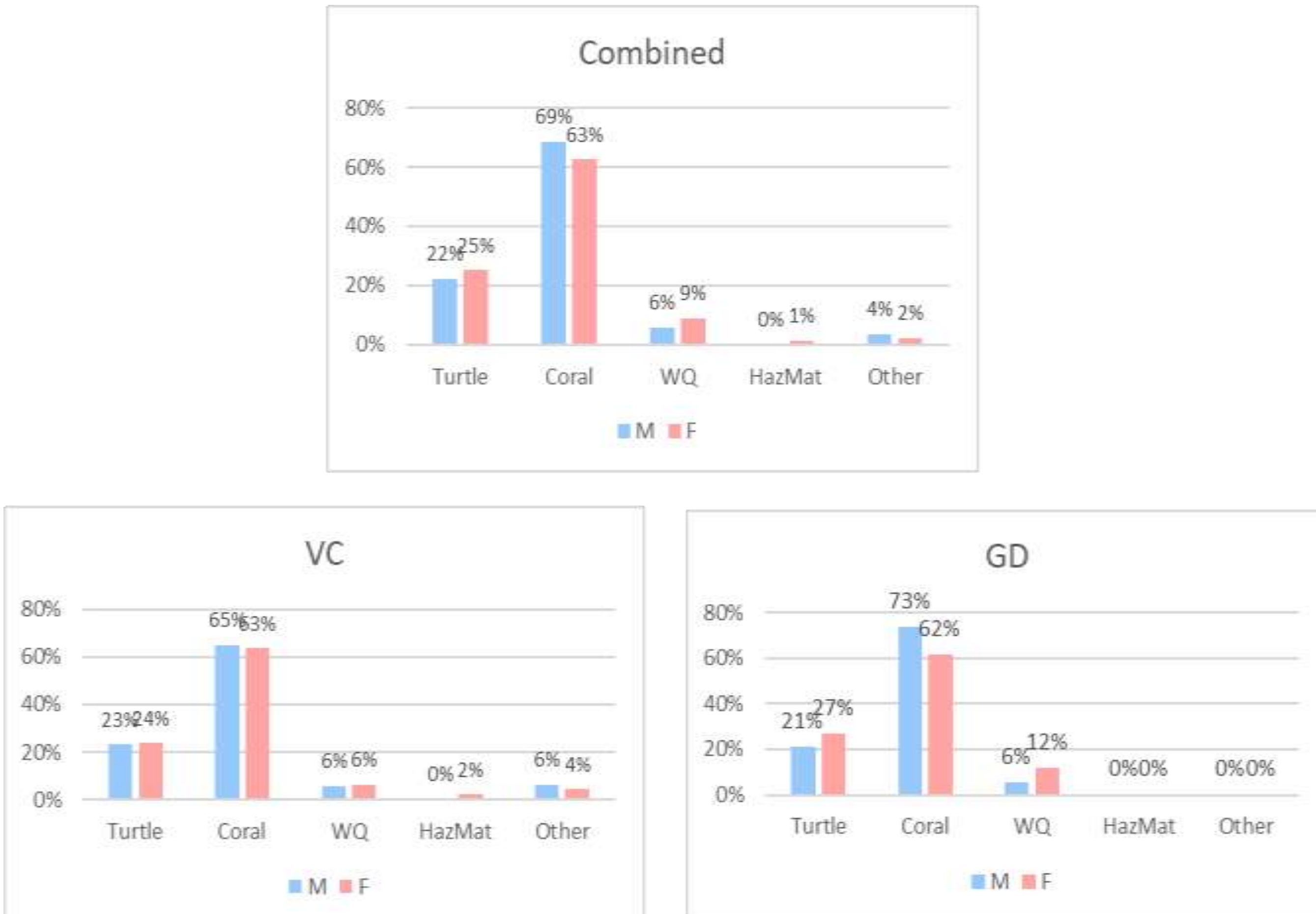


Figure 38. Primary environmental concerns at construction sites

Question 4 - Expectation for Post-Project Change

In general, the population expects improvements from this project. A large majority of respondents (72%) expect the project will improve their lives. A minority of the population does not expect change to their lives (Table 29 and Figure 39). Only one respondent concluded there would be change for the worse; several did not have an opinion. Males were more optimistic than females in their expectation for the better. Females tended to expect no change.

Table 29. Expectations for Post-Project Change

Question and Response Choice	Selection	Percentage of total selections
Do you expect this project would change your life in any way?		
a. No, Not at all	93	27
b. Yes, probably for the better	252	71
c. Yes, probably for the worse	1	0
d. I don't know	6	2
Total	352	100

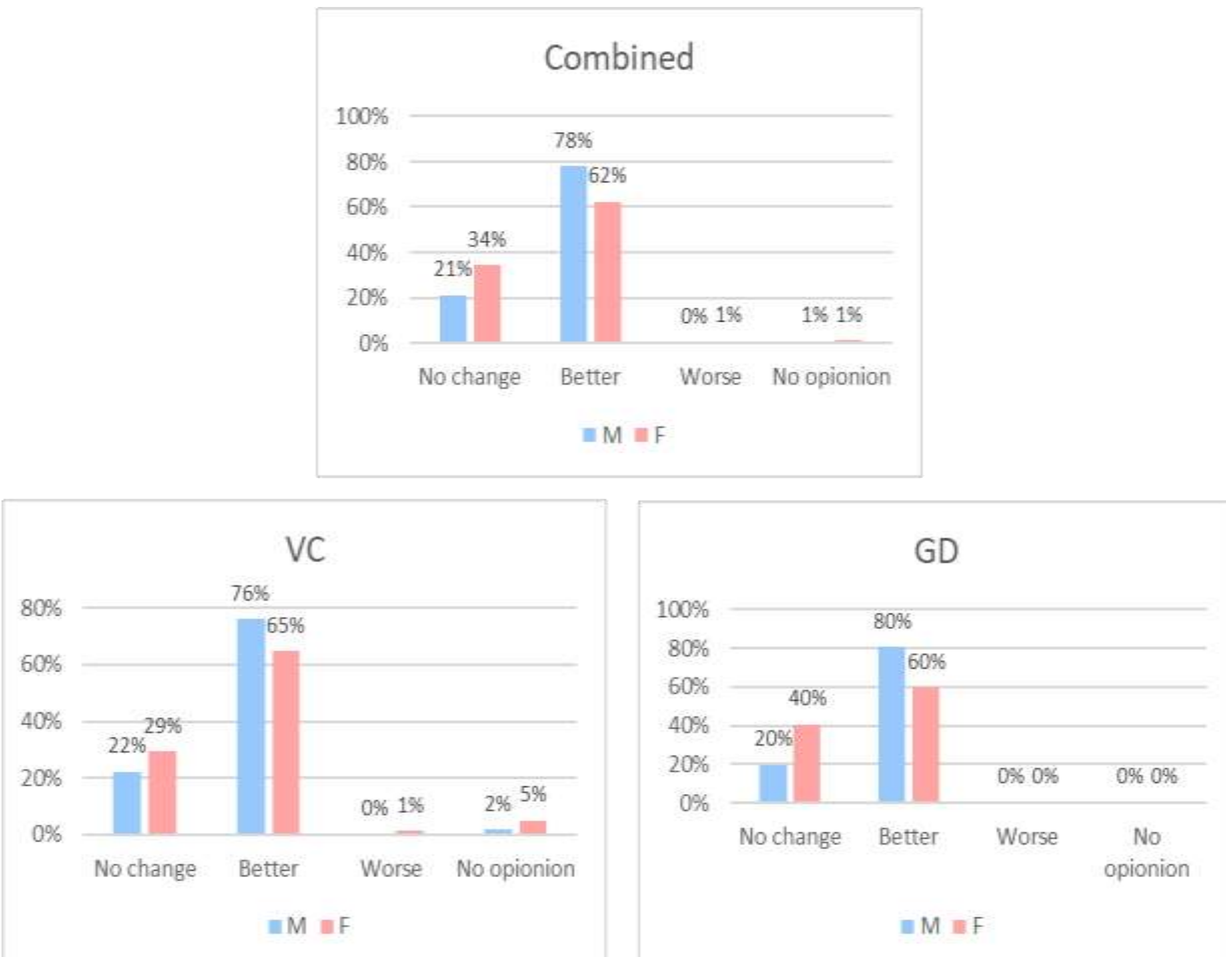


Figure 39. Expectations for post-project change

Question 5 - Important ESIA Issues

When asked what study topics would be desirable in the ESIA, about half of the respondents, (53%) selected nearshore habitats should be studied in the ESIA. The other half (47%) thought they would be satisfied with what the authors of the ESIA would do (Table 30 and Figure 40). Interestingly, no respondents were interested in seeing an ESIA analysis of social issues, air/water quality, or deep ocean sea floor habitats. Consistent with the responses to question 3, the responses to this question suggest that of those interested in environmental issues, most would prefer to see ESIA consideration of nearshore environments over other potentially affected environments such as socioeconomic or deep ocean marine. Men and women selected similarly in both countries.

Table 30. Important ESIA Issues

Question and Response Choice	Selection	Percentage of total selections
What could we study in our ESIA that would help you understand the environmental impacts of this project?		
a. Social issues	4	1
b. Air or water quality	0	0
c. Deep ocean sea floor habitats	0	0
d. Nearshore sea floor habitats	196	55
e. I'm satisfied with what the authors will do	155	45
f. Other/None	0	0
Total	355	100

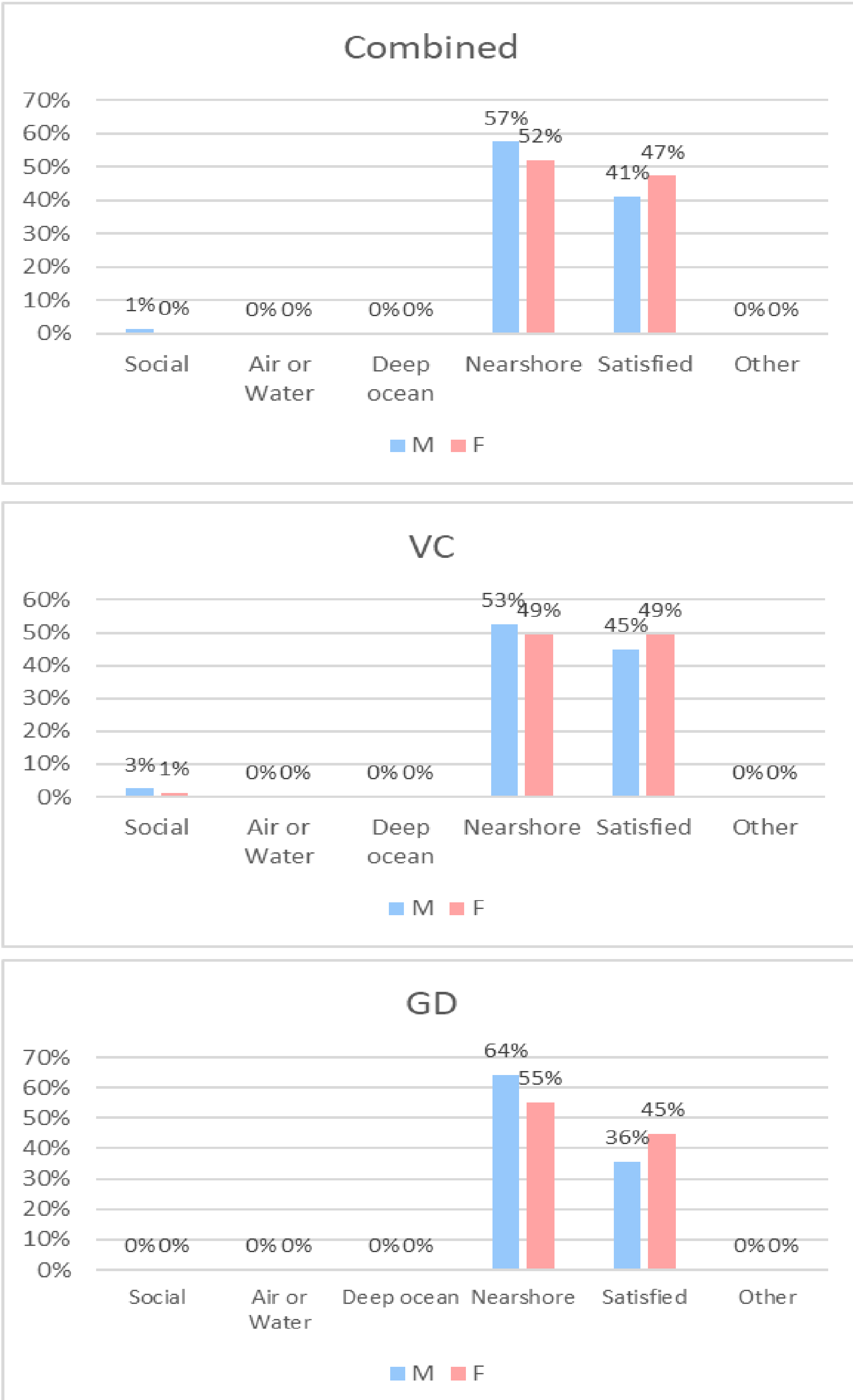


Figure 40. Important ESIA issues

Question 6 - Anticipated Impact Concerns

A large majority of the population is concerned about the idea of a fiber optic cable buried on the beach (77% in this study) and some are concerned about a manhole buried on the beach (23% in this study). The presence of workers installing the cable by hand does not appear to be a problem. Only one respondent was concerned with a large cable laying vessel in sight of land (Table 31 and Figure 41). Men and women selected similar options.

Table 31. Anticipated Impact Concerns

Question and Response Choice	Selection	Percentage of total selections
Do any of these anticipated impacts bother or upset you?		
a. Boats and Divers near shore laying cable by hand	0	0
b. Large cable laying vessel in sight of land	2	1
c. Small fiber optic cable buried underground on the beach	267	77
d. Beach manhole buried above sea level.	80	23
Total	349	100

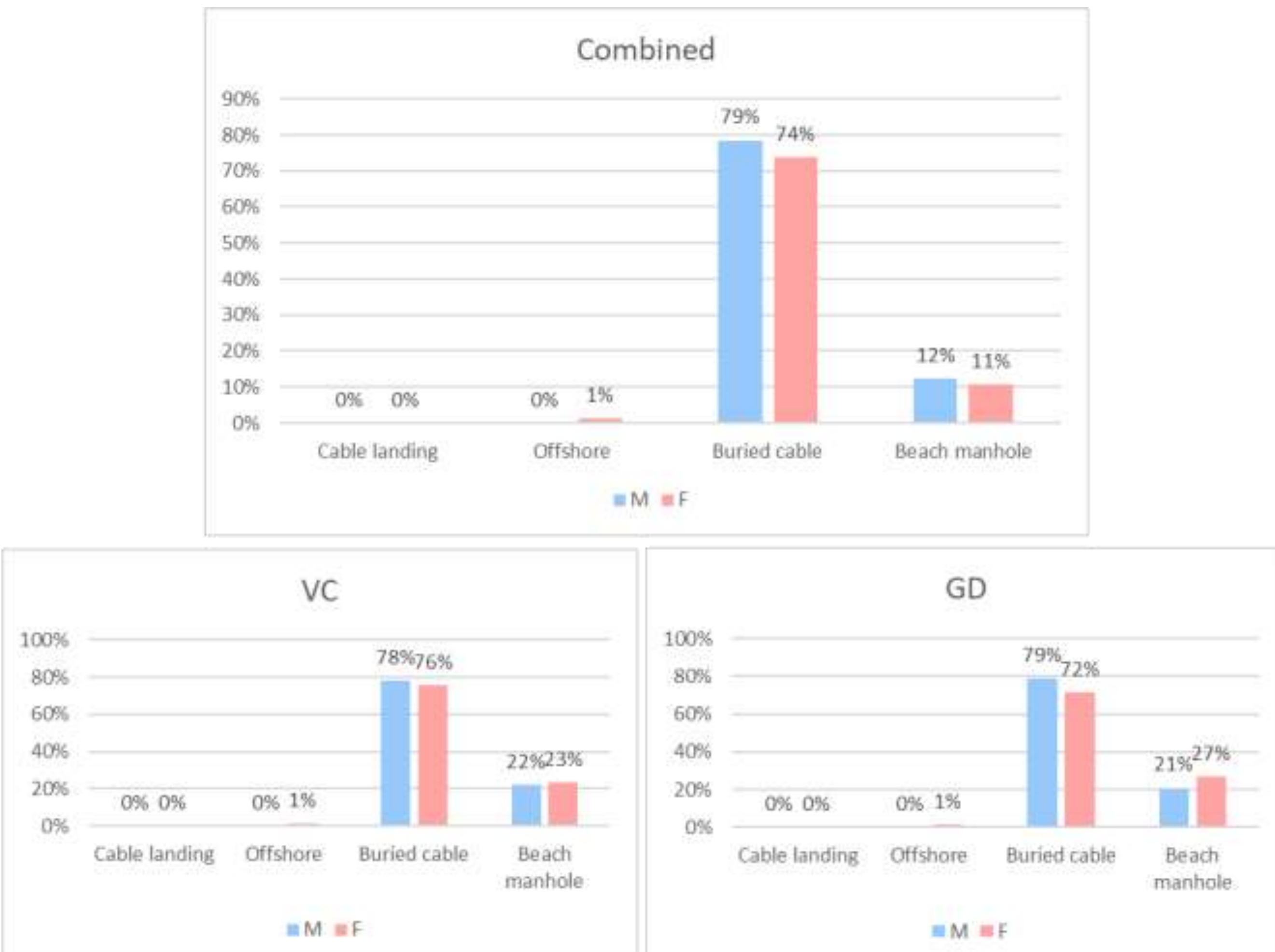


Figure 41. Anticipated impact concerns

Question 7 - Mitigation Measures

Respondents indicated no preference for specific mitigation measures by selecting “other” (88%). There were no suggestions for mitigation. Some respondents believe that shortening the duration of construction might help reduce impacts (Table 32 and Figure 42). There are no meaningful gender differences, but some VC respondents selected reduced time and changed location as mitigation measures.

Table 32. Optional Mitigation Measures

Question and Response Choice	Selection	Percentage of total selections
In Question 6, If you are bothered by any of the selections, how could we minimize or avoid such impacts?		
a. Shorten the presence of marine cable laying equipment at the landing sites	3	1
b. Shorten the duration of construction on the beach	21	6
c. Change the landing site location	18	5
d. Other	309	88
Total	351	100

Figure 42. Optional mitigation measures

<u>Question 8 - Cable Size and Shape Understanding</u>

A simple majority (64%) of the respondents' concerns about the fiber optic cable buried on the beach were allayed after clarification of the size and shape of the cable. About a third of respondents retained their original opinion (Table 33 and Figure 43). There are no appreciable gender differences. However, more GD respondents changed their minds than VC respondents.

Table 33. Concern After Understanding the Size and Shape of the Fiber Optic Cable

Question and Response Choice	Selection	Percentage of total selections
After seeing a picture or a sample of submarine internet cable, are your views about question 6 changed in any way?		
a. Yes	309	64
b. No	166	35
c. No opinion	4	1
Total	479	100

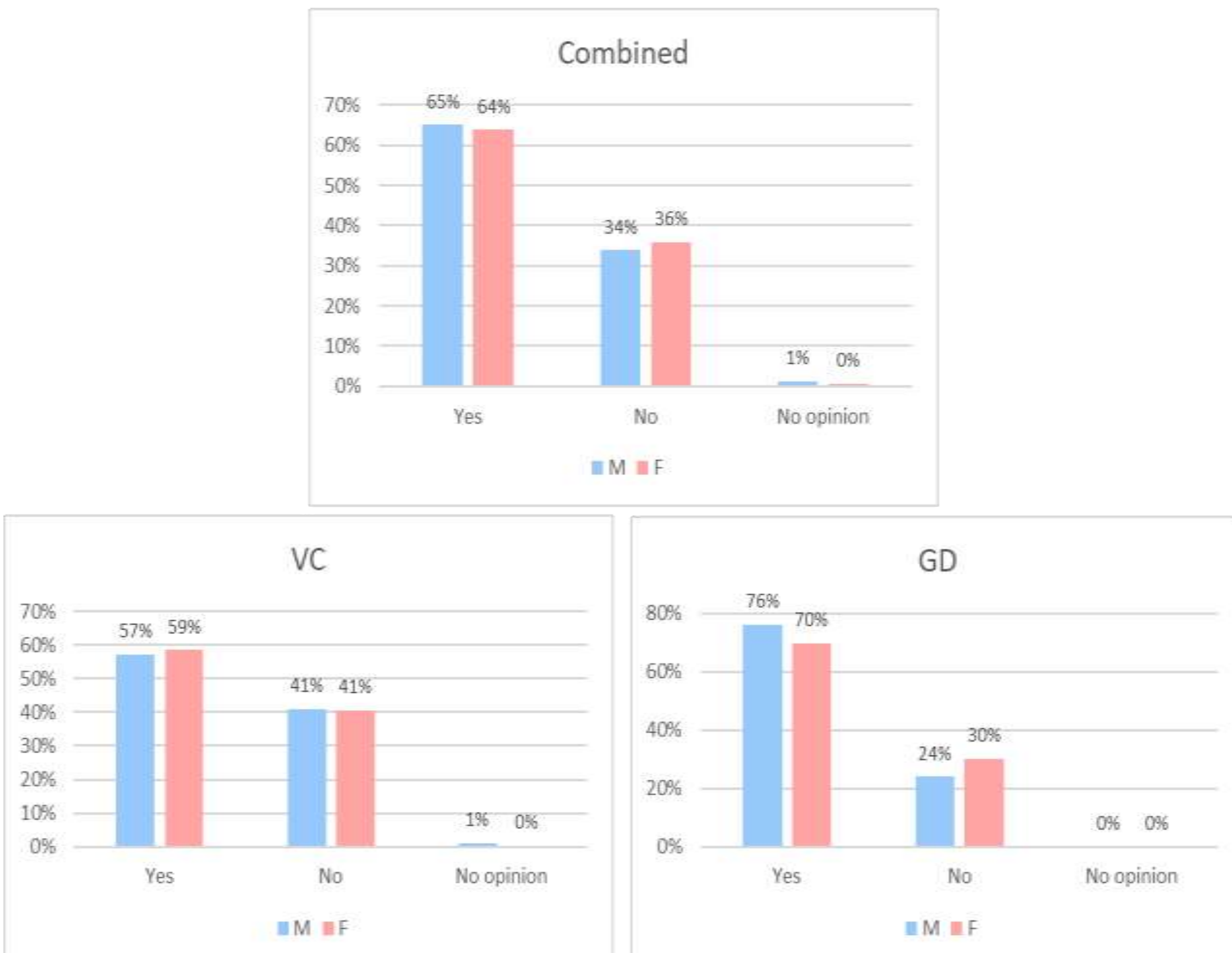


Figure 43. Concern after understanding the size and shape of the fiber optic cable

<u>Question 9 - Conflict with Ongoing Human Activities</u>

No one specific human activity stands out as causing a potential conflict with the project. Respondents were primarily concerned with recreation (38%) and tourism (32%), but less so with conservation (17%) and "other/none" (12%). Only two respondents were concerned with housing as a potential conflict and five respondents were concerned with commercial uses as a potential conflict. Gender and country responses are not appreciably different (Table 34 and Figure 44).

Table 34. Conflict with Ongoing Human Activities

Question and Response Choice	Selection	Percentage of total selections
Are you familiar with any of the proposed landing sites? What kind of ongoing activities might conflict with installing a cable and beach man hole at these sites?		
a. Housing	2	0
b. Recreation	167	38
c. Commercial	5	1
d. Conservation	73	17
e. Tourism	137	32
f. Other/None	53	12
Total	437	100

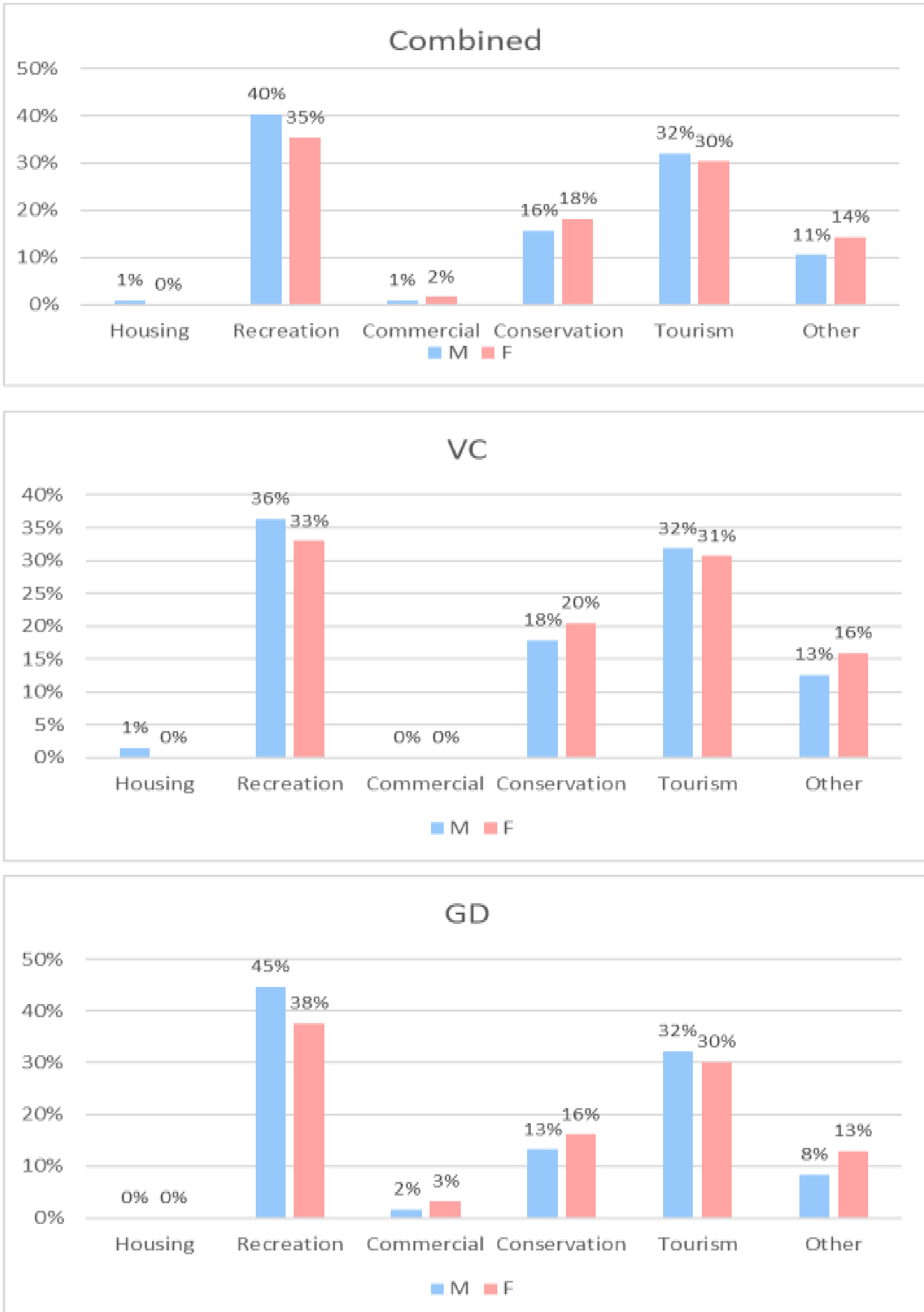


Figure 44. Conflict with ongoing human activities

Question 10 - Racial, Religious or Gender Discrimination

No respondent indicated any experience with discrimination related to internet services. All respondents who participated in this question selected other/none (Table 35 and Figure 45). There are no gender or country variations.

Table 35. Racial, Religious or Gender Discrimination

Question and Response Choice	Selection	Percentage of total selections
Are you aware of any internet service discrimination due to your gender, race, or religion?		
a. Gender	0	0
b. Race	0	0
c. Religion	0	0
d. Other/None	283	100
Total	283	100

Figure 45. Racial, religious, or gender discrimination

6.2.9 Public Consultation

Public meetings were held in VC and GD to apprise the public of the proposed project and to entertain questions of clarification and obtain comments on the project. At each meeting the project was described and the ongoing ESIA preparation was discussed. See APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS for meeting notes and attendance records.

At each of the public consultation meetings, the respective government official described the overarching concepts of the CARCIP program and the government's views. Digicel representatives then discussed the subject of this ESIA: Lot 3 of the CARCIP program. The agenda included discussion of the selection of the cable route and landing sites; government review and approval status; and the grievance redress program. Digicel and the audience engaged in dialogue about the details of the CARCIP program. Four public consultation meetings were held in coordination with the respective government representatives: one in VC, two in Grenada and one in Carriacou.

The VC public consultation was held in Kingstown on January 14, 2019, and was attended by a total of 50 persons. The meeting was also broadcast on public radio. During the question and answer session, the audience asked about the details of internet services to be provided. Comments included two comments addressed to the VC government about the structure of the post-construction internet services and a short discussion about existing subsea cable connections to St. Lucia, St. Martinique, etc. Both of these comments are outside the scope of this ESIA. No ESIA-related comments were presented at this meeting.

The GD public consultation meetings included a public consultation meeting in Grenville Bay on January 28, 2019, Hillsborough on January 29, 2019 and a public consultation meeting in Conference, Grenada on January 31, 2019.

The Grenville meeting was held at the Fish Market and involved mostly fisher people. No major concerned where raised by the people of Grenville, but they asked that the proponent provide more notice of the project to residents, especially any news about jobs.

The Hillsborough, Carriacou, meeting was attended by 18 persons. The most vocal concerns were expressed by a single Carriacou fishermen and his belief that the fishing community would eventually be banned from fishing within the vicinity of the cables. He also adamantly believed there was no real benefit for his fellow fishers and farmers from the installation of the fiber optics. Other concerns that were expressed by the community and further explained by the CARCIP team included how the use of microwave technology would greatly be reduced and electromagnetic fields from the cable itself is much lower than what people realize. Additionally, in Hillsborough, a group of people highlighted the potential risk to turtle nesting activities. Digicel Group agreed at the meeting to allow them to do a turtle egg sweep prior to cable landing activities.

The Conference/Tivoli, Grenada, meeting was held on January 31, 2019, and was attended by 23 persons representing the local communities of Tivoli, La Poterie, Conference and Hermitage, including a representative from the school at which the meeting was held, Tivoli Roman catholic School. Although some of the initial line of questioning was directed at the government representatives due to lack of substantial prior awareness of the CARCIP project, much of the dialogue was a positive engagement in which the audience wanted to understand the social benefits of the cable installation (and to some degree how this reduced reliance on microwave transmission of telecommunication services). There were no environmental issues raised. The audience expressed a desire to continue such engagement in the time before installation operations to minimize any impact to local homeowners and users of the road leading to the Conference landing. The CARCIP team believed the audience understood the overall benefits of the CARCIP project, especially to the local schools and the future generations of the local area.

In addition to the public consultation meetings, the CARCIP team met with fishers at Grenville on January 28, 2019. This focused-topic meeting was attended by 12 persons representing local fishing and farming interests as well as a representative from the Wider Caribbean Sea Turtle Conservation Network (WIDECAST).

The CARCIP team welcomed the participation of the part-time fishers their numerous and well considered questions. Many of these questions were based on a lack of understanding of how the cables work (e.g., Why not use satellites?), where they were going to be located (e.g., Outside of any MPA's), and their sensitivity to marine habitats (e.g., the small size of the cable, eventually self-burying). Based on these inquiries, along with other questions presented by the community revealed the need to better educate the community on the basics of how fiber optics work, their size compared to other cables, the minimal impacts they have on the environment and the overall benefits fiber provides.

In addition to the foregoing, this ESIA will be published and available to the public upon completion. Digicel representatives will provide contact information to obtain a copy of the document.

6.3 Existing Conditions at BMH Landing Sites

The existing conditions at each BMH landing site were first identified through site visits including terrestrial and marine nearshore. The physiographic assessment is based on accessible literature that was reviewed to identify any site-specific characteristics such as underlying geology and soil types within the relevant watershed in which the BMH is located. The terrestrial assessment includes information about general land use and vegetation types in the area and identification of specific species within 11 yd. (10 m) of the BMH. Local avifauna observed during field visits are noted along with any species known to frequent the area.

The marine ecologic assessment is a key component of the EISA and therefore the methodology is more complex and further described, however, only the Grenadine islands were assessed, primarily due to logistical and time constraints. Marine assessments are qualitative and based on available information.

Typical reef morphology in the Caribbean has been described as comprising a back reef or shallow lagoon, a reef crest and a forereef with the forereef often being dominated by spur and groove formations (Goreau and Land 1974). Therefore, for purposes of the marine ecologic assessment, the backreef (lagoon) and the fore reef zones are assessed.

While habitat types have been previously assigned through the MarSIS project over a large scale, habitat types are first quantitatively identified by laying two 50m transects within each of the two zones to identify percentages of: (1) bare sand, (2) submerged vegetation (further identified as sparse, medium or rich seagrass and / or calcareous algae); (3) colonized reef/hard bottom and (4) coral rubble. Secondly, the percentage of live coral coverage is identified by measuring directly under the transect tape the length of the coral and identifying the species. (This allows identification of any species listed under the IUCNs Red List).

Population sizes of key indicator species *Diadema antillarum, Strombus gigas, Panulirus argus and P. guttatus* are counted within 1m on either side of the transect tape. Fish assemblages (variety and abundance) of target fish – those species identified in the Atlantic Gulf Rapid Reef Assessment (AGRRA) methodology – which includes angelfish, butterflyfish, grunts, parrotfish, grouper, snapper, surgeonfish, leatherjacket, filefish, triggerfish and durgon.

Supplemental information, including photos and water quality data can be found in the APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT. Parameters selected for this assessment (nitrates, phosphates, pH, salinity and temperature) were selected simply as rapid assessment indicator to help detect potential causes for any observed degradation issues. No long-term data was made available for comparison over time and is therefore not analyzed further than single quantitative values.

6.3.1 Conference (G3), Grenada

6.3.1.1 Physiography

Conference Bay (Figure 13) is framed by underlying Pleistocene age reworked volcanics overlaid with more recent alluvial and superficial deposits. Collectively, this forms the 645 ac. (261 ha) Conference watershed, a gently sloping catchment with low hills and a very low susceptibility to landslides (VanWesten 2016).

In Grenada the dominant soil-forming factors are climate and topography. The Conference Bay area has a marked spatial distribution of lower rainfall and temperatures here caused by the interior mountain ranges. With other, less mountainous sites, a drier climate and gently sloping hillsides, soils are predominantly clay within the location of the BMH.

6.3.1.2 Terrestrial

Land coverage within the Conference watershed includes 67 ac. (27 ha) of mangrove wetland forest dominated by red mangroves (*Rhizophora mangle*) with black mangrove (*Avicenna germinans*), and white mangrove (*Laguncularia racemosa*). Mangroves stretch to the north northwest parallel to Meadow Beach, starting approximately 11 yd. (10 m) north of a man-made clearing for beach access off the ancillary road behind the beach berm. Agricultural lands outside of the mangrove forest back the rest of a coconut palm-fringed shoreline (Helmer, Kennaway et al. 2008).

Coastal flora near the beach manhole is dominated by seagrape trees (*Coccoloba uvifera*), coconut trees (*Cocos nucifera*), yellow balsam (*Croton flavens*) as well as several stands of beach naupaka (*Scaevola sericea*).

Meadow Beach fronting Conference Bay is composed of volcanic sediments, extending over 875 yd. (800 m) and bounded by Artiste Point to the north and a small rock outcrop on the south near the ancillary road leading to the beach. Historically, this beach was most likely much wider than it is today. Reports in the literature point to extensive sand mining along the east coast of Grenada subsequent erosion in the late 1980’s (Cambers 1987) (IRF and CCA 1991a). The beach was once a major leatherback nesting beach (Eastern Caribbean Natural Area Management Program 1980). In 2006, densities were identified to be 25-100 nests per season but located further south (N 12°09’12.69” / W 61°36’27.92”) of the BMH (Duke University OBIS-SEAMAP 2018). However, nesting densities are currently extremely low, (less than 25 nestings per season) most likely a result of continued beach erosion caused by historical sand mining. The 2018 nesting seasons alone had only 4 nesting leatherbacks with none surviving (Kate Charles, WIDECAST Country Coordinator, personal communication, 14 Sept. 2018).

Opportunistic bird observations were made during the field visit with only two species of birds observed while onsite, the Semipalmated sandpiper (*Calidris pussilla*) considered to be near threatened under the IUCNs Red List and the Magnificent frigate bird (*Fregata magnificens*), considered to be a species of least concern. (Refer to Table 19 for a full listing of avifauna found in Grenada).

6.3.1.3 Marine Habitat & Fisheries

Conference Bay’s exposure to the North Atlantic wave climate can be considered a high-energy environment. The broad shallow shelf (1640 yd. [1500 m] of depths less than 66 ft. [20 m]) fronting the beach allows for strong wave dissipation over the shallow shelf, with added shoreline protection from the system of fringing and patch reefs, interspersed with seagrass beds found within the bay.

Video captured during the dive surveys along the cable route revealed fore reef benthic habitats of coarse sand with patches of high macroalgal coverage (75%), sponge and little (<5%) to no live coral coverage. Small corals are found growing on large boulders which provide the only suitable substrate for coral growth in this area (Figure 46). The low number and diversity of fish species observed are consistent with the uniform bottom. No commercial species observed.

Figure 46. Representative bottom photographs, nearshore at the Conference landing site

The *Greater Grenville Area Land Use Plan* prepared by the Physical Planning Unit identified approximately 371 acres (150 hectares) of Conference Bay seafront that should be dedicated for conservation purposes (Turner, 2009). According to the World Database on Protected Areas (WDPA) (Protected Planet 2019), the proposed "Conference Bay Priority Area of Interest" encompasses Conference and is bounded by La Poterie to the north and Grenville to the south, covering an area of 4.3 sq. mi. (1134 ha) (UNEP-WCM and IUCN, 2019). At the time of this study, the proposed protected area had not been declared.

Grenada's most important fishery targets coastal pelagic species (Baldeo, 2011) and includes:

- Yellowfin tuna (*Thunnus albacares*)
- Blackfin tuna (*Thunnus atlanticus*)
- Albacore (*Thunnus alalunga*)
- Blue marlin (*Makaira nigricans*)
- Swordfish (*Xiphias gladius*)
- Atlantic sailfish (*Istiophorus albicans*)
- Dolphinfish (*Coryphaena hippurus*)
- Wahoo (*Acanthocybium solandri*)
- King mackerel (*Scomberomorus cavalla*)
- Bigeye scad (*Selar crumenophthalmus*)
- Round scad (*Decapterus sp*.)

Methods for fishing coastal pelagics based on research carried out by Finlay (1996) include surface longlines which target Yellowfin tuna, Atlantic sailfish, Swordfish and Blue marlin. Trolling lines are used to capture Blackfin tuna, dolphinfish and barracuda (*Sphyraena barracuda*)]. Beach seine nets are used to capture Bigeye scad, Round scad (locally called 'round robins'), and Rainbow runner (*Elagatis bipinnulata)*] as well as sprat and anchovies. Although species vary in abundance seasonally, a fairly constant overall abundance of seine fish maintains a year-round fishery with relatively constant fishing effort. Other commercial fish include demersal species such as groupers

(*Serranidae*), snappers (*Lutjanidae*) (Jeffery, 2000) and the Caribbean spiny lobster (*Panulirus argus*) because of its high value.

Because of the extensive seagrass beds (*Thalassia testudinum*) once found within Conference Bay, it was one of eleven primary West Indian sea egg (aka White sea urchin), *Tripneustes ventricosus*, fishing grounds prior to the closure in 1995 due to overfishing (Nayar, Hunt et al. 2009). Despite the closure of the fishery as an effort to increase population sizes, the more recent invasion of *Halophila stipulacea* may have repercussions on the overall population of sea eggs since recent studies have identified sea eggs have a preference for grazing in beds of *T. testudinum* over beds of the invasive seagrass (Scheibling, Patriquin et al. 2018).

6.3.1.4 Social Context

The Conference Bay area within the vicinity of the BMH had only one fisherman using a handline from shore during the site survey. A number of other fishermen were observed further north of the area. Due to its location, fishing and other coastal livelihood associated activities such as agriculture, crabbing and charcoal making are the main activities (Isaac 2010). Additionally, the village of Grenville less than 5km to the south of Conference is the second largest port in GD. It functions as the main landing site for fishermen on the eastern side of the island and as a shipping facility for agricultural goods and services to and from Trinidad (Charles 2000).

6.3.2 Hillsborough Bay (Cu1), Carriacou

6.3.2.1 Physiography

Hillsborough Bay (Cu1) is centrally located on the eastern side of Carriacou (Figure 15). The coastline is gently embayed and bounded by a rock outcrop to the north at McIntosh Point (part of the older Anse La Roche formation) and the headland at Lauriston Point. The area is underlaid by quaternary sedimentary rock with an upland topographic ridge along the center of the island which rises to a high point of 954 ft. (291.4 m). The backdrop to the bay is divided into three separate watersheds with no permanent surface channels. The location of the BMH is located within the southern L’Esterre-Lauriston watershed that covers an area of approximately 510 ac. (207 ha). The area is dominated by clay soils.

6.3.2.2 Terrestrial

Carriacou was once covered by tropical deciduous forest but suffered from severe ecologic damage due to plantation clearing by the 1800s (Richardson 1975). Land coverage within the L’Esterre-Laureston watershed includes a large mangrove basin forest covering approximately 86 ac. (35 ha). The basin has a dominant stand of red mangrove, interspersed with black, white and buttonwood mangroves. Historically, the basin was much larger and by 1950, the mangroves had been reduced to one quarter its original size due to its entrance being blocked from the sea, subsequent drying out, as well as the unrestricted cutting of mangrove trees (Howard 1952).

Today, the mangrove basin is backed by the Lauriston Airport to the south. A paved road runs parallel to the mangroves and shoreline to the north but turns perpendicular and bisects the mangrove basin where the road leads to the airport.

A 328 yd. (300 m) stone revetment with four offshore breakwater revetments is seaward of the mangroves. The cable landing site transects a white sandy beach approximately 16 yd. (15 m) wide with only a few seagrape trees (*Coccoloba uvifera*), then crosses the road towards the mangrove basin. The area within close proximity of the BMH is dominated by coastal grasses and but within 11 yd. (10 m) of the mangrove basin. Construction will be performed on the immediate edge of the road, away from the mangroves as to not cause an impact on the mangroves. After construction, all excavated sites will be returned to original condition. At the two culvert crossings, Digicel will bury the cable away from the road to ensure the culvert integrity is not compromised.

Nesting hawksbill sea turtles were historically known to nest along the beach fronting the mangrove basin (Carr, Meylan et al. 1982) within the vicinity of the BMH. However, the revetment most likely deters turtles from nesting in this particular location due to the lack of sandy accommodation space for nesting. Based on the most recent data available from The Wider Caribbean Sea Turtle Network (WIDECAST, Karen Eckert, personal communication 28 Aug. 2018), low densities (<25) of nesting hawksbills and leatherbacks occur approximately 656 yd. (600 m) further west (N 12° 28’ 44.21” / W 61°28’2.5”) and approximately 874.9 yd. (800 m) east (N 12° 28’53.33” / W61°27’37.5”) of the BMH respectively.

Seabirds were observed on the stone breakwaters offshore. These included different species of terns, presumed to be roseate (*Sterna dougallii*) and sandwich terns (*Thalasseus sandvicensis*), brown pelicans (*Pelecanus occidentalis*) and brown boobies (*Sula leucogaster*) all of which are considered species of least concern under the IUCNs Red List.

6.3.2.3 Marine Habitat & Fisheries

The benthic habitat in Hillsborough Bay within the vicinity of the cable route in the deeper fore-reef (10-18m depth) was dominated by colonized reef/hardbottom (87.4%) with patches of sand (12.6%). Live coral coverage was 15.6% composed of nine different coral species (Table 36). Fleshy algal cover was 36%, dominated by *Dictyota* spp. with no calcareous macro-algae observed along the fore-reef transects. The back-reef zone (<10m depth) was dominated by dense submerged marine vegetation composed entirely of the invasive seagrass (*Halophila stipulacea*) covering 56% (APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT). Coral rubble covered 24% with 19% bare sand. Cyanobacteria was also prevalent in the back-reef zone. Other biotic species (sponge, stony coral recruits and soft corals) covered less than 1% of the area assessed.

Fish species within both locations were low in abundance and biodiversity, possibly due to overfishing. Several fish pots were also found during the assessment. The fore-reef had a total of 94 individual fish combined over the two 50 m transects (Table 37).

Table 36. Coral Species in Hillsborough Bay in the Vicinity of the Cable Route

Common name	Genus species
Massive starlet coral	*Siderastrea siderea*
Symmetrical Brain coral	*Pseudodiploria strigosa*
Lesser Starlet coral	*Siderastrea radians*

Great Star coral	*Montastraea cavernosa*
Mountainous Star coral (Mound)	*Orbicella faveolata*
Lobed Star coral	*Orbicella annularis*
Grooved Brain coral	*Diploria labyrinthiformis*
White Star Sheet coral	*Agaricia lamarcki*
Finger coral	*Porites porites*

Table 37. Fish Species Found in Hillsborough Bay in the Vicinity of the Cable Route

Common name	**Genus species**
Blue Chromis	*Chromis cyanea*
Bicolor Damselfish	*Stegastes partitus*
Brown Chromis	*Chromis multilineata*
Rock Beauty	*Holacanthus tricolor*
Banded Butterflyfish	*Chaetodon striatus*
French Grunt *	*Haemulon flavolineatum*
Redband Parrotfish	*Sparisoma aurofrenatum*
Yellowhead Wrasse	*Halichoeres garnoti*
Bluehead Wrasse	*Thalassoma bifasciatum*
Longspine Squirrelfish	*Holocentrus rufus*
Smooth Trunkfish	*Lactophrys triqueter*
Stoplight Parrotfish	*Sparisoma viride*
Coney *	*Cephalopholis fulva*
Ocean Surgeonfish	*Acanthurus bahianus*
Princess Parrotfish	*Scarus taeniopterus*
Foureye Butterflyfish	*Chaetodon capistratus*
Graysby *	*Cephalopholis cruentata*
Yellowtail Snapper *	*Ocyurus chrysurus*
Creole Wrasse	*Clepticus parrae*
Blue Tang	*Acanthurus coeruleus*
Yellowtail Damselfish	*Microspathodon chrysurus*
Tomtate *	*Haemulon aurolineatum*
Bar Jack *	*Caranx ruber*

* Commercially important species

6.3.2.4 Social Context

The Hillsborough community, located further east to the BMH is the largest village on the island and serves as the capital to both Carriacou and neighboring island of Petite Martinique. Several historical and cultural sites are also located in Hillsborough along with a number of stores, bars, restaurants, hotels, one gas station and a small-scale fish processing centre. Hillsborough also serves as a port with ferry services to Grenada and neighboring islands. Despite also being an area for tourism, visitors to the beach were not observed within the vicinity of the BMH but the area does provide a bench to view the scenery.

6.3.3 Arnos Vale (VC1), St. Vincent

6.3.3.1 Physiography

Arnos Vale is located on the southern end of St. Vincent at Greathead Bay, just west of the capital of Kingstown (Figure 16). The town area falls within an embayment between Cane Garden Point to the west and Villa Point to the east and is framed by the Warrawarrow watershed covering an area of 5 sq. mi. (12.88 km^2). The watershed has steep slopes in the higher elevations inland but flatter slopes (<2%) within the urban area of the BMH. The Warrawarrow River runs in a North–South direction, flowing into Greathead Bay in Arnos Vale, approximately 54.7 yd. (50 m) east of the BMH. Sediments from terrestrial rocks of volcanic origin have eroded and are carried by fluvial transport to the coast.

6.3.3.2 Terrestrial

The coastline is predominantly urbanized with the Arnos Vale Playing Field backing the coastline. Land coverage within close proximity of the BMH can be characterized as secondary vegetation, common in disturbed areas (i.e. regrowth of vegetation after development of the existing BMH). However, a vegetative buffer exists between the back beach and lands adjacent to the playing field and is composed of common coastal species such as almond (*Terminalia catappa*) and seagrape (*Coccoloba uvifera*). No birds were observed during the field visit.

6.3.3.3 Marine Habitat & Fisheries

Due to drainage from the Warrawarrow River into Greathead Bay, marine life is sparse because of sedimentation and freshwater influx from upland runoff. Additionally, Island Resources Foundation (IRF and CCA 1991b) identified the location as having serious pollution issues based on the Arnos Vale dump, industrial wastes and the petroleum terminal all located within the vicinity of the existing BMH.

According to the EIS produced prior to the implementation of the now existing cables in Arnos Vale, on the effect to the marine ecosystem from the landing of the subsea cables at Greathead Bay (Punnett and Milner 2006), the study area is described as a featureless flat bottom with silty black coarse sediments with patches of seagrass. Although historically a coral reef system existed along the western side of the bay (IRF, 1991B), no coral reefs were identified along the proposed cable route.

Using the most recent mapping tools available, (UNEP-WCMC 2010) the area appears to be dominated by seagrass habitat, most likely by the invasive species of seagrass due to its ability to colonize in even the most degraded areas. The EIS reports very few fish observations (Punnett and Milner 2006).

6.3.3.4 Social Context

The area within the vicinity of the BMH is a sports center but separated from the beachfront with fencing. During the field visit, only one person was observed fishing but other persons were observed burning garbage near the BMH. Another group of people were also within the vicinity of the BMH to the east but the purpose of their activities is unknown. The site can be considered to be a location where people are likely to be present. During construction, care must be taken to restrict casual access to the construction site.

6.3.4 Chateaubelair (VC2), St. Vincent

6.3.4.1 Physiography

Chateaubelair Bay is located on the northwestern coast of St. Vincent (Figure 18). The deeply embayed village of Chateaubelair is bounded by Richmond Point to the north and Chateaubelair Islet to the southwest, both of which are underlaid by volcanic lava flows. Richmond Peak, elevation 2234 ft. (681 m), forms the backdrop which is part of the mountainous backbone of St. Vincent that stretches most of its length. Highly dissected ridges, deep valleys and high vertical coastal cliffs extending down to the edge of the water characterize the topography on the leeward side.

6.3.4.2 Terrestrial

The landscape backing Chateaubelair is heavily forested and the interior inaccessible while the coastal area is urbanized with buildings and road networks. However, the area surrounding the BMH has almost no natural vegetation due to developments backing the beach, only a few planted species of vegetation. A government dock is located to the northeast of the BMH along with a row of gabion baskets running 33 yd. (30 m) parallel to the shore. Approximately 33 yd. (30 m) to the west of the BMH is a natural watercourse outflow.

The beach within the vicinity of the BMH between the government dock and the natural watercourse outflow is 16 yd. (15 m) wide. This particular section of the beach is not conducive for hawksbill nesting based on the species preference of nesting within close proximity to vegetation (Horrocks and Scott 1991). However, Chateaubelair is historically known as a nesting beach based on opportunistic observations and fishermen interviews (Scott and Horrocks 1993). Available nesting data are not quantified, but presumed to be a density of <25 nestings per season (WIDECAST 2018). The reported nesting beach is approximately 109 yd. (100 m) to the east of the BMH.

6.3.4.3 Marine Habitat & Fisheries

The narrow insular shelf in Chateaubelair Bay supports patchy coral growth on rocky substrates adjacent to the headlands. There are no well-developed fringing or patch reef structures within close proximity of the cable route in the forereef or backreef areas. This shelf is dominated by seagrass beds (UNEP-WCMC 2010).

6.3.4.4 Social Context

The Chateaubelair community is a large fishing and agrarian community with a commercial component. There are some tourist attractions including waterfalls and petroglyphs. Social activities include dominoes, soccer and cricket. Chateaubelair is a port with Customs staff and personnel to capture fish landings.

6.3.5 Owia (VC8), St. Vincent

6.3.5.1 Physiography

Owia is located on the northeast side of St. Vincent (Figure 20). The windward side of St. Vincent has relief that is more gently rolling, with an almost straight coastline with lower cliffs shaped by the continuous erosional forces of waves energised by the Northeast Trade winds. The more gently undulating foothills on this side enclose shallow valleys which occasionally merge in to extensive coastal plains.

Owia Bay is a deep embayment bounded by Owia Pt. to the north (which includes a salt pond formed by lava flows) and Espagnol Pt. to the south. The primary watershed framing Owia includes Fancy and Sandy Bay in the northeastern portion of the island. Dominant soil types include Soufriere loamy sand and Grieggs clay loam.

6.3.5.2 Terrestrial

Owia land cover within the vicinity of the BMH is dominated by buildings, road networks and bare ground. Adjacent to the BMH is the Owia Fishery Center which includes a slipway, tetrapod breakwater, rubble rock mound seawall, a fishery center building and fishermen's locker buildings. Vegetation is dominated by a line of coconut palms (*Cocos nucifera*) and grasses.

6.3.5.3 Marine Habitat & Fisheries

The extent of reef systems along the windward coast are largely limited by sediment influxes, particularly those of volcanic nature. Using the most recent mapping tools available, (UNEP-WCMC 2010) the area has a narrow shelf of fringing reef.

6.3.5.4 Social Context

The fishing communities within the vicinity of the BMH are the furthest from the economic center of the island and are among the poorest in the country. Despite the area having good fishing grounds, it faces onto the Atlantic Ocean and has a topographical restriction of severe wave conditions caused by the swell of the ocean. The construction of the fishery center was an effort to improve safety and increase the employment opportunities of fishing operations. However, fish catch did not achieve the objectives, sustainability of this project is low and overall the project was evaluated as unsatisfactory by a post-evaluation for Japanese grant aid (Nagashima 2013).

During the site visit, a number of fishermen were seen on the docks with numerous fishing vessels hauled onto the slipway. Although the fisheries building appeared in a fairly derelict state, it is presumed the complex is still being used to an extent. Additionally, the parking area provided a play area for some of the local community children.

6.3.6 Airport (U4), Union

6.3.6.1 Physiography

Point Lookout Bay is located on the eastern side of Union Island directly north and adjacent to the Union Island airport (Figure 22). The landing site is located within the Clifton watershed, 224.8 ac. (91 ha), which is backed by Fort Hill, elevation 338 ft. (103m). The steep topography and short distances between higher elevations and the shoreline means that runoff is rapid and does not permit the existence of any perennial streams.

Red Island was located just offshore to the east but reclamation for the extension of the airport filled in part of a fringing reef and connected the small island to the shore. The eastern side of the bay is entirely composed of a stone revetment.

6.3.6.2 Terrestrial

Land coverage within the Clifton watershed is dominated by thin soils, low, secondary woodlands and buildings. Along the shoreline and within close proximity of the BMH (<10m), vegetation consists of severely wind-trimmed dry evergreen scrub, herbaceous shrubs and thorn brush. Some of the key species includes sea lavender (*Argusia gnaphalodes*), *portulaca* spp., cow's tongue cactus (*Opuntia engelmannii*), seagrape trees (*Coccoloba uvifera*), coconut trees (*Cocos nucifera*), yellow balsam (*Croton flavens*), beach naupaka (*Scaevola sericea*). Additionally, buttonwood mangroves (*Conocarpus erectus*) are located within close proximity to the BMH, most likely remnants from a pond that once existed but was filled in and now forms part of the airport apron.

A narrow concrete drainage channel has been implemented running parallel to the airport property for storm water drainage off the airport and from the unpaved road leading to the BMH. Severe beach erosion occurs in this location on the far southern end of the beach but is adjacent to and within close proximity to the location of the cable landing site.

The white sandy beach at Point Lookout is approximately 142 yd. (130 m) long and about 16 yd. (15 m) wide. Although turtle nesting is identified in the MarSIS data, the most recent (WIDECAST 2018) data does not identify this as a nesting beach for any species. No birds were observed within the vicinity of the BMH during the site visit.

6.3.6.3 Marine Habitat & Fisheries

The most extensive and well-developed coral reef complexes are known to be found on the shallow, 30-40 ft. (9-12 m), shelves on the windward side of Union Island. However, the extension of the airport runway bisected and destroyed a portion of the fringing reef that fronted Point Lookout Bay. Development of the airport may also have increased sedimentation loads from infilling, smothering corals while reclamation was taking place. The loss of the pond for filtering runoff from the watershed and change in water flow are all contributory to the observed mortality of the northern portion of the fringing reef.

The fringing reef in Lookout Point Bay has a clear break of about 11 yd. (10 m) in the reef structure running parallel at a distance of approximately 125.8 yd. (115 m) from shore and opens to a sandy seagrass patch fronting the beach. This break has a sandy bottom and is a suitable route for cables to run in order to avoid placement over the reef structure.

The back-reef zone (<10m depth) within the vicinity of the cable route was dominated by coral rock (dead reef) covering 87.8% with 2% coral rubble and 3.2% bare sand and the remaining 7% of dense submerged vegetation composed of the invasive seagrass *Halophila stipulacea*. Fleshy algal cover was high with 64% dominated by *Dictyota* spp. Live coral coverage was 3% and other biotic species (sponge, stony coral recruits and soft corals) covered less than 1% of the area assessed (APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT).

The benthic habitat in the deeper fore-reef, 33-59 ft. (10-18 m), was dominated by sandy bottom (98.3%) with sparse patches of fleshy and calcareous algae (1.7%). No live corals were found in this location.

Fish species within both locations were extremely low in abundance and biodiversity of target species with a total count of 27 target individuals in the back-reef zone including 15 Blue Tang (*Acanthurus coeruleus*), two Banded Butterflyfish (*Chaetodon striatus*) and 10 juvenile parrotfish of unknown species due to their small size. The fore-reef zone had a total six target species including four Bar jack (*Caranx ruber*) and two Yellow Goatfish (*Mulloidichthys martinicus*). The low count of target fish may be in part be due to high surf encountered during the assessment.

No *Diadema* were observed in either location but rock boring urchins were observed in the back-reef zone, common in degraded reef systems. Cushion stars (*Oreaster reticulatus*) were observed (a total of 18) in the fore-reef zone. Three of the cushion stars were found unusually upright and dead. Some tissue necrosis (blackened) was observed around the base of adjacent rays near the mouth but no further investigation was carried out to identify the cause of mortality.

6.3.6.4 Social Context

Tourism is a significant contributor to the economy of Union Island. Clifton is the tourism centre of the island with several stores, fruit and vegetable markets, most of the hotels, restaurants, bars, the airport and other amenities. Many yachts frequent Clifton Harbour for provisions and the island hosts the highest population of water taxi operators in the Grenadine Islands. In the 1990s, the Japanese supported the construction of a fishery complex in Clifton. However, despite facility being more than adequate to cope with current fish landings, operational costs are too high and the facility is not currently utilised. As a result, fishers in Union Island complain of not having enough fishing amenities available to them and rely on selling to the trading vessels.

During the site visit, no persons were seen in the vicinity of the BMH or along the beach. This may in part be due to the close proximity of the airport which will cause a disturbance to beach goers if planes were landing or taking off nearby. Only one historical building is found within the vicinity (watershed) of the BMH, the Point Lookout Fort on Fort Hill.

6.3.7 Nen's Bay (Cn1), Canouan

6.3.7.1 Physiography

Nen's Bay faces west on the southern portion of Canouan (Figure 24). It is an embayment bounded by Bachelors Hall Point to the northeast and Glossy Hill to the west. Reclamation for the Canouan airport extends from the headland at Glossy Hill along the coastline past the beach at Nen's Bay. Bachelor's Hall/Nen's Bay hill rises 197 ft. (60 m), forming the backdrop to Nen's Bay.

The Nen's Bay watershed is approximately 25 ac. (10 ha) with a short distance between higher elevations and the shoreline. Similar to Union Island, runoff is rapid and does not permit the existence of any perennial streams.

6.3.7.2 Terrestrial

Land coverage backing the coastline at Nen's Bay has been drastically altered due to stockpiling of stone and sediments, development of the airport, waste landfill and land clearing. Based on comparing satellite images (Google Earth™) between 2005 and 2016, a small pond was reduced by 50% in size from infilling and about 50% of the vegetation was cleared.

The area will have once been coastal woodland backed by mangrove forest. Today, the dominant vegetation along the shoreline and within the vicinity of the BMH is manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*) and tropical almond (*Terminalia catappa)*. A number of dead trees were interspersed with live vegetation towards the western end of the shoreline, suggesting changing edaphic regimes related to sediment stockpiling.

The white sandy beach at Nen's Bay has also been reduced by a third in length to approximately 241 yd. (220 m). Open stockpiles of sediment line the shoreline on the western end to a height of about 33 ft. (10 m). Without any erosion control measures to contain these sediments, runoff directly into the sea will further deteriorate water quality and overall health of the bay. Based on available data (WIDECAST 2018), Nen's Bay is not a turtle nesting location.

6.3.7.3 Marine Habitat & Fisheries

The marine habitat at Nen's Bay is characterized by a strip of reef, about 273 yd. (250 m) wide, that extends from the headland at Bachelors Hall Point across the entire bay and connects to Glossy Hill. Between this reef and the shoreline, some dredging has occurred and the marine habitat is dominated by silt and seagrasses. According to the Environmental Impact Assessment for a new waste disposal plan and development (DICAM 2014), an additional channel through the reef is proposed to be dredged in Nen's Bay. Further dredging, coupled with current land use practices (uncontained debris/waste and poor erosion control practices) have rendered this bay severely degraded.

The back-reef zone (<10m depth) was extremely silty with poor visibility, partially due to intense rainfall prior to the assessment (APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT). Only one transect was completed. The bottom at this site is 100% silt with a layer of cyanobacteria covering part of the transect. No fish or invertebrates were observed.

The dominant benthic substrate within the fore-reef zone was dominated by 91% coral rock, 3% coral rubble and 6% sand. The invasive seagrass *Halophila stipulacea* covered 7%, fleshy algal coverage was 22.5% with live coral coverage on the reef being 8.2%. Several corals were also observed to have coral disease. Other biotic species (sponge, stony coral recruits and soft corals) covered 4% of the area assessed. No *Diadema were* observed, but a total of 66 fish individuals were observed (Table 38).

Table 38. Fish Observed on the Fore-reef Zone at Nen's Bay, Canouan

Common name	Genus species	Individuals
Banded butterflyfish	*Chaetodon striatus*	6
Black margate	*Anisotremus surinamensis*	4

Blue tang	*Acanthurus coeruleus*	20
Coney	*Cephalopholis fulva*	2
Doctorfish	*Acanthurus chirurgus*	10
Foureye butterflyfish	*Chaetodon capistratus*	2
French angelfish	*Pomacanthus paru*	2
French grunt	*Haemulon flavolineatum*	6
Graysby	*Cephalopholis cruentata*	1
Princess parrotfish	*Scarus taeniopterus*	2
Spotfin butterflyfish	*Chaetodon ocellatus*	1
Stoplight parrotfish	*Sparisoma viride*	3
Yellow goatfish	*Mulloidichthys martinicus*	2
Yellowtail snapper	*Ocyurus chrysurus*	5
TOTAL		66

6.3.7.4 Social Context

Nen's bay is not currently used for recreational purposes but several shacks and boats hauled onshore on the northern end of the beach indicate there is some fishing activity within the bay. Additionally, several free-divers were seen fishing during the Ecological Resources Assessment. As noted in Section 5.6.2, future development will preclude recreational and subsistence land use at this site. The timeframe for that development is unknown.

6.3.8 Endeavor Bay (M2), Mustique

6.3.8.1 Physiography

Endeavor Bay is a gentle embayment on the northwest coast of Mustique bounded by a basaltic lava flow headland to the north and a superficial rock outcrop to the south. The bay is framed by the 18.2 ac. (7.4 ha) Endeavor/Honor Bay watershed with generally low hills with <3° slope.

6.3.8.2 Terrestrial

Land cover within this watershed has been cultivated and landscaped with two storm water ponds and a wide range of native and non-native species of vegetation. Impervious cover is low (9%) within this watershed due to low density developments that include several villas, a small hotel and its amenities.

The white sandy beach extends approximately 273 yd. (250 m) long and 16 yd. (15 m) wide. According to the WIDECAST country coordinator located in Mustique, turtles are not known to currently be nesting on this beach.

A denser vegetative buffer exists along the back of the berm on opposite ends of the beach, providing easy access from the central part of the beach. However, a wide, 7 ft. (3 m) provides access to an existing shore cable landing, but this area is also vegetated with both native and non-native species of vegetation, none of which are identified under the IUCNs Red List as being threatened.

6.3.8.3 Marine Habitat & Fisheries

The cable route passes through the Mustique Conservation Area which extends 1000 yards from the shoreline. However, the vicinity in which the cable runs from a sea depth of 59 ft. (18 m) to the shore is almost featureless and entirely void of any corals or coral reef complex. A fringing coral reef is located further to the north along with a coral nursery but both are found well outside the path of the cable.

The fore-reef zone, 33-60 ft. (10-18 m) deep, is composed of 100% dense invasive seagrass (*Halophila stipulacea*) interspersed with various species of calcareous and fleshy algae. Along the nearshore back-reef zone (<10m depth), the benthic habitat is composed of 100% sandy bottom interspersed with sparse patches of calcareous algae and a few rock boulders. While the boulders have several coral recruits and clusters of *Diadema*, they are outside of the cable route. A total of 300+ target species of fish were observed, the majority being juvenile grunts.

6.3.8.4 Social Context

The location of the BMH is the only preferred option requested by MCL. From a social perspective, this location is mainly used by resort guests. Its location towards the southern end of the beach, near the resort beach bar/restaurant allows for limited obstruction for pedestrians and helps maintain the pristine nature of all other beaches in Mustique.

6.3.9 Lower Bay (B1), Bequia

6.3.9.1 Physiography

Admiralty Bay is a deep leeward embayment that forms the lower “S” shape portion of the island. It is further subdivided into smaller bays with Lower Bay being on the southernmost end (Figure 28). The beach is bounded by Belle Point to the south and a rock outcrop composed of conglomerate beach rock with basaltic clasts (locally called Retreat) to the north. The backdrop to Lower Bay is framed by the 76 ac. (30 ha) watershed.

6.3.9.2 Terrestrial

Most of the land cover near the shoreline has buildings and road networks with a major road running parallel to the entire length of the shore. Between the high-water mark and the road is a vegetative buffer of coastal woodland that extends landward past the road. Vegetation where the cable lands on the shore at Lower Bay is limited to a few species and includes manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*) and tropical almond (*Terminalia catappa)*.

The beach at Lower Bay is approximately 656 yd. (600 m) long and 22 yd. (20 m) wide. The beach soil is composed of a mixture of marine and volcanic sediments. A vegetative buffer provides some protection from coastal erosion caused by high wave energy. In contrast, severe erosion occurs further north along the shoreline of Port Elizabeth, where gabions and seawalls have been built to protect shoreline developments. However, some erosion is occurring within the vicinity (<10m) of the cable landing site in Lower Bay. Exposed tree roots on adjacent vegetation (particularly the Manchineel trees) and an erosional gully starting from the roadside flowing seaward. Additionally, several boulders and a dead tree trunk appear to have been purposely placed near the side of a beachside bar/restaurant. Most likely, the combination of runoff down the road running perpendicular to the shore (and the road in which the cable will run towards the landing site) and the proximity of the building to the shore / built directly on the beach are the underlying cause for erosion in this area.

Lower Bay is identified as a possible nesting habitat for hawksbill sea turtles (Duke University OBIS-SEAMAP 2018) but this information was based on community interviews (opportunistic sightings) in the 1990s with a low level of confidence on the validity of the data. Additionally, available data (WIDECAST 2018) only identifies the adjacent beach to the north (Princess Margaret Beach) as a nesting beach for hawksbills but this data is also based on information from the 1990s. Several sea and shorebirds are known to be in this area (Table 39).

Table 39. Sea and Shorebirds Known to Frequent Lower Bay, Bequia

Common name	**Genus species**	**Notes**
Laughing Gull	*Leucophaeus atricilla*	
Brown Noddy	*Anous stolidus*	
Sooty Tern	*Onychoprion fuscatus*	
Bridled Tern	*Onychoprion anaethetus*	
Least Tern	*Sternula antillarum*	(Rare/Accidental)
Roseate Tern	*Sterna dougallii*	
Common Tern	*Sterna hirundo*	
Royal Tern	*Thalasseus maximus*	
Sandwich Tern	*Thalasseus sandvicensis*	
Red-billed Tropicbird	*Phaethon aethereus*	(Rare/Accidental)
Audubon's Shearwater	*Puffinus lherminieri*	
Magnificent Frigatebird	*Fregata magnificens*	
Masked Booby	*Sula dactylatra*	
Brown Booby	*Sula leucogaster*	
Red-footed Booby	*Sula sula*	
Brown Pelican	*Pelecanus occidentalis*	

6.3.9.3 Marine Habitat & Fisheries

The seafloor within the vicinity of the cable route in the fore-reef zone was dominated by hardbottom (77.4%) with coral rubble (totaling 14.4%), bare sand (12.6%) and seagrass (. Live coral coverage was 12.8% with fleshy algae covering 23.2% and invasive seagrass covering 10%. Recruits totaled 4.1% and soft corals covered 1.8%. Anchor damage (overturned coral heads) was found in various locations near the transect lines.

The back-reef zone was dominated by invasive seagrass (81%) with bare sand covering 17% and coral rubble 2%. Live coral coverage was less than 1%. A total of 11 West Indian sea eggs (*T. ventricosus*) were also observed within the vicinity of the transect. Considering it has been documented that *T. ventricosus* prefers the species *Thalassia testudinum*, there is potential for this to be a future research project for the local government. Bequia had a wide variety and abundance of target fish with over 225 individuals counted.

6.3.9.4 Social Context

Lower Bay hosts several beach bars, restaurants and villas and also has fish landing site further south of the BMH. Although the area had very few people on the beach during the site visit, it is known to be a popular recreational area.

Although no boats were seen anchored during the site visit, the area is indicated as an anchorage on nautical charts. According to one person (a local divemaster), Lower Bay is often used by the larger vessels, particularly when there is a swell. Anchor damage to corals during the Ecological Resources Assessment also verified this area may be heavily used.

Further north is Port Elizabeth, where the main ferry terminal is located. The area is also very popular with visiting yachts due to the large sheltered anchorage and a number of other tourism amenities that cater to the yachting community. Maritime activities such as boat building and whaling are also a rich part of the Bequia heritage and continue to be active today.

7.0 ASSESSMENT OF POTENTIAL RISKS AND IMPACTS

The following discussion presents the impact assessment of the laying and operations of fiber optic cables and the development of BMHs. The section comprises a detailed narrative of risks and impacts and, where possible, quantifies potential impacts on resources within the PAI. Mitigation measures are noted in the analysis and summarized in Section 7.7, Risk – Impact – Mitigation Conclusions; and again in Section 8.0, ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN.

Impacts (consequences or effects) caused by the project occur at the same time and place and can be either beneficial or adverse. Indirect impacts are those effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.

The relative importance of an impact depends on the context in which the impact occurs and the intensity of the impact. Impacts can vary in degree or magnitude from a slightly noticeable change to a total change in the environment. Impacts can also occur over a short or lengthy duration and with, or without environmental recovery. Significant impacts are those effects that will result in substantial changes to the environment over a longer period of time and should receive the greatest attention to avoid or minimize these to insignificant levels.

7.1 Physiography

Because of the minor disturbance caused by cable laying, no adverse effects to the physical resources of the PAI are expected. The entire cable laying operation will take approximately one month. The cable is paid out by the cable ship at a speed and tension designed to lay the cable on the sea bed without suspended portions between bathymetric dips and rises. Currents in the deeper portions are less than that required to lift the cable. The cable lies on the surface seabed, eventually to be covered by sediment or overgrown in shallower areas by living organisms. This will have no effect on bathymetric contours or substrata.

The cable itself is only 33 mm in diameter. Over a length of 139.8 mi. (225 km), covering a sea floor corridor 1.30 inch (33 mm) wide, the area of the seafloor covered will be 79,917.5 sq. ft. (7424.6 sq. m or 1.83 ac.). Less than two acres of the seafloor covered is a minor impact area over a 140-mile distance. The proposed subsea cable will be laid on the surface of the seabed. Over time, it will most likely be covered by normal sedimentary processes or be covered by colonizing invertebrate organisms. As discussed in the project description, the cable is laid with enough slack to enable a continuous connection with the seafloor without kinking or suspended portions. In those locations where the seabed is muddy or silty, the cable might sink into the substrate. No other effects are anticipated regarding oceanic substrata.

BMH construction and connections to the front haul infrastructure will have a temporary and minor effect on the beach. BMH construction for all sites will take less than one month. At each landing site above sea level and behind the beach berm (except for the pre-existing BMH at Arnos Vale) earthworks and cast-in-place concrete BMH installation will take less than one week to complete. Some BMH installations can be conducted simultaneously. An area of approximately 5,000 sf (465 m^2 or 0.11 acre) will be needed to accommodate construction vehicles, excavation stockpile, cement truck and BMH excavation and casting.

After construction, the ground surface will be returned to pre-construction topography and grain size condition. The excavation itself will only extend eight to ten feed beneath the surface. Contractors will stockpile sands to be used as surface backfill. Beach soils are a combination of sands and rock. Where the sands are shallow, excavations will cut into the volcanic or sedimentary layers beneath. During construction of the BMH, the site will be managed to avoid erosion of the stockpiles and subsequent sediment runoff.

All construction activities will be performed with strict adherence to occupational health and safety plans and local requirements. Occupational health and safety requirements will include, but are not limited to:

- Suitable Personal Protective Equipment for the activity at all times
- Traffic and public control during construction operations
- Emergency response plans in place
- Environmental controls including spill kits available

7.2 Marine Biology

Cable installation has an effect that is limited in spatial extent and temporary in nature. The installation, maintenance, presence on the seabed, and removal of the cable will also affect the environment in some way (Zajac 1957; Horne 2002) but few published studies exist on the interaction between cables and the marine environment (Heezen 1957; Marra 1989; Reiter and Deis 2000; Sultsman, Halter et al. 2002; Andrulewicz, Napierska et al. 2003). As noted previously, should decommissioning become necessary, a risk management approach will be taken to determine the least environmentally intrusive method (Emu 2004).

The cable will be surface laid. Thus, the potential physical disturbance is limited to the surface of the seabed. Impacts might include damage and removal of flora and fauna living on the seabed. This disturbance can result in the reduction of species diversity, abundance and biomass within the effected footprint (Dernie, Kaiser et al. 2003). While some mobile benthic species are able to avoid most disturbances, sessile and sensitive species (such as slower growing or fragile species) will be more impacted (OSPAR 2009). However, compared to other offshore activities such as bottom trawling, ship anchoring or large-scale dredging, seabed disturbance resulting from subsea cable activities are considered temporary and have a relatively limited extent (Carter, Burnett et al. 2009; OSPAR 2012), with the seabed usually returning to its original state (Department for Business Enterprise and Regulatory Reform (BERR) 2008). The impacts on benthic communities will depend on the sensitivity and conservation of the species that characterize the communities along the cable route (Department for Environment Food and Rural Affairs (DEFRA) 2010).

Cables cover a large longitudinal area and are likely to encounter a variety of habitats at different depths. While recovery rates will differ across different habitats (Dernie, Kaiser et al. 2003), and sensitive species may show longer recovery periods (Dunham, Pegg et al. 2015), the overall footprint on the seabed is small. The cable for this project is only 33 mm in diameter spanning a distance of 139.8 mi. (225 km). The actual cable coverage on the sea floor will be 1.30 inch (33 mm) wide along the 139.8 miles; the area of the seafloor covered will be 1.83 ac. (7424.6 sq. m).

Disturbance caused by cables is restricted to a narrow strip of seabed, normally limited at most to an area 2-3 m either side of the cable (Carter, Burnett et al. 2009; Bald, Hernandez et al. 2014). The subsea cables themselves, if not eventually buried by normal sedimentary action will also provide a solid substrate for a variety of species. This “reef effect” can lead to a positive effect by increasing faunal diversity and benthic community composition (Tyrell and Byers 2007; OSPAR 2009; Kerchhof, Rumes et al. 2010; Langhamer 2012).

Subsea cables are encased in an inert plastic material; the entire cable has an expected life of over 30 years, longer than the technology has been in existence. Cable operators typically assume about 40-year lifespan (VanVickle 2014; Corning 2016). Installation is therefore considered a singular event that will not occur again unless maintenance is required, or if the removal of the cable is needed (Carter, Burnett et al. 2014).

Coral reefs and intertidal habitats are of special concern, particularly due to the overall decline in reef habitats throughout the Caribbean. However, the selection of the CARCIP cable route avoids most sensitive habitats. Based on the benthic communities identified during the marine assessment, most existing biotic communities either exhibit sand, dead coral/rock, a low percentage of live coral coverage or dense coverage of the invasive seagrass *Halophila stipulacea*. In the case of the invasive seagrass, the aggressive nature of this species to (re)colonize reduces the overall long-term impact. In locations where the coral coverage is higher, divers will lay cables by hand and any live species can generally be avoided or moved to avoid being crushed, such as the West Indian sea egg. In areas such as Carriacou, where the live coral coverage is higher, the presence of a marine biologist can be employed to reduce the risk of impacting any live corals.

The cable ship operator maintains safety and spill-prevention policies in accordance with The International Convention for the Prevention of Pollution from Ships (MARPOL), as amended (IMO 2018). There is a low probability of both hazardous material spill and hazardous waste discharge. The cable ship operator also maintains a spill prevention and countermeasures plan and trains all crew on safety and hazardous material handling and cleanup. In addition, after construction is complete, the cable will enter Digicel’s asset monitoring program. The Digicel O&M team will include bi-weekly visits to the locations to complete physical inspections. The cable itself will be continuously monitored through the network. Any issues, technical or social will be remedied upon identification.

7.3 Fisheries

Subsea cable deployment has the potential to impact various fish species but mobile fish and shellfish are expected to be able to move away during cable laying operations. However, subsea cable deployment has the potential to impact fishing activity. Temporary impacts are related to the restriction to fishing grounds, temporary fish stock displacement or the snagging of fishing gear, which can consequently lead to minimal reduced returns and/or increased costs for the fisheries industry (Department for Business Enterprise and Regulatory Reform (BERR) 2008). Exclusion of vessel traffic from the cable deployment area will be noticeable at the cable landing sites but the duration of cable landing activities will not exceed three days and notice of activity will be posted at least one month before deployment. Fishing vessels will be prevented from fishing in the immediate area during cable laying and landing operations by the designation of safety zones around work boats. The short duration of cable installation will cause only a minor, shot-lived impact to fishers and vessel traffic and impacts associated with restriction to fisheries areas are considered very short-term. The presence of a cable on the seabed will have a negligible effect on local fishing efforts. The small cable size and self-burial in time will present a very minor potential to foul gear such as nets or hand lines.

7.4 Terrestrial Biology

Installation of the BMH and cable landing is anticipated to cause minor and short-lived effects to habitats and species onshore. BMH installation sites were selected to minimize disruption of the land and include bare, disturbed or developed site areas. Important habitats such as mangroves and undeveloped forests have been avoided. The typical description of a BMH installation site can be described as on a sandy beach, adjacent to a roadway, in a parking area, or along a pedestrian beach access walkway.

Landing site construction may temporarily displace species such as, rodents, mammals, and reptiles but there is no foreseeable adverse impact upon these species. None of the construction sites are located in any land protected area (such as forest or watershed). Those species identified specifically as “threatened” (under the IUCN) that may use these locations for nesting (sea turtles) or foraging (avifauna) are assessed in the following section (7.5 Endangered Species). After construction, the sites will be returned to their pre-construction condition, further limiting the possibility of damaging terrestrial habitat.

Cable installation will have some impact on foraging birds, specifically wintering and migratory birds, through the indirect loss of prey species because of the presence of the cable laying vessel and small craft operations. However, the impact of prey availability is not usually considered significant and can be justified by the ability of birds to forage in different areas. Human beach access to some sites may also be temporarily restricted but Public notice will be provided to warn the community of ongoing construction.

7.5 Threatened Species

Several species identified by the IUCN as threatened can be found within the PAI. Activities during installation of the cable and construction of the BMHs could potentially affect these species, but this effect is expected to be limited. Threatened species found in the PAI include species of fish, corals, marine mammals, sea turtles, plants and one bird species, the Semipalmated plover. These species are discussed in Section 6.2.

Cable routes with little to no corals have been selected and cables will be hand laid by divers to ensure all coral species are avoided. Fish have a tendency to move away from abnormal activity and obstructions so threatened species will doubtfully be impacted at all.

The cable laying vessel will use typical depth and position locating instruments that operate at frequencies and power settings that have been found not to be injurious to marine mammals relative to U.S. Endangered Species Act standards (U.S. Navy 2012). Engine noise and noises associated with cable deployment are low frequency noises that will be temporary and short-lived.

During offshore cable laying, threatened marine mammals and sea turtles will be avoided by Marine Mammal Observers onboard the vessel who are assigned watches to alert those in charge of ship/vessel control of potential collision. The slow speed of the cable laying vessel and the agility of smaller cable landing vessels will help to avoid collision with marine mammals and sea turtles.

Shore-based cable trenching activities has the potential to disrupt sea turtle nesting and hatching activities if performed during the sea turtle nesting season. However, high density nesting beaches (>25 activities) were excluded during the site selection process based on data and recommendations obtained from WIDECAST country coordinators or respective Government departments.

The VC Chief Fisheries Division (APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS) specifically identified hawksbill nesting activity at Chateaubelair and expressed concern about scheduling of landing in May/June as this would be the peak of the leatherback nesting season and the beginning of the nesting season for the green and hawksbill sea turtles. The Fisheries Division recommended work be conducted in the December to February period when it is less likely for there to be unwanted interactions with turtle nests. Although this site, along with all other sites within the PAI has zero to low nesting densities (see Section 6.2.4 Marine Environment), sea turtle experts will monitor nesting beaches prior to and during the commencement of beach works as a precautionary measure. This will result in insignificant direct, indirect, or cumulative effects.

No threatened species of plants are found directly along the cable landing or BMH sites. Other foraging shore and sea birds can be deterred away from shoreline landing and construction activity through the employment of flags or flagging tape attached to removable rebar, PVC, etc. prior to development activities. Flags will be removed and properly discarded upon the completion of installation of both the cable and BMH.

7.6 Socioeconomic

Installation of BMHs and fiber optic cables will occur in sites that have been used by humans for fishing, port facilities and recreation in the past. Each beach landing site was selected, in part, to avoid existing beach uses such as moorages, piers, parks, swimming beaches, etc. Landing site selection also avoided residences, forest, parks, marine protected areas, coral reefs and the like to minimize construction costs and mitigate potential adverse effects to biological resources (discussed above). The selected location of each landing site strikes a balance between existing human use and environmental conservation. The landing site construction and cable laying will be visible to local residents, but such events will occur in little used areas and on the ocean and not disrupt ongoing human activities. Three landing sites are near development in VC: Chateaubelair, Owia and Arnos Vale. These sites are near commercial/light industrial land uses and construction would not directly affect residential areas. As noted in the project description, local contractors will be employed to construct the BMH facilities and terrestrial cable connections. According to estimates from the installer (IT International Telecom 2019) the project has a potential of creating approximately 500 jobs, directly benefiting local employment near each landing site.

While the proposed action will not result in any permanent involuntary resettlement of local populations, the World Bank Guidance and Policies on Involuntary Resettlement (OP 4.12, rev. 2013) have been considered in this analysis. Through the site selection process identified in Section 5, this ESIA specifically considered Policy OP 4.12.2(a), "Involuntary Resettlement should be avoided…"

Contacts and discussions with local residents, land managers and government officials have identified no sensitive social conditions that could be adversely affected by BMH construction or cable laying. To the contrary, contacts indicate the project is desirable overall. The installation of fiber optic connections to the various islands is viewed as a social benefit as it will improve internet connections for the individual, provide opportunity for improving education and improve government services conducted on the internet. This, condition also may provide secondary benefits of maintaining or improving social conditions for a growing population. There will be construction labor and material supply opportunities during BMH construction. Regardless, unpublished gatherings or festivities could be temporarily affected during construction.

The social survey conducted for this project (Section 6.2.8) indicated a broad dissatisfaction with existing internet services and hope for future improvements with the CARCIP project. A large majority (40%) of respondents desire lower internet pricing. Others desire improved speed and fewer interruptions. A majority of respondents have experienced a general dissatisfaction with existing internet service (62%) and thought the project would improve their lives in general (71%). Racial, religious or gender discrimination with internet services does not appear to be a problem for any respondent who provided comment. Eighty percent of the total respondents answered this question regarding discrimination and all selected "Other," indicating no experience with the listed discrimination issues.

The environmental focus of about half of the population is the nearshore marine and beach terrestrial environments; what can be seen and experienced on and near the beach. Coral protection is the main interest item. The public appears to be concerned about the post-construction presence of a fiber optic cable and beach manhole buried on the beach. Most of the respondents (64%) reported a change of mind after hearing the cable description.

No respondents were interested in seeing analysis of social issues, air/water quality, or deep ocean sea floor habitats. Regarding potential conflict with ongoing human activities, respondents were broadly of the same mind with a minor country variation regarding recreation (listed below). No additional mitigation was repeatedly indicated, either from selections or "write in" suggestions.

Overall, there were few gender or country variations. Most males and females selected options similarly and there were few variations between respondents from either country. The following list identifies other, less dramatic but notable differences by gender or country:

- Question 1: Existing Services — Males are more dissatisfied than females.
- Question 2: Improvement — Females wish a lower price more than males.
- Question 4: Expectations — Females expect no change more than males and males expect change for the better more than females.

- Question 8: Cable understanding — Grenadians reported less concern than Vincentians after understanding the cable size.
- Question 9: Potential conflict — Grenadians are slightly more concerned about recreation than Vincentians.

At the BMH landing sites, there will be no historical or archeological effect. No historical properties were identified during the site visits and the following desktop study. The potential for archeological sites or artifacts is similarly negligible. These sites are on the shoreline and beach front that have been developed and disturbed by human activities for many years, leaving little chance of an unknown historic or archeological value. The petroglyphs on St. Vincent Island are well removed from the construction areas and will not be affected.

There are a variety of marine navigation and transportation activities marine activities in the PAI that could conflict with installation of the fiber optic cable. Some navigation activities might pose a threat to the cable itself in areas closer to landing sites. Some BMH landing sites are within view of passing cargo vessels, ferries, fishermen and recreational boaters. The cable lay design was conducted to avoid major sea traffic lanes and anchorages to avoid damage to the cable. Cable laying will only be noticeable as a slow-moving vessel while laying (about 3 kt). The cable route has been designed to avoid marine navigation as practicable.

The cable landing operation will cause vessels to change course and avoid cable installation operations. Impacts to vessel navigation will be somewhat avoidable by routing the cable location to avoid traditional sea lanes and harbor anchorages. All of the information collected during the marine route survey will be available to the vessel team to enable them to address all seabed features and stay on the engineered route. Because of the relatively short duration and movement of the project cable installation, the impact to smaller vessels is expected to be a minor inconvenience. Additionally, the International Regulations for Preventing Collisions at Sea 1972 (COLREGs) and the Commonwealth of Nations Submarine Telegraph Act will be adhered to. Larger vessels such a cargo and ferry vessels would not be affected because the cable landing site selection avoids such routes and vessel landings. During cable landing, the cable vessel will be positioned generally within one half mile offshore for about three days. Landing the cable will involve one or two small vessels and cable floats between the cable ship and the shore. This construction area will not be available to navigation during cable landing.

To help avoid disruption of local vessel navigation and offset minor effects during cable landings, Digicel Group will provide notice to the UKHO to notify the fishing and transport industry, port authorities and other seabed users about the cable and its installation. Digicel will also notify the governments of intended construction schedules so that additional notifications can be made as appropriate, such as community boards, community centers and churches.

7.7 Risk – Impact – Mitigation Conclusions

Figure 47 presents the CARCIP ESIA definition of impact with regards to impact likelihood and impact consequence. The terms are defined and highlighted to clearly differentiate between low, medium, high and severe impact.

Table 40 summarizes the potential impact of the project on listed environmental resources. The table then summarizes conclusions of impact, where it might occur, mitigation measures proposed and an assessment of the remaining (residual) impact after mitigation has been applied. This list is a summary of the measures indicated in previous sections of the ESIA.

Qualitative measure of LIKELIHOOD (how likely is it that this event/issue will occur without mitigation measures	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Qualitative measure of CONSEQUENCES (what will be the consequence/result if this issue occurs without identified mitigation measures and includes the scale, frequency, duration and intensity of the consequence)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

		CONSEQUENCE				
		Minor	**Moderate**	**High**	**Major**	**Critical**
LIKELIHOOD	**Highly Likely**	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Figure 47. Measures and definitions of impact based on author's generic version of a two-variable risk matrix, as used for this CARCIP EISA

Table 40. Risk - Impact - Mitigation Summary. Ratings have been annotated with positive impact (+) and adverse impact (-). Color coding matches impact definition in Figure 47

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Natural Environment - Terrestrial								
Physiography (Coastal geomorphology)								
Excavation (area less than 5,000 ft^2 (465 m^2) of sediments removed for the installation of a permanent beach manhole	Permanent structures may result in temporarily altered or restricted sediment transport along shorelines during construction.	Permanent BMH is located well above high water mark (HWM)and except for Arnos Vale, is located behind the beach berm; structure will take less than 1 week to construct and be placed well above high water mark and below grade	POSSIBLE	MODERATE	- MEDIUM	All locations are landward of operational (normal circumstances) littoral transport processes (i.e. above high water mark / behind the beach berm) except for Arnos Vale where a pre-existing manhole is located along the shoreline	BMHs to be located as far as practicably possible from the shoreline and buried below grade; continuous beach monitoring programme Excavated material (sediment) is returned to pre-existing state;	Little to no risk expected
	Sediment runoff downstream due to pre-existing conditions (erosional gullies originating landside from heavy rainfall)	Pre-existing erosional conditions exist near Union & Lower Bay Bequia landing sites	POSSIBLE	MODERATE	- MEDIUM	All sites	All cables are to be located as far as practicably possible from existing erosion and below grade, continuous beach monitoring programme	-Limited risk but will be part of a monitoring program
Installation of beach infrastructure	Excavated material may escape confined area of works due to rain/wind	Works do not exceed 2-3 days	UNLIKELY	MINOR	- LOW	All Sites	Wetting of material during high winds and containment of sediment using silt fencing in the event of heavy rainfall, prolonging time for construction	Little to no risk expected
Long term effects of climatic changes (Sea level rise, increased storm activity)	Increased natural vulnerability of cable/BMH along shore	Cable with a very small footprint; Minimal project lifespan is over 30 years; sea level rise is estimated at <0.10m over this period	RARE	HIGH	- LOW	All locations	Cable infrastructure has a small footprint within the greater need for island-wide climate change hazard vulnerability adaptation and mitigation	-Limited risk but should be part of a monitoring program, not within the scope of this project.

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Flora and Fauna								
Beach construction	BMH footprint may cause loss of terrestrial habitat and/or habitat fragmentation	No IUCN threatened or endangered species reported in project area	UNLIKELY	MINOR	- LOW	All locations	Little to no significant vegetation exists within the BMH footprint and all excavated material will be restored to its pre-existing state. No live species will be brought onto the site.	No risk expected
Avifauna								
Temporary Increased excavation works, vessel movement, etc.	Noise & vibration disturbance	Construction duration less than one week; Semipalmated sandpiper is found at Conference	POSSIBLE	MINOR	- LOW	Conference	Placement of flagging deterrent along shoreline prior to works and removal following completion	Little to no risk expected
Natural Environment - Marine								
Bathymetry								
Cable lay operations	System is surface laid so seabed disturbance to deep sea sand & muds is minimal to zero	Entire CARCIP cable coverage is 7424.6 sq. m or 1.83 ac.	UNLIKELY	MINOR	- LOW	All subsea locations	Cable is very small and will not alter bathymetry, no mitigation required	No risk expected
Sediments								
Lay & cable operations	Seabed disturbance to deep sea sand & muds	Automated deployment avoids suspended and kinked segment	UNLIKELY	MINOR	- LOW	All subsea locations	Cable is very small and will not alter bathymetry in any way, no mitigation required	No risk expected
	Potential contaminant release from sediment	Trenching (cable ploughing) will not occur to cause sediment plumes or release any potential contaminants	RARE	MINOR	- LOW	All subsea locations	Cable is laid directly on the seabed with minimal disturbance, no mitigation required	

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Abiotic habitat type (rock, dead reef framework, sands)								
Cable lay operations	Seabed disturbance to abiotic habitat	Trenching (cable ploughing) will not occur to cause sediment plumes or release any potential contaminants	RARE	MINOR	- LOW	All subsea locations	Cable is laid directly on the seabed with minimal disturbance, no mitigation required	No risk expected
Climate change - increased storm activity, acidification	Ocean acidification can weaken carbonate framework to be more susceptible to scouring from cables	Only Carriacou has live coral coverage (>10%) within the immediate vicinity of the cable route; few threatened species can be avoided	LIKELY	MODERATE	- MEDIUM	Bequia, Canouan, Carriacou	Cable route avoids live coral coverage in all locations	No life-cycle risk expected
Biotic Habitat Type (Live hard bottom including stony & soft corals, sponge, etc.; seagrass beds)								
Climate change - increased storm activity, acidification	Seabed disturbance to biotic habitat communities	Only Carriacou has live coral coverage (>10%) within the immediate vicinity of the cable route; few threatened species can be avoided	POSSIBLE	MODERATE	- MEDIUM	Carriacou	Live coral coverage will be avoided in all locations. In Carriacou, this will be confirmed by a marine biologist as this is the only location with over 10% live coral coverage near the cable route.	-Reduced risk with implementation of measures
Cable lay operations	Colonization of the cable (i.e. Increased biomass)	Cable provides surface area to colonize with marine organisms	LIKELY	MINOR	- LOW	All locations	Potential benefit to provide habitat and increase biomass, no mitigation required	No risk expected
	Altered sediment concentrations & depositions	Turbidity is not expected since cables will be laid directly on the seabed, not ploughed	RARE	MINOR	- LOW	All locations	Cable will self-bury itself over time and will not cause sediment plumes, no mitigation required	No risk expected
Cable lay operations	Vessels are pathway for invasive species	Cable vessel arriving from foreign waters (Norway)	POSSIBLE	HIGH	- MEDIUM	All locations	Vessel will have new antifouling bottom paint (reduces risk of foreign species attached to the hull from entering Caribbean waters) and ballast water is freshwater, no mitigation measures required	No risk expected

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Natural Environment - Marine Fauna								
Populations of Indicator Species (D. antillarum, Strombus gigas, P. guttatus)								
Cable lay operations	Crushing or dislocation of indicator species from habitat	Very few indicator species were found during the marine assessments	UNLIKELY	MINOR	- LOW	All locations	No significant populations of key indicator species within footprint of cable, no mitigation required	No risk expected
Fish Assemblages								
Cable lay operations	Pathway for invasive species	Cable vessel arriving from foreign waters (Norway)	POSSIBLE	HIGH	- MEDIUM	All locations	Vessel will have new antifouling bottom paint and ballast water is freshwater, no mitigation measures required	No risk expected
	Noise & disturbance from vessel/installation	Fish will avoid contact and easily swim away from activity	UNLIKELY	MINOR	- LOW		Vessel movement is very slow, small footprint, no mitigation required	
Marine Mammals								
Cable lay operations	Noise & disturbance from vessel/installation	Minimal noise compared to activates such as drilling or piling	UNLIKELY	MINOR	- LOW	All locations	Implement an observer for foraging sea turtles and marine mammals; works must be halted if there is a sighting within 100m of the vessel or cables being laid until it leaves the area	-Reduced risk with implementation of measures
Sea Turtles								
Cable lay operations	Entanglement with floats/lines	Turtles are highly mobile and will avoid contact; cable installation methodology has minimal use of any rope or lines	UNLIKELY	MODERATE	- LOW	All locations	Implement an observer for foraging sea turtles and marine mammals; works must be halted if there is a sighting within 100m of the vessel or cables being laid until it leaves the area	No risk expected
Earthworks & onshore cable trenching	Excavation for cable can disturb nesting turtles and/or clutches	Nesting season runs March to July	POSSIBLE	HIGH	- MEDIUM	Carriacou, Bequia	Deploy a turtle specialist prior to and during construction works of BMH to ensure nesting sea turtles & clutches are not disturbed	

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Human Environment - Socio-Economic								
Commercial Fisheries								
Cable lay operations	Temporary displacement of localized fishing activity	Lay operations are short-term (up to three days in each location)	POSSIBLE	MODERATE	- MEDIUM	Chateaubelair, Owia, Canouan, Carriacou	Notification of scheduled deployment required	-Reduced risk with implementation of measures
Navigation & Shipping								
Cable lay and beach landing operations	Disturbance from vessel & installation activity	Lay operations are short-term (up to three days in each location)	POSSIBLE	MODERATE	- MEDIUM	All locations	Notification of scheduled deployment required	No risk expected
Presence of cable	Entanglement of anchor on cables	Cable will bury itself over a short period of time	POSSIBLE	MODERATE	- MEDIUM	All location	Notification to marine authorities of deployed cable location is required	
Tourism								
Cable lay and beach landing operations	Temporary disturbance of recreational resources (i.e. anchorages, dive sites, beaches)	All major recreational beaches are avoided, dive sites are avoided	LIKELY	MINOR	- LOW	All locations	Notification of scheduled deployment is required	- Reduced risk with implementation of measures
	Obstructed /visual effects	All new BMH are buried and below grade	UNLIKELY	MINOR	- LOW	All locations except Arnos Vale	Minor earthwork will be returned to pre-construction conditions	No risk expected

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Archaeology & Heritage								
Beach construction	Disturbance from trenching cables & BMH onshore	Shipwrecks are avoided; beaches are historically well-used reducing potential for in-tact artifacts	RARE	MINOR	- LOW	All Locations	Findings of any pottery, artifacts, etc., during terrestrial works requires work stoppage and notification to VC and GR governments	No risk expected
Land Use								
Earthworks on private lands	Lease /agreements in place prior to construction, no impact	Land acquisition engineers employed to resolve any land ownership issues	RARE	HIGH	- LOW	Private land locations: *Bequia *Chateaubelair *Owia *Mustique	As required by Digicel	No risk expected
Climate change - Sea level rise, increased storm activity, erosion	Altered shoreline from BMH construction and operations, climate change; BMH are installed well above high-water mark, and will be flush with the ground	Cable lay is not the cause of climate change	POSSIBLE	HIGH	- MEDIUM		Cable infrastructure is a small footprint within the greater need for island-wide climate change hazard vulnerability adaptation and mitigation. Because improved communications will be part of climate change adaptation, no mitigation measures are needed for this part of the project.	
Stakeholders								
Completed infrastructure	Enhanced global telecommunications & access potentially increasing employment opportunities	Long term effect	LIKELY	HIGH	+ HIGH		Positive impact does not require mitigation	**+ High**
Completed infrastructure	Perceived exposure to Electromagnetic Field	Long term effect	RARE	MINOR	- LOW		No Electromagnetic field with the CARCIP cable system as its non-powered. Education about how fiber optics work.	**- Low**
Completed infrastructure	Reduced exposure to microwaves	Long term effect	HIGHLY LIKLEY	MINOR	+ MEDIUM		Positive impact does not require mitigation	**+ Medium**

SOURCE OF RISK	POTENTIAL IMPACT	CONTEXT AND DURATION	ASSESSMENT			LOCATION	CONCLUSION AND MITIGATION	RESIDUAL RISK
			LIKELIHOOD	CONSE-QUENCE	RATING + or -			
Workers, inhabitants/visitors within immediate vicinity of shore landing locations								
Beach construction and cable landing operations	Human hazards working with / near large machinery, noise, dust	Construction activity and cable lay are very short term (less than 1 week)	POSSIBLE	MINOR	- LOW	All locations	Implement HSE Plan	No risk expected
	Traffic inconvenience along roads where cable will cross		POSSIBLE	MINOR	- LOW	Carriacou, Bequia	Notification of all works to the local community prior to commencement; construction period is short term, no other mitigation required	No risk expected
Governing Environment - Law and Policy Management								
Legal Framework	Works resulting in illegal activity	Short term	POSSIBLE	MODERATE	- MEDIUM	All locations	Implement ESMP	No risk expected

8.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The ESIA provides baseline information on the existing conditions of the PAI, potential impacts and mitigation measures designed to avoid, prevent, or minimize, the potential damage and negative impacts of cable laying and BMH construction on the natural and human environments within the PAI, including adjacent areas beyond the immediate footprint of the cable and BMH sites. These measures are reflected in this Environmental and Social Management Plan (EMP) to ensure that all actions are managed and that unforeseen or unidentified impacts of the project are detected and resolved.

The ESMP provides a plan and protocol for identifying and monitoring the parameters likely to be affected by the implementation of the Project. Additionally, the ESMP recommends actions prior to, and during, construction that shall mitigate the impacts of construction on the natural and human environments. A tabular summary of all mitigation measures is included in Table 42 at the end of this section.

8.1 Public Affairs

Digicel Group will continue to apprise internet users and the public about ongoing events regarding the CARCIP cable throughout construction. The following measure shall be applied:

1) Digicel will maintain a notification list of interested parties. As required, “SMS blasts” (short message service over cell phones) will be sent to this notification list.
    a) Introduction message to CARCIP and Lot 3, prior to construction of BMH and front haul
    b) Updates on progress
    c) Project Completion message thanking interested parties for their understanding and cooperation during the time.

8.2 Pre-Construction Phase

Prior to the implementation of the CARSIP Project, written approvals must be acquired from WB and relevant governments. It is expected that Digicel shall advertise and market its successful completion of the permitting process and detail the dates of commencement for implementation of the Project.

A key personnel contact list (relevant government officials, IT, Digicel, specialists, etc.) needs to be made available with a clear chain of command established for environmental management purposes.

The following Pre-Construction Phase measures shall be deployed up to ten days before commencement of work:

1) The final Routing Report should be made readily available in a non-technical summary detailing dates, general description of work and maps showing cable routes and BMH locations for use as part of the Public Notification of Work (for both cable laying operations offshore and BMHs).
2) Public notifications (flyers, newspaper ads and radio announcements) are required 10 days prior to commencement of work in key communities (and adjacent communities,

particularly fishing communities) where vessel operations are taking place and near BMH locations.

3) Demarcate areas of BMH construction using roadwork cones or similar (1 day prior to commencement of work). Contractors shall maintain a record of inspections (written & photos)
4) Conference, Grenada requires a flagging deterrent for avifauna foraging along the shoreline (particularly for the semipalmated sandpiper which is listed as threatened under the IUCN and was observed foraging along the shore during surveys). Contractors shall maintain a record of inspections (written & photos)
5) Onboard marine mammal/sea turtle observers identified; Sea turtle specialists (WIDECAST) notified and shall begin monitoring beaches (Conference and Carriacou). Contractors shall maintain a written compliance confirmed by specialists

8.3 Construction Phase: BMH Construction and Cable Landing

Immediately upon commencement of BMH construction and cable landing, the following Construction Phase measures shall be deployed:

1) Contractor shall ensure areas of BMH construction is undertaken in compliance with the specifications provided in Appendix IV and local construction and traffic control ordinances.
   a) Markers shall remain onsite during trenching of cables and during the construction of the BMHs. Markers shall be removed upon completion of work
   b) Contractor shall ensure that the correct notifications of the works are given to the local authorities.
   c) Contractor shall undertake works during daylight working hours and in compliance with local noise codes and ordinances.
   d) When working on roadways, the contractor shall provide traffic control measures.
   e) Contractor shall provide ductile iron or steel road plates to cover any exposed trenching to accommodate emergency access.
   f) Contractor shall maintain a daily record of inspections (written & photos)
2) Contractor shall ensure onsite erosion and sedimentation measures are included in each site design. The upland limits of construction shall be marked with sediment control fabric fencing. Rock and straw bale barriers shall be installed in drainage ways located inside the limits of construction. Soil stockpiles shall be protected with filter fabric fencing to keep contained and to avoid runoff into coastal waters in the event of heavy rainfall. Disposal of erosion and sediment control measures shall be in compliance with local disposal codes and ordinances.
   a) Contractor shall remove and dispose of all erosion and sediment measures upon completion.
   b) Contractor shall maintain a daily record of inspections (written & photos)

c) Pre-existing erosional areas (Union Island and Bequia) shall be demarcated prior to work to ensure erosion is not exacerbated by construction work. Contractor shall maintain a daily record of inspections (written & photos)

3) Contractor shall ensure turtle observation specialists are on-site (Conference, Grenada and Carriacou) during BMH construction and trenching activities

4) Any waste/garbage generated by contractors shall be removed and properly disposed of each day of work. Contractor shall maintain a daily record of inspections (written & photos)

5) Contractor shall ensure all construction equipment is in working condition AT ALL TIMES (no oil leaks, no well-maintained engines/low to zero exhaust) to reduce potential for any type of spills, poor air quality emissions and excess noise. Contractor shall conduct equipment maintenance at a facility established for such purpose. Contractor shall not change oil and oil filters on the construction site.

6) Work shall be suspended when any indication of faulty equipment is noticed and work may be resumed when repairs are completed. Contractor shall maintain a daily record of inspections (written & photos)

8.4 Construction Phase: Offshore Vessel Operations

The following actions shall be undertaken by vessel operators:

1) Trained marine mammal specialists shall be stationed on board to observe and notify the officer on watch of the presence of marine mammals and sea turtles during all marine activities

2) Maritime operations shall be temporarily suspended in the event any marine mammal or sea turtle is within 100 ft (30 m) of any cable laying vessel until the animal moves away from the area. Specialists shall maintain and certify records of operations and sightings.

3) Contractor shall ensure the vessel has an Oil Spill Prevention and Control Plan, a Waste Management Plan and a Hazardous Materials Management Plan

   a) Maintain adherence to Annex V of MARPOL prohibiting the disposal to sea of any plastics while restricting the discharge of other non-hazardous waste in coastal waters areas. Hazardous waste should be stored on board the vessel until it can be disposed at a suitably equipped port, respecting the requirements of the Basel Convention on Transboundary Shipment of Hazardous Wastes.

   b) Cable vessel is required to adhere to International Maritime organization (IMO) regulations on bilge and ballast water discharge in order to avoid unintentional introduction of non-native species to the marine environment.

4) Contractor shall ensure divers are used during cable laying operations in nearshore locations. At Carriacou in the nearshore, a marine biologist shall inspect and prepare a written compliance report as soon as cables are laid.

8.5 Operational Phase

The following measures shall be undertaken after construction and during operations:

1) Digicel Technical O&M Team will conduct inspections of the terrestrial portions of the cable infrastructure following the current maintenance plan. This includes bi-weekly visits to the identified locations to complete physical inspections of critical sites.
2) Impacts from extreme climatic events such as hurricanes is not expected to occur. For example, the passing of hurricane Maria (Category 4 at the time of land fall) across Puerto Rico in 2017 did not cause any cable damage. However, in the event of any damage, repairs shall be made by Digicel.
3) The deep-water cable is laid such that it is placed continuously in contact with the bottom in as straight a line as possible, avoiding kinks and suspensions.
4) The cable owner shall repair damages from storms, high wave energy and erosion.

8.6 Grievance Redress Mechanism

A Grievance Redress Mechanism (GRM) is provided here in the event that a citizen wishes to present a grievance, complaint or request for change. An example of a grievance is the failure of a contractor to fully complete a task such as restoring a trench following the 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 shall usually be resolved.

The GRM mechanism does not impede access to regular judicial process, but simply provides a simpler access to complaint resolution. The Proponent shall inform community members about the GRM before commencement of any marine work. This shall be done as part of consultation session where engineering details and project specifics shall be communicated.

The following six-step mechanism (Table 41) shall be implemented for grievance redress of social and environmental matters.

Table 41. Grievance Redress Mechanism Process

Step	Process	Duration
1	Affected Person (AP) takes grievance Proponent or Contractor	Any time
2	Proponent or contractor reviews issue, and in consultation with Grenada or St. Vincent Government provided CARCIP coordinator, relevant agencies and contractor (if appropriate), agrees to a solution and records the results.	2 weeks
3	Proponent reports to the AP and gets clearance the complaint has been resolved.	1 week
If Unresolved		

4	Proponent take grievance to Government Planning committee	Decision within 2 weeks
5	If not resolved the Government Planning committee must take the matter to the Relevant Minister for approval	2 weeks
6	Minters 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 the matter can be resolved in State or National Court		

During implementation, Digicel Group shall be responsible for implementing this mechanism. Digicel Group shall be the grievance focal point, and receive and address project related concerns, via a designated staff member. Concerns shall be resolved first by the Contractor Project Manager. Resolutions shall include notification to the commenters of their rights and options. During the construction period the contractor shall be a key participant in the grievance redress process, and the Contractor Project Manager shall assign a GRM coordinator if not self-performed.

Any complaint shall be recorded and investigated by the Proponent and the contractor (as appropriate). A complaints register shall be maintained, and shall 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 shall also cross-reference any non-compliance report and/or corrective action report or other relevant documentation filed in relation to the original complaint.

All corrective actions and complaint responses carried out on site shall be reported back to the Proponent and contractor. The Proponent shall include the complaints register and reporting on corrective actions/responses in its progress reports to the World Bank.

Throughout this process, the Government Planning departments shall always be available to hear public complaints and provide advice if the complainant feels that Proponent responses are not satisfactory. The Proponent and contractor shall make sure that this cooperation is available.

Mitigation Summary

The various mitigation measures to be applied during construction and operation typically are specific to the location and time at which project activity is ongoing. As a recapitulation of these mitigation measures, Table 42 is provided to assist implementation of the ESMP.

Table 42. Mitigation Measure Summary

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
Pre-Construction Period						
Natural Environment						
Terrestrial Environment	Disturbance of terrestrial organisms & habitats	Ensure routing report is prepared demonstrating route avoidance of habitats (specifically wetlands)	During pre-construction period	Routing report	Digicel	Digicel
Marine Environment	Disturbance of marine organisms and habitats	Ensure routing report is prepared demonstrating route avoidance of habitats	During pre-construction period	Routing report	International Telecom	Digicel
Protected Areas (National Parks & MPAs)	Disturbance of marine organisms and habitats in protected areas	Ensure routing report is prepared demonstrating route avoidance of habitats	During preconstruction period	Routing report	International Telecom	Digicel
Species potentially at risk	Entanglement in cable by marine mammals Nest excavation / disturbance of nesting turtles	Confirm inclusion in procedures	When procedures are being written	Record to file	International Telecom	Digicel
Human Environment						
Community Information	Misconceptions regarding the project raising people's fears over project footprint and potential damages to marine resources	Confirm that community consultation activities are taking place	At key project milestones	Note to file	Digicel	Digicel

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
Community Grievances	Minor concerns/issues developing community resentments due to unaddressed project related concerns.	Confirm that requirements for a grievance redress mechanism (GRM) is in Contract specifications.	During detailed design stage	A note to file	International Telecom	Digicel
		GRM is also implemented and records kept.	At all stages	Records kept		
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	Digicel	Digicel
Construction Period						
Natural Environment						
Marine Habitats	Disturbance of marine organisms and habitats	Inspect cable laying operation in coastal waters and confirm avoidance	As soon as work takes place into nearshore waters	Record of events - written and photos	International Telecom	Digicel
Coastal and Deep Ocean Habitats	Accidental discharge of pollutants from vessel.	Ensure vessel has proper procedures	At start of work and for all vessels used	Written compliance checklist	Digicel	Digicel
Coral Communities (Carriacou)	Impact on live coral heads	Marine biologist to 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 from marine biologist.	International Telecom	Digicel
Species of Special Interest – Cetaceans & Nesting sea turtles & nests	Entanglement in cable risk for deep diving cetaceans	Marine biology training on the sensitivity of cetaceans	Beginning of installation	Note to file	International Telecom	Digicel

PARAMETERS	PROJECT IMPACT	MONITORING	WHEN/ FREQUENCY/ DURATION	OUTPUT	IMPLEMENTATION	SUPERVISION
	Disturbance of nesting sea turtles & excavation of nests	Discussion with sea turtle specialist (Conference, Carriacou & Bequia)	Prior to and during BMH construction			
Human Environment						
Land Use	Straying of agreed to cable alignment into adjacent areas. Community perception of cable	Obtain review and file record/notes/ minutes of consultations completed	Within 5 days of land use issue consultation taking place	Record of community consultation	Digicel	Digicel
Access	Temporary loss of access to coastal & marine environment	Ensure access is temporary in nature	At start of construction where access restrictions could arise	Note to file	Digicel	Digicel
Post-Construction Period						
Natural Environment						
Coastal Erosion	Increased erosion	Inspection of BMHs for erosion from BMH to shore	Regular intervals after BMH installation	Report and corrective measures as require	Digicel	Digicel
Navigation Anchorage	Cable damage	Remote monitoring of cable system	After installation	Corrective measures to repair	Digicel	Digicel

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11.0 APPENDICES

11.1 APPENDIX I: TERMS OF REFERENCE

Caribbean Regional Communications Infrastructure Program (CARCIP)
Submarine Fiber Optic Cable
Between
St. Vincent and the Grenadines and Grenada

Terms of Reference

September 6, 2018

Point of contact:

Digicel Group

Mr. Niall Savage, Program Manager

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1.0 Background and Project Details

The Caribbean Regional Communications Infrastructure Programme (CARCIP) is a communications improvement program initiated collaboratively by the Governments of St. Vincent and the Grenadines, St. Lucia and Grenada; and funded by the World Bank. CARCIP will modernize and fill gaps in the region's Information and Communications Technologies (ICT) infrastructure to improve development opportunities and public service efficiency. Participating countries include St. Vincent and the Grenadines, St. Lucia and Grenada.

With this proposed project, CARCIP will install and operate a modern submarine telecommunications cable between St. Vincent and Grenada with cable landings on the intervening islands of Bequia, Mustique, Canouan, Union Island and Carriacou. An additional submarine cable link will be installed between Chateaubelair and Fancy on St. Vincent (Figure 1). The submarine cables will tie into terrestrial cables, cable stations and routed to users such as government offices and schools onshore.

The system will connect St. Vincent and Grenada – who currently have high-speed fiber optic service via Southern Caribbean Fiber – with smaller islands currently only serviced using microwave radio, and will support expansion of high bandwidth 4G LTE wireless services, HDTV, government services and business, along with high-speed internet for local & tourism users to these islands.

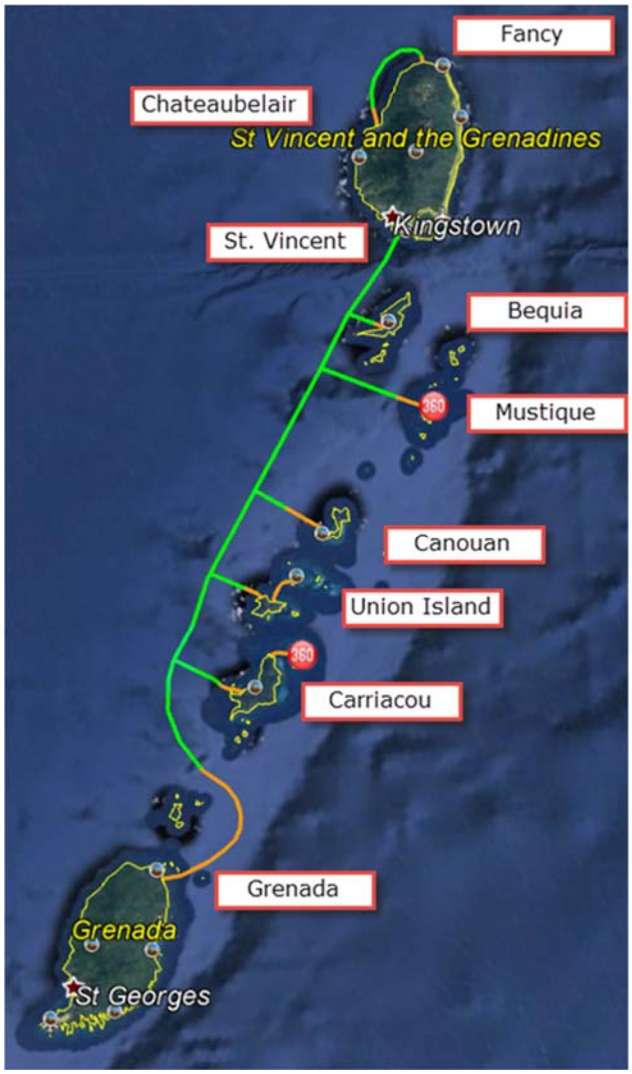


Figure 1: CARCIP cable route overview.

1.1 Objectives

The object of the CARCIP project is to enable Grenada as well as St. Vincent and the Grenadines to advance the development of Information and Communication Technologies (ICT) and to foster regional economic development and growth. This objective will be supported by the installation of the fiber optic submarine cable to individual islands.

1.2 Key infrastructure and location

The basic infrastructure components of this project will comprise:

- Approximately 225km of fiber optic cable, incorporating Branching Units (BUs) (Figure 2) laid on the sea floor. Both double (Figure 3) and single armor cable (Figure 4) will be used and
- A beach manhole landing facility at each landing site. From the beach manhole, cable will be installed at a later date to connect with new and existing fiber optic cabling ashore.

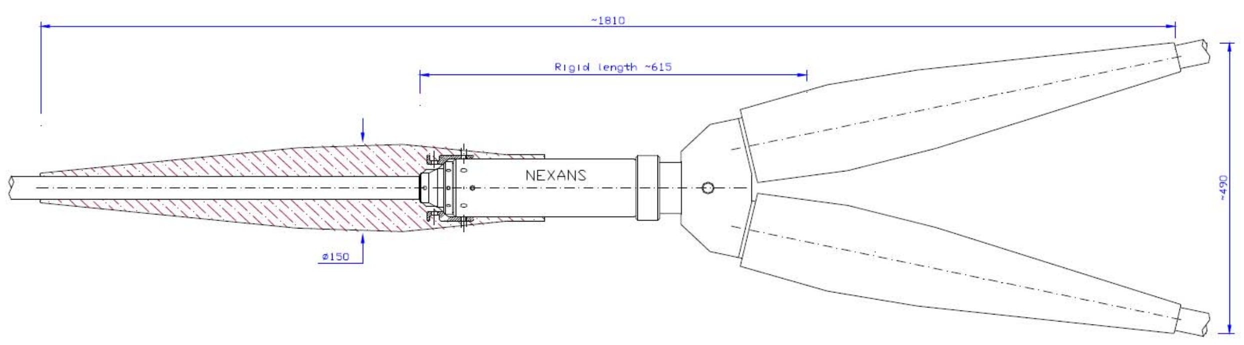
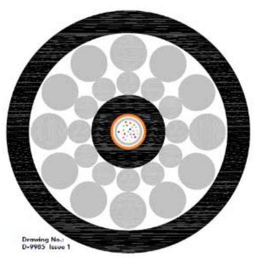


Figure 2: CARCIP branching unit details.

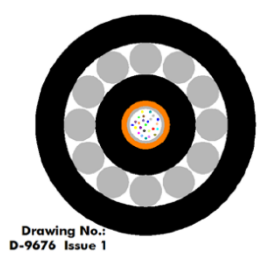
Figure 3 below shows indicative cross-sections of Double Armour (DA) cable type.



Physical characteristics	Unit	Nominal value	±
Cable core diameter	mm	10	1
Cable outer diameter	mm	33	1.5
Weight in air, approx.	kg/m	3.2	0.2
Weight in seawater, approx.	kg/m	2.3	0.2

Figure 3: CARCIP double armour cable type.

Figure 4 below shows indicative cross-sections of Single Armour (SA) cable type.



Physical characteristics	Unit	Nominal value	±
Cable core diameter	mm	10	1
Cable outer diameter	mm	20/22	1.5
Weight in air, approx.	kg/m	1.1	0.2
Weight in seawater, approx.	kg/m	0.7	0.2

Figure 4: CARCIP single armour cable type.

1.3 Location

The preferred cable landing locations will be developed from options on each island based on environmental, social and execution aspects. The alternative cable routes, landing sites and considerations of selection will be documented in the Cable Route Study (CRS). Current provisional cable landing options are identified herein. Refer to Figure 1, cable route overview, and Figure 5 through Figure 13 below.

The defined route and the location of the beach manholes will be determined through the design process. Each of the optional landing sites will be addressed as alternatives in the Environmental and Social Impact Assessment (ESIA) process.

1.3.1 Fancy

Fancy, located at the northern end of St. Vincent, has four optional shore ends (Figure 5).

Figure 5: Fancy Shore End Options

1.3.2 Chateaubelair

Chateaubelair, also located at the northern end of St. Vincent, has three optional shore ends (Figure 6).

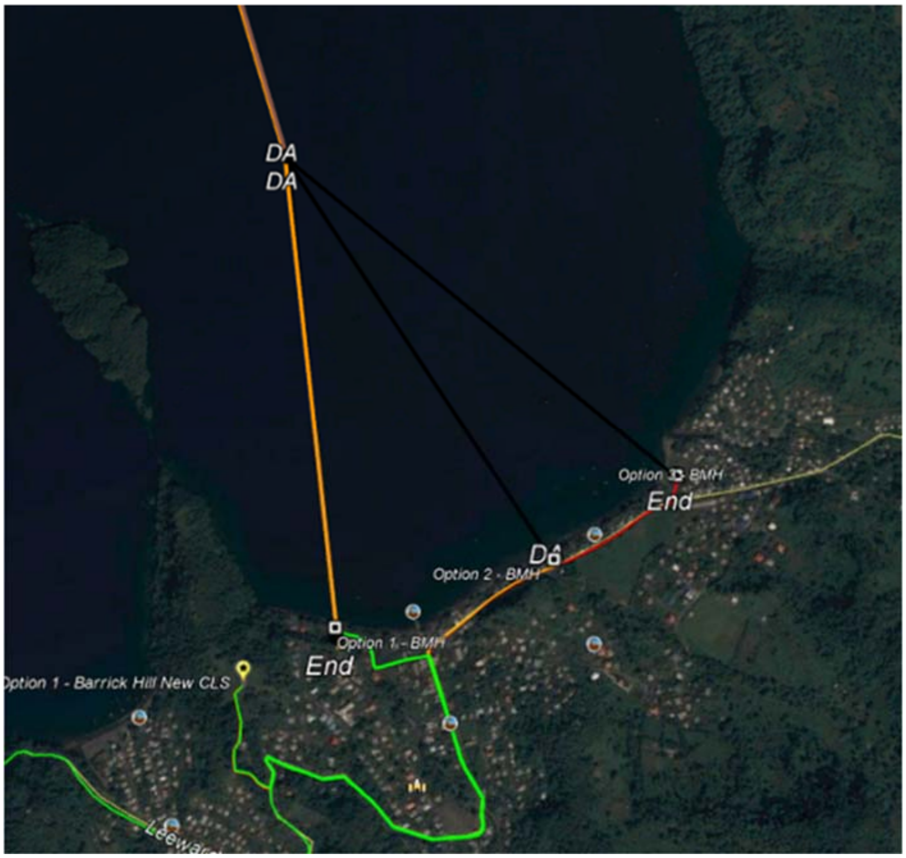


Figure 6: Chateaubelair shore end options.

1.3.3 Arnos Vale, St. Vincent

On the southern end of St. Vincent, the shore end location will be an existing beach manhole near the Arnos Vale Stadium (Figure 7).

Figure 7. Arnos Vale, Saint Vincent preferred shore end location.

1.3.4 Bequia

Two shore end location options are in consideration for the island of Bequia (Figure 8).

Figure 8: Bequia shore end options.

1.3.5 Mustique

Two shore end options exist for the Mustique locations as outlined in Figure 9.

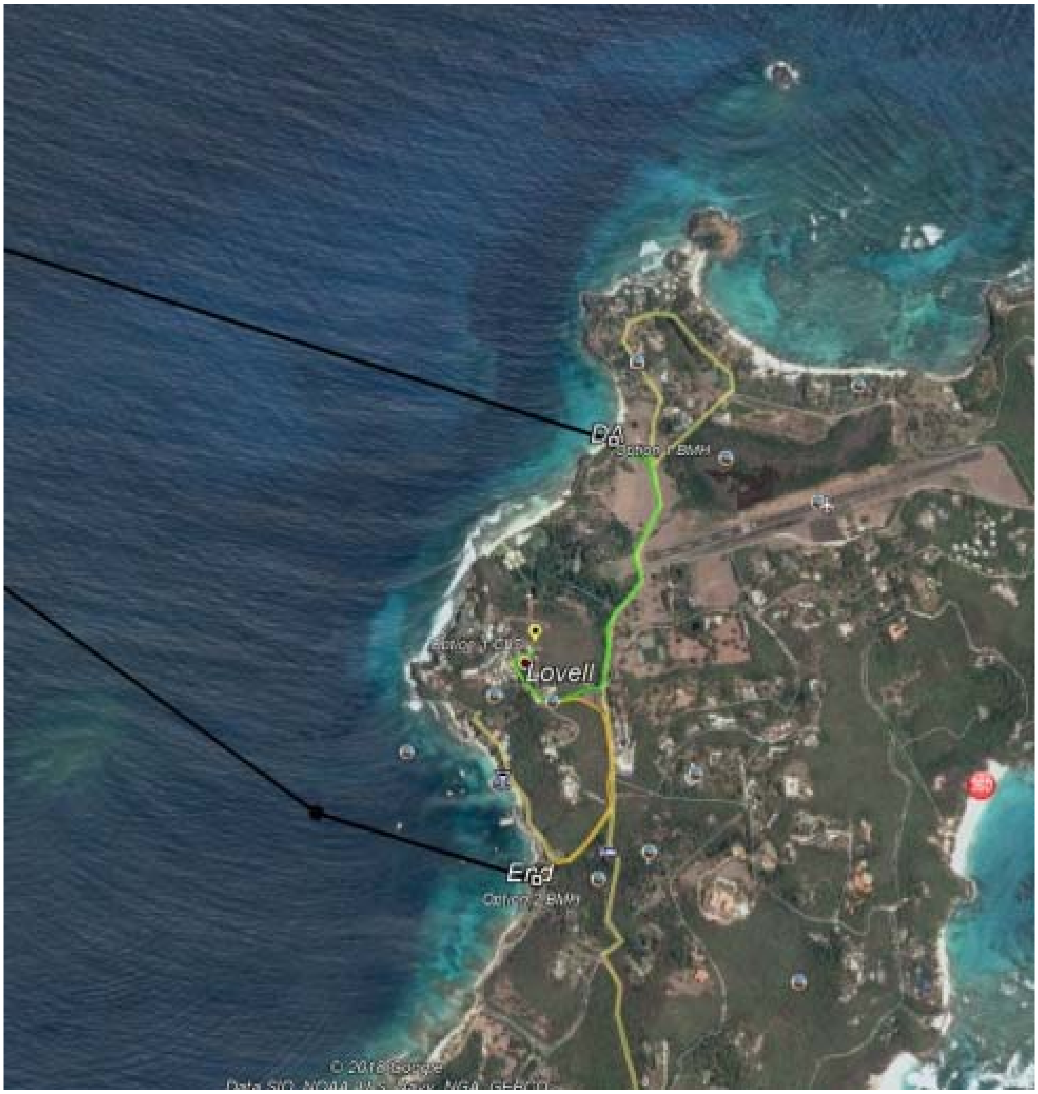


Figure 9: Mustique shore end options.

1.3.6 Canouan

Three shore end options exist for the Canouan locations as outlined in Figure 10.

Figure 10: Canouan shore end options.

1.3.7 Union

Two shore end options exist for the Union locations as outlined in Figure 11.

Figure 11: Union shore end options.

1.3.8 Carriacou

Four shore end options exist for the Carriacou locations as outlined in Figure 12.

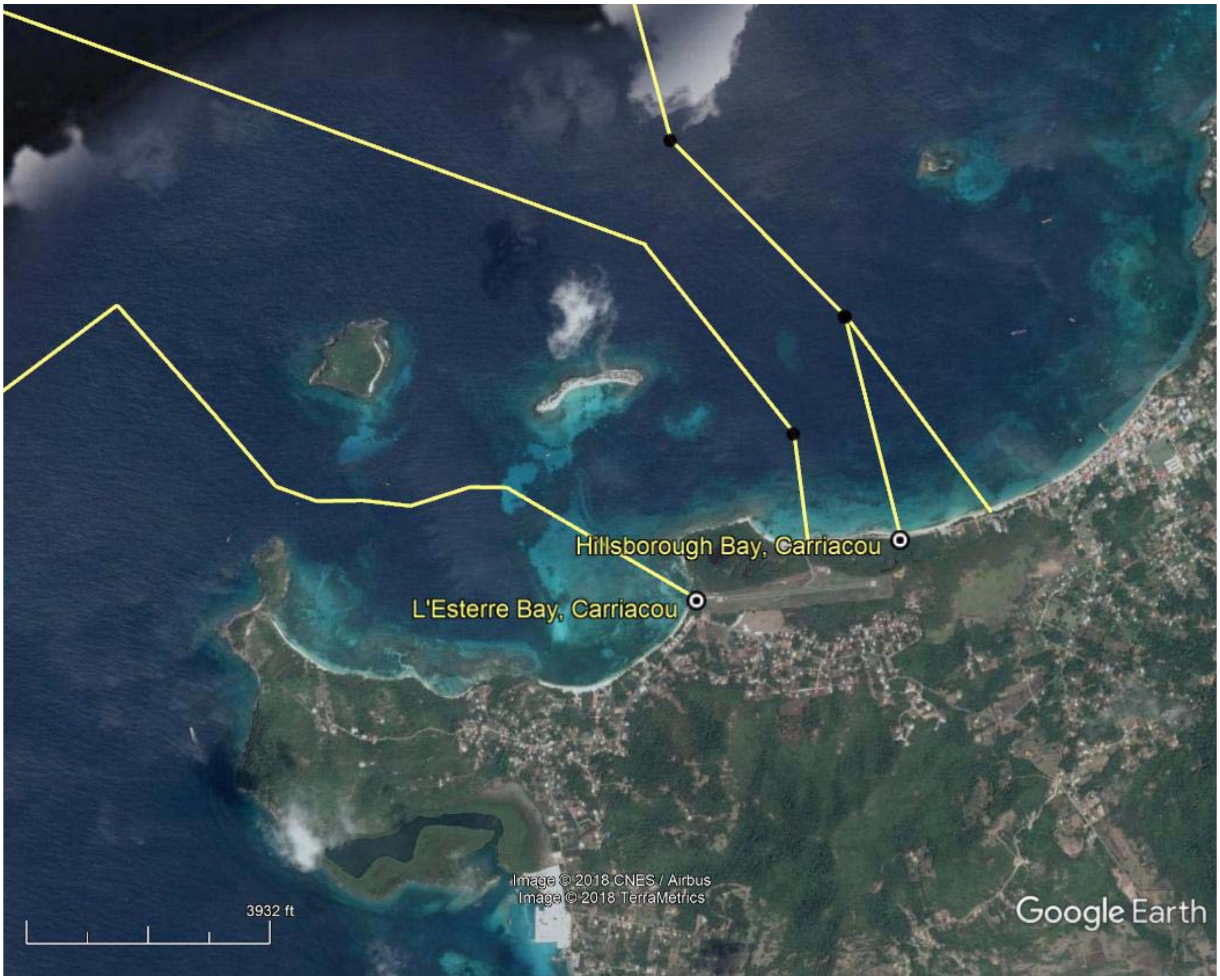


Figure 12: Carriacou shore end options.

1.3.9 Grenada

Three shore end options exist for the Grenada locations as outlined in Figure 13.

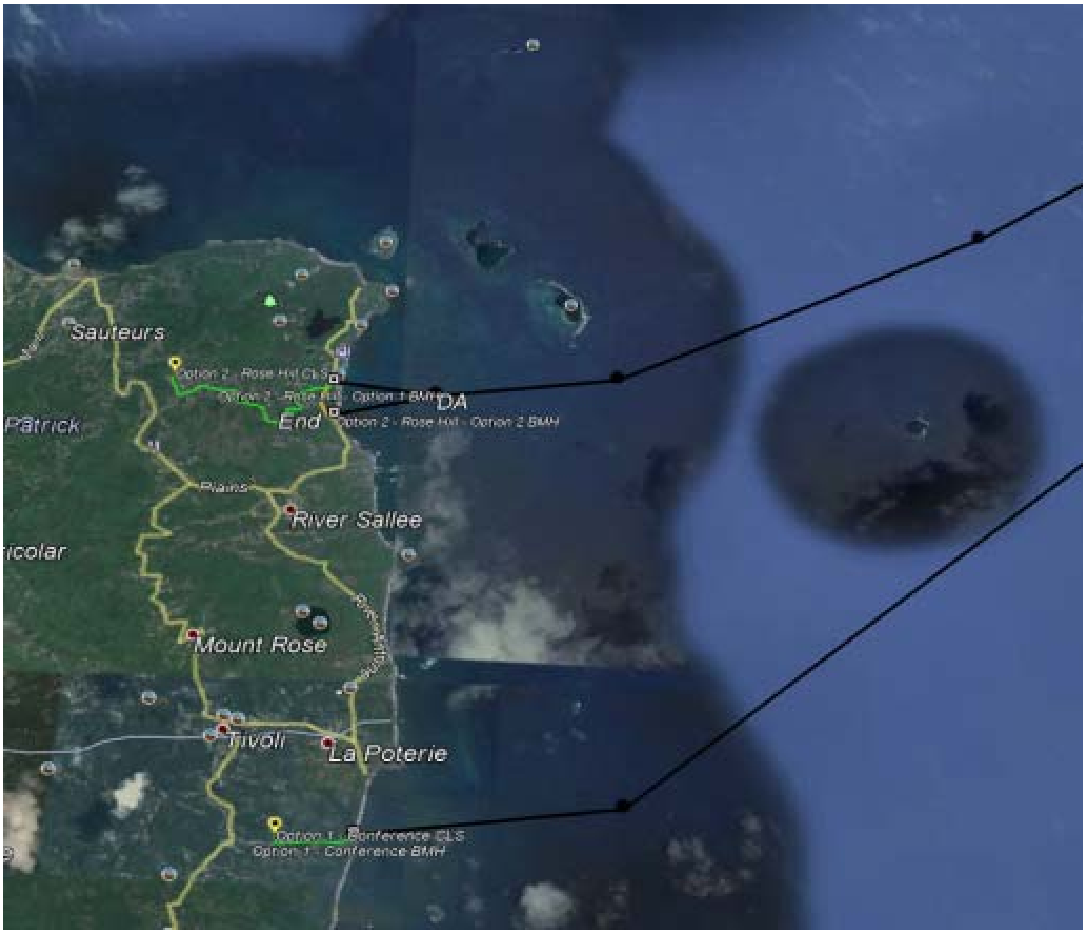


Figure 13: Grenada shore end options.

1.4 Project design and installation process

The CARCIP cable system is planned to be installed in a one-vessel campaign in the spring / summer of 2019. Before installation, a cable route study and marine route survey will be done concurrently. The cable route study will address details such as the environmental features, metocean data and technical aspects of proposed routes and landing sites.

The main construction-phase activities of the Project will include a detailed marine survey to characterize the route and avoid hazards and/or environmentally significant zones. These 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 CARCIP installation commonly assesses a seabed corridor from 1 to 10 km wide with repeat passes where necessary. A detailed design of the submerged infrastructure (cable and repeaters) will determine the cable route and cable types and quantities, and clarify the nature of its deployment on the seafloor – surface laying, or burial, supplementary protection, etc.

In parallel with design efforts, applications for all relevant permits and authorizations by the both Grenada and St. Vincent and the Grenadines Government agencies (including preparation of ESIA and land access authorizations) will be completed before installation can begin.

The cable will be surface-laid along the entire route with a potential for a small area of diver burial in willow waters. Construction of landing facilities will comprise a small beach manhole (BMH) approximately 6.6 ft x 6.6 ft x 6.6 ft located about the high-water mark. The shore end, from the BMH to the sea, will be covered with standard articulated piping and then double armored cable to a water depth of 656 feet followed by single armored cable in deeper water depths.

1.5 Scope of WB Safeguards Requirements

The SVG-GR CARCIP project will be implemented within WB safeguards policy OP4.01 Environmental and Social Impact Assessment, OP 4.04 - Natural Habitats, and OP 4.11 Physical Cultural Resources. An Environmental and Social Impact Assessment (ESIA) of the project is required to assess potential environmental and social impacts; to engage project-affected groups and non-governmental organizations; and to prepare an Environmental Management Plan (EMP). The EMP will address measures to mitigate (avoid, reduce, or offset) adverse environmental impacts during implementation and operation of the SVG-GR CARCIP project and the actions needed implement these measures. The EMP will be integrated into the ESIA. The provisional ESIA Table of Contents is included in Section 8.0 Appendix B – Environmental and Social Impact Assessment (ESIA) Table of Contents

The ESIA will reference the Cable Route Study (CRS) to address protection, maintenance, and rehabilitation of natural habitats and their functions within WB safeguards policy. The ESIA will identify natural habitat issues and special needs for natural habitat conservation, including the degree of threat to identified natural habitats, and measures for protecting such areas in the context of Saint Vincent and the Grenadines and Grenada development principles. The ESIA will consider feasible alternatives for the project and proposed locations and demonstrate overall benefits of the project.

The project will also be consistent with the CARCIP Environmental and Social Management Framework (ESMF).

2.0 Country Context

Both Saint Vincent and the Grenadines and Grenada have ratified several international environmental Agreements and Conventions and by their signature of the St. Georges Declaration (SDG) of 2001 have committed themselves to the Principles for Environmental Sustainability in the Organization of the Eastern Caribbean States (OECS). They all have in place several pieces of legislation and institutions to protect their environments; some of those legislations were originally enacted in the 1940's and amended in recent times.

The primary focus from environmental legislation in these countries has been on the protection of sensitive and important natural resources, protection of public health and safety, and the promotion of sound environmental and natural resource management principles and practices.

2.1 Saint Vincent and the Grenadines

In Saint Vincent and the Grenadines, the National Telecommunications and Regulatory Commission (NTRC) provides regulatory oversight of telecommunications development. The NTRC operates under the Treaty Establishing the Eastern Caribbean Telecommunications Authority (ECTEL) of 2000 and the Saint Vincent and the Grenadines Telecommunications Act No. 1 of 2001. This project will follow policies and procedures of the NTRC during environmental and permit review.

Physical planning in Saint Vincent and the Grenadines for this project will follow the Town and Country Planning Act, 1992, as amended. A Physical Planning and Development Board (PPDB) of 14 members are the executive of the Act. PPDB members are selected from various government ministries/departments, and other public offices.

The Physical Planning Unit (PPU) is responsible for the implementation of the Act and board directives. The PPU is responsible for development planning (figure 3.3) and development control as the regulatory body. Ministries represented on the PPDB include government officers (or their nominees) as officio members of the Board:

- Director of Planning;
- Head of National Properties Ltd;
- Chief Engineer;
- Chief Agricultural Officer;
- Chief Surveyor;
- Chief Environmental Health Officer;
- General Manager of Housing and Land Development Corporation;
- Manager of Central Water and Sewerage;
- General Manager of St Vincent Electricity Services Ltd;
- Commissioner of Police;
- Warden of Kingstown Town Board; and
- Additional members as appointed by the Cabinet.

2.2 Grenada

Grenada also has a National Telecommunications and Regulatory Commission (NTRC) which provides regulatory oversight of telecommunications development. The Grenada NTRC operates under the Telecommunications Act of 2000. This project will follow policies and procedures of the Grenada NTRC during environmental and permit review.

Physical planning in Grenada will follow the Physical Planning Development Control Act Number 23 of 2016. The Development Control Authority (DCA), Ministry of Infrastructure Development, Public Utilities, Energy, Transport & Implementation, is responsible for implementation of the of the Act. Environmental documentation submitted to the DCA is reviewed by the following ministries:

- Ministry of Health;
- Ministry of Works;
- Government Structural Engineer; and
- Government Architect.

3.0 Scope of Services

3.1 Policy, legal and administrative framework

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.

Relevant physical planning legislation in Saint Vincent and the Grenadines that will be followed by this project includes:

- The Town and Country Planning Act;
- The Waste Management Act;
- The Environmental Health Services Act;
- The Wildlife Protection Act;
- The Forest Resource Conservation Act;
- The Marine Parks Act; and
- The National Parks Authority Act.

Relevant physical planning legislation in Grenada that will be followed by this project includes:

- Physical Planning Development Control Act Number 23 of 2016;
- Waste management Act of 2001;
- Waste Management Act of 2001;
- Fisheries Act of 1986;
- National Parks and Protected Areas Act of 1991;
- Amendment to the Beach Protection Act (Prohibits sand mining); and
- National Trust Act.

3.2 Existing Marine and Shoreline Context

The consultant will define a suitable project influence area (PIA) based on the proposed corridor of the marine cables, and the proposed location(s) of terrestrial infrastructure, and all reasonable alternatives.

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 include at least one field visit to each of the nine landing sites. 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.

The consultant will assess the following topics within the project area of influence through onsite assessment, literature review and interviews with stakeholders:

- Marine conservation, management and protected areas.
- Archeological, cultural or historical properties including shipwrecks.
- Land use and land ownership of landing sites.
- Social and economic marine use including fishing, mining, shipping and tourism.
- Near shore and reef hydrography and bathymetry, tidal data or any other data required to support cable installation.
- Social context of the islands. Characteristics should include basic socio-economic data, population, and issues relating to gender or vulnerable persons in relation to the proposed project.

The purpose of the data collection is to describe the nature of the environment, describe the social context and identify sensitive sites and receptors that should be avoided by the project. Three disciplinary areas are of special interest:

3.2.1 Physical

The contractor will obtain physical oceanographic and onshore topographic data during production of the Cable Route Survey (CRS) also being conducted for this project. Offshore data will include bathymetry, geology, hydrology and climate. These data will be correlated with the impact assessments of the ESIA.

Of primary interest are hazards to the cable itself as well as potential adverse environmental effects. Risks from seismic activity, tropical hurricane, flash flood, storm surge and coastal erosion will be included. These data for the region will be analyzed to route the cable appropriately.

3.2.2 Biological

The contractor will describe the general characteristics of coastal and marine habitats adjacent to each BMH and along the potential cable alignments as observed during site visits conducted 3-9 September 2018 at each landing site. Additional site visits to each of the Grenadine islands will collect data on fish assemblages in the nearshore and reefs; benthic coverage of live coral and seagrass with attention to species listed by the The International Union for Conservation of Nature (IUCN) Red List[1]; dominant biotic and abiotic habitat types; population sizes of key indicator species, *Diadema antillarum, Strombus gigas*, *Panulirus argus and P. guttatus*; and absence/presence of coral diseases.

The contractor will also describe in detail the shoreline, including a qualitative assessment of the terrestrial ecology (vegetation) found within 10m of each proposed manhole site. This assessment

[1] https://newredlist.iucnredlist.org/

will also include known avifauna that frequent the general area. The total distance to any mangrove species and/or wetland area will also be measured from the BMH location. Water quality testing will be carried out using a Hach DR900 handheld portable meter. Parameters include nitrates, phosphates, pH, salinity and water temperature.

There are a number of marine protected areas within the study area that will be considered. Turtle nesting has been identified at a number of beaches within study area; shore-end operations will be planned to avoid or reduce impact on turtles. Sensitive habitats (coral, seagrass and mangroves) and will be avoided likewise. The EMP will identify Best Management Practices to insure avoidance of adverse impact where appropriate.

3.2.3 Social and Public Involvement

During the ESIA process, the consultant will contact project-affected groups and local nongovernmental organizations (NGOs) regarding the project's environmental aspects and will take their views into account. These consultations will be conducted earlier than, and in addition to any government-initiated public consultations held after the ESIA is published in its initial form. Consultations with the government officials and the public at large will be initiated as early as possible to support the analysis of the ESIA. Public opinion will be obtained through a person-on-the-street survey. The survey is described in detail in Appendix A, Social Survey.

Additional social information will be brought forward from the concurrent CRS into the ESIA:

- Fishing is an important sector to the local people, the sector is predominately small scale (nets, pots) and longline. Most fishermen operate from small boats close to shore using traditional methods. No bottom trawling is conducted. Whaling is conducted by the people of Bequia, the annual quota is four whales a year, whaling season is February through April.
- The majority of vessel traffic in the study area is inter-island ferry, cruise and cargo. The area is very popular for pleasure boating with the busiest time from January to April.
- Marine protected areas (MPA) have been identified by the governments to conserve habitats, species and sensitive environments.
- A few of the preferred landings are located near or within anchorages, cable awareness plan will be key.
- Coastal construction on Canouan is currently ongoing, proposed developments on Carriacou and northern Grenada could impact landing sites. Illegal sand mining has been identified throughout study area. There are plans to relocate the p[ort from Hillsborough to Tyrel Bay.

3.3 Environmental and Social Impact Assessment

The consultant will prepare an ESIA for the proposed project to apply for both Saint Vincent and the Grenadines and Grenada consent. The purpose of the ESIA is to evaluate the project's potential environmental risks, examine alternatives, identify optimal routing of undersea cables, siting of cable landing stations, and recommend measures to mitigate, manage and/or avoid adverse environmental impacts during project construction and operation. The ESIA will address environmental effects from submarine cable installation and operation in both Saint Vincent and the Grenadines and Grenada. The ESIA will be used in application for project approval from two host nation approvals following their respective planning laws and the requirements of the National Telecommunications Regulatory Commission (NTRC). As discussed above, an EMP will be integrated into the ESIA.

The ESIA will address this project as a Category B project (no significant impact) in conformance with the World Bank Operational Manual OP 4.01 – Environmental and Social Impact Assessment (Revised April 2013). The ESIA will also conform to the guidance of the Environmental Management Framework (EMF) prepared for the CARCIP project (December, 2011).

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. 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. 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.

The ESIA preparation will include the following surveys within the project area of influence:

- Identification of land use and land ownership at the proposed beach manhole and cable route locations.
- Marine survey of reef areas potentially affected along proposed cable routes (Section 3.2.2).
- Location of shipwrecks, designated historical properties and the likelihood of prehistoric artifacts.
- Identification of 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.

Additional information will be gathered desk top review and interviews:

- Near shore and reef hydrography and bathymetry, tidal data or any other data required to support the marine survey.
- Conservation and marine management areas, including fisheries, marine protected areas and terrestrial protected areas.
- Archaeological sites, sites of cultural significance or other physical cultural resources.
- Social context of the islands. 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 the CARCIP project.

The consultant will identify the social benefits and negative impacts from the project, with a focus on the connectivity of the islands to improved communications technology. Guidance provided in these documents will be followed to address the need for environmental impact mitigation.

4.0 Required Skills of the Consultant

The assignment requires a suitably qualified team with knowledge of, and relevant professional experience with conducting environmental and social impact assessments for similar projects. The following skill sets are required.

4.1 Telecommunications Cable Engineer

An established submarine telecommunications cable design and installation team will be required to conduct a Cable Route Survey (CRS) identifying sensitive subsea and terrestrial features, habitats, restrictions that will cause cable route avoidance, to design the cable route according to findings of the CRS and install the cable to a designated landing site beach man hole. The CRS will present hazards to cable placement and risks to continued cable operation. The CRS will also identify optional landing sites and considerations for selection of a preferred landing site at each of the islands to be connected. The Cable Engineering team will have the experience, capacity and ability to design, purchase and install fiber optic submarine cabling and install a beach manhole at each landing site.

4.2 Environmental Planner

Preparation of the ESIA will be planned and managed by an Environmental Planner with senior level experience of 10 years or more. A graduate level degree in Environmental Management, related environmental science or environmental engineering is required. Environmental planning will be conducted in an ethical manner.

The ESIA will be edited by the Environmental Planner using narrative and analytical information collected by a Marine Scientist and a Permit Engineer.

4.3 Marine Scientist

Marine surveys and impact assessment will be conducted by the Marine Scientist with PhD education level. The Marine Scientist must have a PhD degree in a relevant life science discipline and experience in coastal and shoreline management.

The Marine Scientist will complete a marine survey of the reef area between the outer reef and the high-water mark, along proposed / likely cable routes. Observations will include visual observation of species and habitats in the nearshore environment at proposed landing locations. Shipwrecks and other archaeological, cultural or historical artefacts or sites will be noted.

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. Social activity at the landing sites will be observed during site visits and in interviews with stakeholders.

4.4 Permit Engineer

Project engineering documentation and project facilitation will be provided by an Engineer located in either Saint Vincent and the Grenadines or Grenada. The Permit Engineer will have a graduate degree in engineering or relevant discipline and be familiar with the personnel and procedures of each government.

5.0 Deliverables of the Consultant

Deliverables include:

- Cable Route Study
- Environmental and Social Impact Assessment
- Construction Permits

The consultant team will report to the project owner on a weekly basis regarding the overall status of the project and progress toward achieving deliverable milestones. The consultant team will maintain a schedule of tasks and milestones required to provide deliverables on a suitable timeframe as agreed between the owner and consultant team.

6.0 Timeline

The duration of the project is approximately one year and includes the following milestones:

Site Visits and Agency Consultation ....September 2018
Marine Surveys ....October 2018
Social Surveys ....October 2018
Environmental and Social Impact Assessment distributed.........November 2018
Government Public Consultation...November 2018
Governments' Project Approval ....December 2018
Construction and Minor Works Permits ....December 2018
NTRC Licensing, separate process by project owner................January 2019
BMH Construction..January 2019
Cable Laying...May-June 2019
System Testing..June 2019

7.0 Appendix A – CARCIP Social Survey

Project Description
(Read this description and/or show the Slideshow to respondents before questions)

The Grenada to St. Vincent Submarine Cable System is intended, as part of the larger CARCIP initiative, to develop and support Information and Communications Technology (ICT) in the region via provision of undersea fiber optic communications infrastructure.

The system will connect St. Vincent and Grenada, who currently have high-speed fiber optic service via Southern Caribbean Fiber, with smaller islands currently only serviced using microwave radio, and will support expansion of 4G LTE wireless services, HDTV, government services, along with high-speed internet for local & tourism users to these islands:

Island, Segment	Site Name
GRENADA	Conference
ST. VINCENT, South	Arnos Vale
BEQUIA	Lower Bay
MUSTIQUE	Endeavor Bay
CANOUAN	Nens' Bay
UNION	Airport - Preferred
CARRIACOU	L'Esterre Bay
ST. VINCENT, North	Chateaubelair (Leeward)
	Owia (Windward)

Construction applications will be submitted to the governments of Saint Vincent and the Grenadines and Grenada in October and an Environmental and Social Impact Assessment will be prepared, submitted to both governments, and available in late November 2018.

We are interested in your thoughts and ideas on this project so that we can prepare an Environmental and Social Impact Assessment with your opinions in mind. Please help us formulate a course of study that will consider your comments by answering the following questions. This will not be your only opportunity to comment. The governments of St. Vincent and the Grenadines and Grenada will organize public consultation opportunities after the Environmental and Social Impact Assessment is prepared.

Questions

1. What is your opinion of the current internet services you now have?
    a. I am satisfied
    b. I not satisfied
    c. I have no opinion
2. What would you like to see improved in your current internet services?
    a. Improved internet speed
    b. Fewer interruptions and less down time

   c. Lower internet service price
   d. I have no opinion
3. What are your primary environmental concerns at the construction sites, if any?
   a. Turtle conservation
   b. Coral protection
   c. Water quality
   d. Hazardous material spills
   e. Other ________________________
4. Do you expect this project would change your life in any way?
   a. No, not at all
   b. Yes, probably for the better
   c. Yes, probably for the worse
   d. I don't know
5. What could we study in our ESIA that would help you understand the environmental impacts of this project?
   a. Social issues
   b. Air or Water quality
   c. Deep ocean sea floor habitats
   d. Nearshore sea floor habitats
   e. I'm satisfied with what the authors will do
   f. Other___________________________
6. Do any of these anticipated impacts bother or upset you?
   a. Boats and divers near shore laying cable by hand
   b. Large cable laying vessel in sight of land
   c. Small fiber optic cable buried underground on the beach
   d. Beach manhole buried above sea level
7. In Question 6, if you are bothered by any of the selections, how could we minimize or avoid such impacts?
   a. Shorten the presence of marine cable laying equipment at the landing sites.
   b. Shorten the duration of construction on the beach to install an underground beach manhole to house the cable connections.
   c. Change the landing site location
   d. Other ___________________________
8. After seeing a picture or a sample of submarine internet cable, are your views about question 6 changed in any way?
   a. Yes
   b. No
   c. No opinion
9. Are you familiar with any of the proposed landing sites? What kind of ongoing activities might conflict with installing a cable and beach man hole at these sites?
   a. Housing
   b. Recreation
   c. Commercial
   d. Conservation

  e. Tourism
  f. Other ___________________

10. Are you aware of any internet service discrimination due to your gender, race, or religion?
  a. Gender
  b. Race
  c. Religion
  d. Other _______________

8.0 Appendix B – Environmental and Social Impact Assessment (ESIA) Table of Contents

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11.2 APPENDIX II: CODES OF PRACTICE

11.2 APPENDIX II: CODES OF PRACTICE

11.2.1 Subsea Cable Laying and Landing (telecommunications)

The cable installer carries safety certification. Safety is the first objective with a corporate goal of Zero Incidents is the basis the Occupational Health & Safety Assessment Series (OHSAS) 18001 certified Safety Management System (SMS).

The cable installer is also committed to minimizing the impact on the environment while growing its business. The contractor has implemented an International Organization for Standardization (ISO) 14001 certified Environmental Management System (EMS) which incorporates pollution prevention and reduction initiatives into daily operations.

11.2.2 Environmental Planning

The ESIA has been prepared by professionals who subscribe to the following Environmental Code of Practice:

The Academy of Board Certified Environmental Professionals, Inc.
Code of Ethics and Standards of Practice for Environmental Professionals

Introduction. The objectives of Environmental Professionals are to conduct their personal and professional lives and activities in an ethical manner. Honesty, justice and courtesy form moral philosophy which, associated with a mutual interest among people, constitute the foundation of ethics. Environmental Professionals should recognize such a standard, not in passive observance, but as a set of dynamic principles guiding their conduct and way of life. It is their duty to practice their profession according to this Code of Ethics. As the keystone of professional conduct is integrity, Environmental Professionals will discharge their duties with fidelity to the public, their employers, clients, and with fairness and impartiality to all. It is their duty to interest themselves in public welfare, and to be ready to apply their special knowledge for the benefit of mankind and their environment.

Creed. The objectives of the Environmental Professional are:
1. To recognize and attempt to reconcile societal and individual human needs with responsibility for physical, natural, and cultural systems.
2. To promote and develop policies, plans, activities and projects that achieve complementary and mutual support between natural and man-made, and present and future components of the physical, natural and cultural environment.

Ethics. As an Environmental Professional I will:
1. Be personally responsible for the validity of all data collected, analyses performed, or plans developed by me or under my direction. I will be responsible and ethical in my professional activities.
2. Encourage research, planning, design, management and review of activities in a scientifically and technically objective manner. I will incorporate the best principles of the environmental sciences for the mitigation of environmental harm and enhancement of environmental quality.
3. Not condone misrepresentation of work I have performed or that was performed under my direction.
4. Examine all of my relationships or actions which could be legitimately interpreted as a conflict of interest by clients, officials, the public or peers. In any instance where I have a financial or personal interest in the activities with which they are directly or indirectly involved, I will make a full disclosure of that interest to my employer, client, or other affected parties.
5. Not engage in conduct involving dishonesty, fraud, deceit or misrepresentation or discrimination.
6. Not accept fees wholly or partially contingent on the client's desired result where that desired result conflicts with my professional judgment.

Guidance for Practice as an Environmental Professional. As an Environmental Professional I will:
1. Encourage environmental planning to begin in the earliest stages of project conceptualization.
2. Recognize that total environmental management involves the consideration of all environmental factors including: technical, economic, ecological, and sociopolitical and their relationships.
3. Incorporate the best principle of design and environmental planning when recommending measures to reduce environmental harm and enhance environmental quality.
4. Conduct my analysis, planning, design and review my activities primarily in subject areas for which I am qualified, and shall encourage and recognize the participation of other professionals in subject areas where I am less experienced. I shall utilize and participate in interdisciplinary teams wherever practical to determine impacts, define and evaluate all reasonable alternatives to proposed actions, and assess short-term versus long-term productivity with and without the project or action.
5. Seek common, adequate, and sound technical grounds for communication with and respect for the contributions of other professionals in developing and reviewing policies, plans, activities, and projects.
6. Determine that the policies, plans, activities or projects in which I am involved are consistent with all governing laws, ordinances, guidelines, plans, and policies, to the best of my knowledge and ability.
7. Encourage public participation at the earliest feasible time in an open and productive atmosphere.
8. Conduct my professional activities in a manner that ensures consideration of technically and economically feasible alternatives.

Encourage Development of the Profession. As an Environmental Professional I will:
1. Assist in maintaining the integrity and competence of my profession.
2. Encourage education and research, and the development of useful technical information relating to the environmental field.
3. Be prohibited from lobbying in the name of the National Association of Environmental Professionals.
4. Advertise and present my services in a manner that avoids the use of material and methods that may bring discredit to the profession.

11.3 APPENDIX III: VESSEL AND CABLE SPECIFICATIONS

APPENDIX III: VESSEL AND CABLE SPECIFICATIONS

- **CS IT Intrepid**

International Telecom — Simply the best !

C.S. IT INTREPID

The IT Intrepid is a fully furnished cable ship capable of installation and maintenance activities in all ocean depths. Her immediate responsibility is to be on cable repair and maintenance stand-by for the *Sentinel Maintenance* program. The IT Intrepid is fitted with the IT ROVJET 207 for cable work and inspection to 2,500m.

SPECIFICATIONS

DIMENSIONS
Length Overall 115.0m
Breadth Moulded 18.0m
Depth Moulded 10.1m
Max Draught 6.3m
Gross Tonnage 6141t
Port of registry ....Barbados

CLASSIFICATION
ABS, A1, AMS, ACCU
(Previously LR Ice Class 3)

DYNAMIC POSITIONING
Cegelec 900 series

POWER AND PROPULSION
2 x Main engines at 2,200kW
2 x Auxiliary engines at 750kW
2 x Propulsion Motors at 2,000kW

EMERGENCY GENERATORS
1 x 350kW Caterpillar diesel

SPEED/ENDURANCE
Maximum Speed ....13.5 Knots
Cruising Speed ....12 Knots
Endurance 42 days @ 12 Knots

THRUSTERS
Bow Thruster.........1 x White Gill 750kW
Stern Thruster.......1 x White Gill 750kW

CABLE MACHINERY
2 x 3.5m dia. CDE, 40t max pulling capacity
18 wheel pair LCE, 18t max pulling capacity
1 x 1 wheel pair transporter

CAPACITY (Max)
2 x Main Tanks, 1 x Spare
Cable Load Capacity....1200t (up to 1700t)
Cable Volume..............................1232m³
Repeaters Capacity...............................45

CRANES/LIFTING CAPACITIES
Bow Gantry......................1 x 5t bow hoist
FWD STBD.............3t at 16m / 6t at 6.7m
AFT PORT..................3t at 16m / 6t at 8m
ROV CRANE (FWD PORT).......9t at 10.5m / 21.5t at 4m

ACCOMMODATION
Officers and Crew 76
Passengers 10
Total Berths 86

A-FRAME
Certification ....ABS
SWL 25t
Weight.............................45t

IT PLOW
Weight..............................17t
Burial Depth............up to 1.5m
Burial speed............ 0.6-1km/h
Bending Radius.................1.5m

IT ROVJET 207
Operating Dept.....Up to 2500m
Power..........................200hP
Max Payload....................54kg
Max Operation Sea State.........6
Burial up to 1.5m with cable depressor

ZODIAC RHIB (Zodiac 733IO)
Length Overall 7.24m
Beam max inflated 7.74m
Draft..........................0.53m
Max Horsepower 300
Person capacity ...... 15A + 0C

- **Articulated Pipe Specifications**

International Telecom — Simply the best !

N-PIPE

Articulated Pipes and accessory

IT International Telecom is a world leader in the shore end protection of fiber optic and power transmission cables.

With the latest iteration of the N-Pipe product line, IT Engineers have applied lessons-learned in the field to the development of this newest evolution in ductile iron products. Combining years of experience in the design, manufacture and installation of N-Pipe, IT has taken its patented N-Pipe technology to the next level.

IT N-Pipe is designed so that each segment consists of two (2) identical and completely interchangeable components. These pieces easily snap together prior to bolting, thus avoiding hard-to-install “A” and “B” side components. Not only has this breakthrough facilitated ease of shipping and storage of the N-Pipe, it has also greatly simplified installation by divers in low-visibility submarine environments and at shore ends.

N-Pipe combines time-tested quality and efficiency of installation for significant cost savings while setting the industry standard for shore end cable protection

N-PIPE

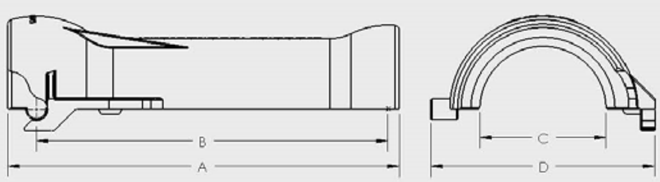
Articulated Pipes and accessory

-Material:	Ductile Cast Iron 65-45-12 (ASTM 536)	-Abrasion resistance:	Good
-Pipe tensile strength:	> 300 kN	-Corrosion resistance:	Very good

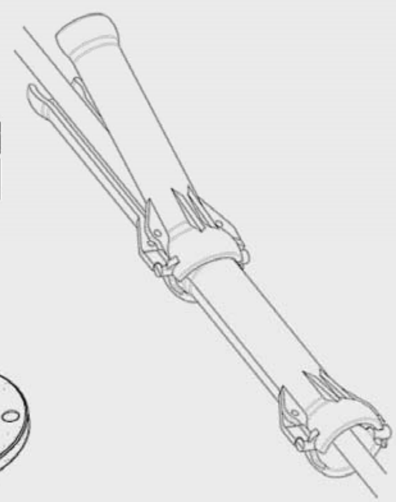
SPECIFICATIONS

		N55	N110	N180
Overall length	(A)	550mm (21.7in)	563mm (22.2in)	557mm (21.9in)
Effective installed length	(B)	500mm (19.7in)	500mm (19.7in)	500mm (19.7in)
Internal diameter	(C)	55mm (2.2in)	110mm (4.3in)	180mm (7.1in)
Maximum width	(D)	155mm (6.1in)	237mm (9.3in)	317mm (12.5in)
Weight per part (air)		5kg (11lbs)	12kg (26lbs)	16kg (35lbs)
Weight per meter (air)		20kg (44lbs)	47kg (103lbs)	64kg (141lbs)
17" height shipping crate* weight		100 units/crate 25 m/crate 500 kg (1110lbs)	50 units/crate 12.5 m/crate 590 kg (1300lbs)	N/A
22" height shipping crate* weight		N/A	N/A	24 units/crate 6 m/crate 410 kg (900lbs)

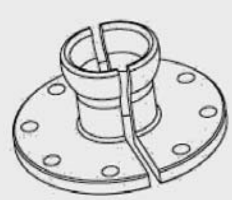
* Crate common footprint is 1000mm x 1000mm



N180 model shown



The N55 coupling consists in the male end of a standard N55 articulated pipe with a flange on the end. The flange is a standard ASME 4" class 150. The thickness is 19mm (3/4in) and includes 8 holes to fit 5/8 in bolt / anchor. The flange OD is 228.6mm (9in). The total length of the unit is 120mm (4.7in) and weight 6.6kg (14.5lbs). Note that one coupling unit is made of two halves



11.4 APPENDIX IV: CABLE LANDING STATION SPECIFICATIONS

CARCIP

ESIA Supporting Documentation
(Front Haul & CLS)

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1 Introduction

This document is designed to provide information for inclusion into the CARCIP ESIA in relation to the following aspects.

- BMH (Beach Manhole) locations.
- Seaward ducts details.
- CLS (Cable Landing Station)/terminating point locations.
- Front haul duct details.
- JC (Jointing Chamber) and PB (Pulling Box) locations.
- TP (Terminating Points)

The details in this document are proposals based on desk top and site-specific information, the exact as build information may differ following detailed site surveys due to local conditions.

2 Network Design

The following sections provide information on the proposed design at each landing point location for each island.

2.1 St Vincent – Seg 8

2.1.1 Arnos Vale

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the Northern section of the CARCIP trunk cable as there are facilities in place that house the existing GCN Segment 7 and Segment 9 submarine cable systems.

2.1.1.1 BMH

There is an existing BMH with two spare 200mm seaward facing ducts available so there would be no excavations at this location. The location of the existing BMH is shown in Table 2.1.1.1.1 below.

Description	Co-ordinates
Existing BMH Location	13^{O} 08.435’N 61^{O} 12.706’W

Table 2.1.1.1.1

Image 2.1.1.1.1 below shows the existing BMH at the Arnos Vale landing point.

Image 2.1.1.1.1

2.1.1.2 CLS

The CLS at Arnos Vale is an existing building and requires no additional construction, Image 2.1.1.2.1 below shows the exterior of the existing facility at Arnos Vale.

The geographical location of the CLS is shown in Table 2.1.1.3.2.

Image 2.1.1.2.1

2.1.1.3 Front Haul

The front haul at this landing is already in existence and will not require any excavations, the new front haul cable will be installed in the existing ducts and will only require the opening of the existing lids on the jointing chambers.

Image 2.1.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.1.1.3.1

Image 2.1.1.3.2 below shows the existing SLD (Straight Line Diagram) for the front haul route between the BMH and the CLS including the seaward ducts.

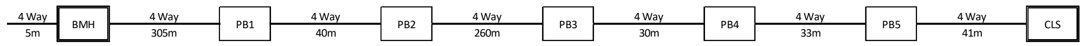


Image 2.1.1.3.2

Table 2.1.1.3.1 below shows a summary of the front haul infrastructure at the Arnos Vale landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	714m	0m
No. of BMH	1	0
No. of JC’s	0	0
No. of PB’s	5	0
4 Way Duct – Soft Dig	N/A	0m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	0m
2 Way Duct – Hard Dig	N/A	0m

Table 2.1.1.3.1

Table 2.1.1.3.2 below shows the geographical co-ordinates of the BMH, PB’s and CLS.

Description	Co-ordinates
Existing BMH Location	13^{O} 08.435’N 61^{O} 12.706’W
PB1	13^{O} 08.554’N 61^{O} 12.610’W
PB2	13^{O} 08.510’N 61^{O} 12.593’W
PB3	13^{O} 08.573’N 61^{O} 12.469’W
PB4	13^{O} 08.577’N 61^{O} 12.460’W
PB5	13^{O} 08.591’N 61^{O} 12.464’W
CLS	13^{O} 08.590’N 61^{O} 12.460’W

Table 2.1.1.3.2

2.2 St Vincent – Seg 8.6 West

2.2.1 Chateaubelair

The BMH, TP and front haul location for this landing have been selected as the primary landing point for the Western landing of this section of the CARCIP festoon system, there are no existing facilities at this landing location.

2.2.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.2.1.1.1 below. The area of the BMH is in an area of soft ground off the coastal road adjacent to the existing Customs Offices.

Description	Co-ordinates
New BMH Location	13^{O} 17.459’N 61^{O} 14.455’W

Table 2.2.1.1.1

Image 2.2.1.1.1 below shows the proposed location of the new BMH at the Chateaubelair landing point.

Image 2.2.1.1.1

2.2.1.2 CLS

As this segment of the CARCIP submarine cable system is an extension of the terrestrial optical fibre network so there is no CLS planned for this location. As such and to enable a safe functional operation of the submarine cable section a physical fibre disconnect is installed, this will be achieved by the use of a TP with optical fibre connections between the front haul cable from the BMH and the backhaul cable to the terrestrial fibre ring.

The proposed location of the TP is close to the BMH which is also close to an existing services pole feeding the Customs Offices, the geographical location of the TP is shown in Table 2.2.1.3.2.

2.2.1.3 Front Haul

There is no existing front haul infrastructure at this location, due to there being no CLS at this location the front haul route is extremely short between the BMH and the TP.

Image 2.2.1.3.1 below shows an overview of the front haul route between the BMH and the TP, including the seaward ducts.

Image 2.2.1.3.1

Image 2.2.1.3.2 below shows the SLD for the front haul route between the BMH and the TP including the seaward ducts, with the red line being hard dig and the green line being soft dig. The seaward ducts from the BMH cross the existing concrete coastal road and exit down onto the beach.

Image 2.2.1.3.2

Table 2.2.1.3.1 below shows a summary of the front haul infrastructure at the Chateaubelair landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	14m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	0
No. of TP's	0	1
4 Way Duct – Soft Dig	N/A	0m
4 Way Duct – Hard Dig	N/A	8m
2 Way Duct – Soft Dig	N/A	6m
2 Way Duct – Hard Dig	N/A	0m

Table 2.2.1.3.1

Table 2.2.1.3.2 below shows the geographical co-ordinates of the BMH and TP.

Description	Co-ordinates
New BMH Location	13^{O} 17.459'N 61^{O} 14.455'W
TP	13^{O} 17.455'N 61^{O} 14.458'W

Table 2.2.1.3.2

2.3 St Vincent – Seg 8.6 East

2.3.1 Owia Bay

The BMH, TP and front haul location for this landing have been selected as the primary landing point for the Eastern landing of this section of the CARCIP festoon system, there are no existing facilities at this landing location.

2.3.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.3.1.1.1 below. The area of the BMH is in an area of soft ground in front of the fisheries offices/facilities adjacent to the carriageway to the small harbour wall. It should be noted that although the top layer of sediments appear to be soft dig, under the surface could be larger consolidated materials.

Description	Co-ordinates
New BMH Location	13^{O} 22.386'N 61^{O} 8.575'W

Table 2.3.1.1.1

Image 2.3.1.1.1 below shows the proposed location of the new BMH at the Chateaubelair landing point.

Image 2.3.1.1.1

2.3.1.2 CLS

As this segment of the CARCIP submarine cable system is an extension of the terrestrial optical fibre network so there is no CLS planned for this location. As such and to enable a safe functional operation of the submarine cable section a physical fibre disconnect is installed, this will be achieved by the use of a TP with optical fibre connections between the front haul cable from the BMH and the backhaul cable to the terrestrial fibre ring.

The proposed location of the TP is close to the BMH, this area is close to the main coastal road which will be part of the fibre ring. To enable connection from the TP to the terrestrial fibre this would require one or two poles from the TP, the geographical location of the TP is shown in Table 2.3.1.3.2.

2.3.1.3 Front Haul

There is no existing front haul infrastructure at this location, due to there being no CLS at this location the front haul route is extremely short between the BMH and the TP.

Image 2.3.1.3.1 below shows an overview of the front haul route between the BMH and the TP, including the seaward ducts.

Image 2.3.1.3.1

Image 2.3.1.3.2 below shows the SLD for the front haul route between the BMH and the TP including the seaward ducts, with the green line being soft dig, although it should be noted that the ground although appears to be soft dig could have larger consolidated materials beneath.

Image 2.3.1.3.2

Table 2.3.1.3.1 below shows a summary of the front haul infrastructure at the Owia Bay landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	21m
No. of BMH	0	1

No. of JC's	0	0
No. of PB's	0	0
No. of TP's	0	1
4 Way Duct – Soft Dig	N/A	6m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	15m
2 Way Duct – Hard Dig	N/A	0m

Table 2.3.1.3.1

Table 2.3.1.3.2 below shows the geographical co-ordinates of the BMH and TP.

Description	Co-ordinates
New BMH Location	13^{O} 22.386'N 61^{O} 8.575'W
TP	13^{O} 22.381'N 61^{O} 8.582'W

Table 2.3.1.3.2

2.4 Bequia – Seg 8.1

2.4.1 Lower Bay South

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system, there are no existing facilities at this landing location other than the Digicel cell site at Friendship where it is proposed that the new CLS should be located.

2.4.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.4.1.1.1 below. The area of the BMH is in an area of soft ground in the verge set just back off the junction of the coastal road and the road leading up the hill to the Friendship cell site.

Description	Co-ordinates
New BMH Location	12^{O} 59.822'N 61^{O} 14.711'W

Table 2.4.1.1.1

Image 2.4.1.1.1 below shows the proposed location of the new BMH at the Lower Bay landing point.

Image 2.4.1.1.1

2.4.1.2 CLS

The chosen location for the new CLS is at the existing Digicel Friendship cell site, the design of this CLS will be as detailed within this document. The geographical location of the CLS is shown in Table 2.4.1.3.2.

2.4.1.3 Front Haul

There is no existing front haul infrastructure at this location, the road up to the Friendship cell site from the BMH is soft dig on the lower sections but with two concrete tyre strips up the inclined section. It should be possible to soft dig either side of these strips or through the central soft section. This would need to be confirmed from a further local survey.

Image 2.4.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.4.1.3.1

Image 2.4.1.3.2 below shows the SLD for the front haul route between the BMH and the CLS including the seaward ducts, with the green line being soft dig and the red line being hard dig, although it should be noted that some of the route up the incline to the CLS may have some short sections of hard dig, this would need confirming on site. The section of duct from the BMH to the beach landing is hard dig and crosses the concrete coastal road.

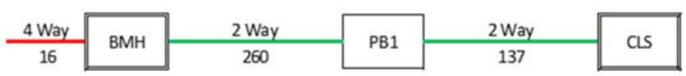


Image 2.4.1.3.2

Table 2.4.1.3.1 below shows a summary of the front haul infrastructure at the Owia Bay landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	413m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	1
4 Way Duct – Soft Dig	N/A	0m
4 Way Duct – Hard Dig	N/A	16m
2 Way Duct – Soft Dig	N/A	397m
2 Way Duct – Hard Dig	N/A	0m

Table 2.4.1.3.1

Table 2.4.1.3.2 below shows the geographical co-ordinates of the BMH, PB and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 59.822'N 61^{O} 14.711'W

PB1	12^{O} 59.716’N 61^{O} 14.617’W
CLS	12^{O} 59.646’N 61^{O} 14.639’W

Table 2.4.1.3.2

2.5 Mustique – Seg 8.2

2.5.1 Endeavour Bay

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system, there are no existing facilities at this landing location other than the existing MCL (Mustique Company Ltd) head end building where it is proposed that the new SLTE (Submarine Line Terminating Equipment) should be located.

2.5.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.5.1.1.1 below. The area of the BMH is in an area of soft ground at the end of a small carp park adjacent to the beach café.

Description	Co-ordinates
New BMH Location	12^{O} 53.355’N 61^{O} 11.124’W

Table 2.5.1.1.1

Image 2.5.1.1.1 below shows the proposed location of the new BMH at the Endeavour Bay landing point.

Image 2.5.1.1.1

2.5.1.2 CLS

For this landing there is no proposed new CLS, the SLTE will be housed within the existing MCL head end building. The geographical location of the CLS is shown in Table 2.5.1.3.2. Image 2.5.1.2.1 below shows the exterior of the existing MCL head end site.

Image 2.5.1.2.1

Image 2.5.1.2.1 below shows the existing rack utilisation within the MCL head end site.

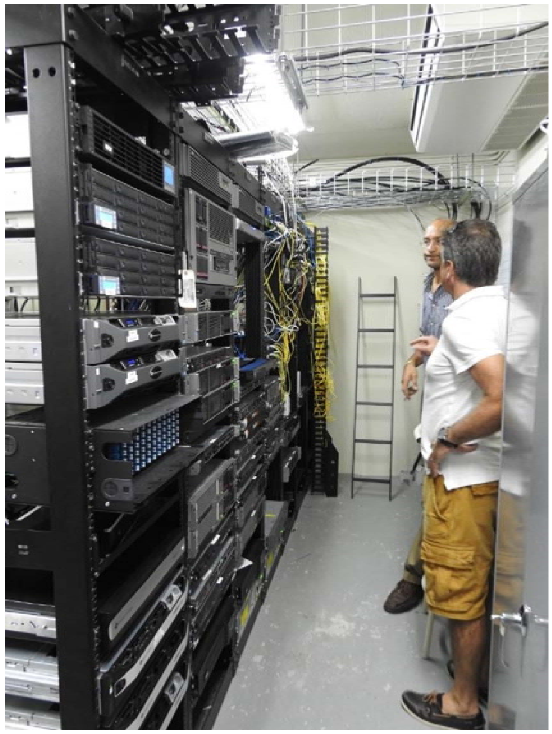


Image 2.5.1.2.2

2.5.1.3 Front Haul

The front haul for this location is largely in place by way of the existing MCL underground infrastructure. This will predominantly be used for the front haul for this landing with only a short section being required to connect the BMH to the existing infrastructure.

The exact location of the end of the MCL duct infrastructure is roughly adjacent to the existing spa near the proposed landing. It is recommended that a new PB is built on the existing duct end to enable the new front haul to the BMH to be linked.

BMH and front haul construction on the island will be sub-contracted out to MCL in line with their local policy.

Image 2.5.1.3.1 below shows an overview of the front haul route between the BMH and the advised location of the existing MCL duct, including the seaward ducts.

Image 2.5.1.3.1

Image 2.5.1.3.2 below shows the SLD for the front haul route between the BMH and the existing MCL ducts, including the seaward ducts, with the green line being soft dig.

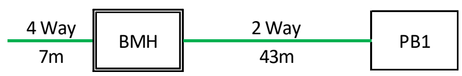


Image 2.5.1.3.2

Table 2.5.1.3.1 below shows a summary of the front haul infrastructure at the Endeavour Bay landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	306m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	1
4 Way Duct – Soft Dig	N/A	7m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	43m
2 Way Duct – Hard Dig	N/A	0m

Table 2.5.1.3.1

Table 2.5.1.3.2 below shows the geographical co-ordinates of the BMH, PB and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 53.355'N 61^{O} 11.124'W
PB1	12^{O} 53.343'N 61^{O} 11.104'W
CLS	12^{O} 53.050'N 61^{O} 11.254'W

Table 2.5.1.3.2

2.6 Canouan – Seg 8.3

2.6.1 Nens Bay

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system.

2.6.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.6.1.1.1 below. The area of the BMH is in an area of soft ground at the back of the beach landing near the municipal dump and a proposed development of land reclamation and a new industrial area.

Description	Co-ordinates
New BMH Location	12^{O} 42.005'N 61^{O} 20.347'W

Table 2.6.1.1.1

Image 2.6.1.1.1 below shows the proposed location of the new BMH at the Nens Bay landing point.

Image 2.6.1.1.1

2.6.1.2 CLS

Due to the proximity of the nearest Digicel cell site it was a requirement to identify a new site for the CLS. The site identified was Canouan airport, the design of this CLS will be as detailed within this document. The geographical location of the proposed CLS is shown in Table 2.6.1.3.2.

Image 2.6.1.2.1 below shows the Canouan cell site.

Image 2.6.1.2.1

2.6.1.3 Front Haul

There is no existing front haul infrastructure at this location, from what was surveyed on the day of the site survey the road from the landing site to the proposed CLS location at the airport is concrete with soft verges either side of the concrete road. In theory it could be possible to complete the front haul dig in soft ground on the airport perimeter side of the road which would negate any carriageway crossings, if this is not possible and the dig has to go on the outside of the carriageway then two carriageway crossings would be required. For these purposes the first option has been considered.

Image 2.6.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.6.1.3.1

Image 2.6.1.3.2 below shows the SLD for the front haul route between the BMH and the CLS including the seaward ducts, with the green line being soft dig. As previously mentioned, this is based on the premise that the front haul can be excavated within the boundaries of the existing carriageway and the airport perimeter road which is feasible.

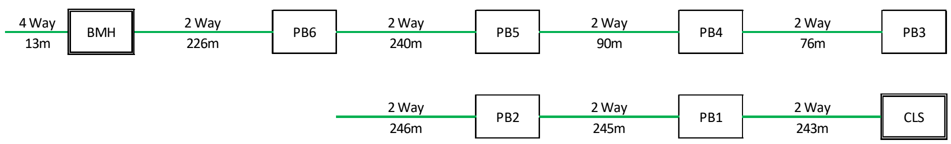


Image 2.6.1.3.2

Table 2.6.1.3.1 below shows a summary of the front haul infrastructure at the Nens Bay landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	1,379m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	6
4 Way Duct – Soft Dig	N/A	13m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	1,366m
2 Way Duct – Hard Dig	N/A	0m

Table 2.6.1.3.1

Table 2.6.1.3.2 below shows the geographical co-ordinates of the BMH, PB's and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 42.005'N 61^{O} 20.347'W
PB6	12^{O} 41.888'N 61^{O} 20.362'W

PB5	12^{O} 41.809'N 61^{O} 20.261'W
PB4	12^{O} 41.775'N 61^{O} 20.292'W
PB3	12^{O} 41.794'N 61^{O} 20.330'W
PB2	12^{O} 41.852'N 61^{O} 20.450'W
PB1	12^{O} 41.862'N 61^{O} 20.581'W
CLS	12^{O} 41.931'N 61^{O} 20.694'W

Table 2.6.1.3.2

2.7 Union – Seg 8.4

2.7.1 Airport

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system, there are no existing facilities at this landing location.

2.7.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.7.1.1.1 below. The area of the BMH is in an area of soft ground at the back of the beach landing adjacent to a private dwelling and the airport perimeter fence.

Description	Co-ordinates
New BMH Location	12^{O} 36.063'N 61^{O} 24.720'W

Table 2.7.1.1.1

Image 2.7.1.1.1 below shows the proposed location of the new BMH at the Airport landing point.

Image 2.7.1.1.1

2.7.1.2 CLS

The nearest Digicel sites are the Ashton and Union cell sites, due to the proximity of these to the proposed landing it was a requirement to identify new sites for the CLS. One of the sites identified was Union airport, the design of this CLS will be as detailed within this document. The geographical location of the proposed CLS is shown in Table 2.7.1.3.2.

2.7.1.3 Front Haul

There is no existing front haul infrastructure at this location, from what was surveyed on the day of the site survey the road from the landing site to the proposed CLS location at the airport is all soft grounds and runs adjacent to the airport perimeter fence/boundary. As the ground approaches the CLS location in the airport compound the ground level of the adjacent road rises slightly but it would be possible to bring the ducts down this bank and into the airport grounds and to the CLS.

It may also be possible to bring the ducts directly into the airport compound close to the BMH location and then contain all excavations within the airport perimeter.

Image 2.7.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.7.1.3.1

Image 2.7.1.3.2 below shows the SLD for the front haul route between the BMH and the CLS including the seaward ducts, with the green line being soft dig, based on utilising a route outside of the airport compound.

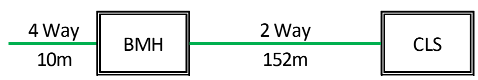


Image 2.7.1.3.2

Table 2.7.1.3.1 below shows a summary of the front haul infrastructure at the Airport landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	162m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	0
4 Way Duct – Soft Dig	N/A	10m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	152m
2 Way Duct – Hard Dig	N/A	0m

Table 2.7.1.3.1

Table 2.7.1.3.2 below shows the geographical co-ordinates of the BMH and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 36.063'N 61^{O} 24.720'W
CLS	12^{O} 36.023'N 61^{O} 24.791'W

Table 2.7.1.3.2

2.8 Carriacou – Seg 8.5

2.8.1 Hillsborough Bay

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system.

2.8.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.8.1.1.1 below. The area of the BMH is in an area of soft ground on the seaward side of the coastal road with a sparsely wooded area leading down to the beach.

Description	Co-ordinates
New BMH Location	12^{O} 28.720'N 61^{O} 28.082'W

Table 2.8.1.1.1

Image 2.8.1.1.1 below shows the proposed location of the new BMH at the Hillsborough Bay landing point.

Image 2.8.1.1.1

2.8.1.2 CLS

The nearest Digicel site is the Belair cell site, then the Hillsborough cell site, due to the proximity of both of these sites it was agreed that an alternative site for the CLS was required to prevent large front haul builds. One of the sites identified was Carriacou airport, the design of this CLS will be as detailed within this document. The geographical location of the proposed CLS is shown in Table 2.8.1.3.2.

2.8.1.3 Front Haul

There is no existing front haul infrastructure at this location, from what was surveyed on the day of the site survey the route from the proposed BMH to the airport is a difficult dig, from the BMH to the entrance road to the airport should predominantly be soft dig on the landward side of the coastal road but the access to the airport site is via a concrete carriageway, either side of this carriageway there is a very narrow soft verge before the land moves into wooded areas which also appears to lead into mangrove. There are also two culverts underneath the airport entrance road, there are two proposed methods to cross these culverts, it should be noted, neither of the methods below would restrict the flow of the culverts under the road. The details of these two methods are detailed below.

1. The primary method would be to trench between the edge of the existing concrete road and the existing head wall of the culvert wall, there is a existing soft ground area between the two of approximately 400-500mm. If there is sufficient depth to excavate, install the two ducts and reinstate with concrete then this method will be employed.
2. If there is insufficient sediment cover for the primary method then the next preferred method would be to affix two steel ducts to the outside of the concrete head wall of the culvert, these two ducts would then be slewed in at either side to pick up the ducts either side of the culvert.

As part of the front haul build at this location there are two road crossings, one at the BMH location (crossing the two-lane coastal road) and the other at the junction of the coastal road and the airport entry road (crossing the two-lane road). Due to the narrowness of both roads it is likely that during the excavation of the trench for the ducts it is likely that the entire width of the road will be excavated in one operation. During the excavation, duct placement and reinstatement works access to and from the airport will be restricted. In order to minimise this disruption, the following mitigations will be put in place.

1. Ensure that the correct notifications of the works are given to the local authorities.
2. Ensure that construction works are undertaken during the quite period of the airport, peak periods for flights into CRU are between 0800hrs – 0900hrs and 1400hrs – 1700hrs.
3. Ensure that traffic control measures are put in place.
4. Ensure that ductile iron or steel road plates are available to broach the exposed trench/works during operations should emergency access be required.

Some of the front haul route between the BMH and the CLS potentially could be hard dig, where the airport access road runs through the wooded/mangrove area. For the sake of this report it has been assumed that this will be soft dig, if this is not possible then approximately 100m may be in the concrete carriageway, this would require further surveying to confirm.

Image 2.8.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.8.1.3.1

Image 2.8.1.3.2 below shows the SLD for the front haul route between the BMH and the CLS including the seaward ducts, with the green line being soft dig and red being hard dig.

Image 2.8.1.3.2

Table 2.8.1.3.1 below shows a summary of the front haul infrastructure at the Lauriston Point landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	649m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	2
4 Way Duct – Soft Dig	N/A	3m
4 Way Duct – Hard Dig	N/A	7m
2 Way Duct – Soft Dig	N/A	624m
2 Way Duct – Hard Dig	N/A	15m

Table 2.8.1.3.1

Table 2.8.1.3.2 below shows the geographical co-ordinates of the BMH and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 28.720'N 61^{O} 28.082'W

PB2	12^{O} 28.719'N 61^{O} 28.210'W
PB1	12^{O} 28.698'N 61^{O} 28.348'W
CLS	12^{O} 28.622'N 61^{O} 28.327'W

Table 2.8.1.3.2

2.9 Grenada – Seg 8

2.9.1 Conference

The BMH, CLS and front haul location for this landing have been selected as the primary landing point for the branch segment of the CARCIP main system, there are no existing facilities at this landing location other than the Digicel cell site at Conference where it is proposed that the new CLS should be located.

2.9.1.1 BMH

This is a new submarine cable landing and as such there is no existing BMH, the chosen location following the site survey for the new BMH is shown in Table 2.9.1.1.1 below. The area of the BMH is in an area of soft ground at the end of a track leading down to the beach landing point.

Description	Co-ordinates
New BMH Location	12^{O} 9.673'N 61^{O} 36.390'W

Table 2.9.1.1.1

Image 2.9.1.1.1 below shows the proposed location of the new BMH at the Conference landing point.

Image 2.9.1.1.1

2.9.1.2 CLS

The chosen location for the new CLS is at the existing Digicel Conference cell site, the site has sufficient space within the existing compound to house a CLS, the design of this CLS will be as detailed within this document. The geographical location of the CLS is shown in Table 2.9.1.3.2.

Image 2.9.1.2.1 below shows the existing Conference cell site.

Image 2.9.1.2.1

2.9.1.3 Front Haul

There is no existing front haul infrastructure at this location, from what was surveyed on the day of the site survey the road from the beach landing is all soft dig with the exception of the last short section to the CLS where there is a concrete road present with very narrow soft verges. It may be possible to excavate alongside these verges but for these purposes it is assumed that the last section will be hard dig.

Image 2.9.1.3.1 below shows an overview of the front haul route between the BMH and the CLS, including the seaward ducts.

Image 2.9.1.3.1

Image 2.9.1.3.2 below shows the SLD for the front haul route between the BMH and the CLS including the seaward ducts, with the green line being soft dig and the red line being hard dig, although it should be noted that it may be possible to complete all the dig in soft ground, but this would need confirming on site.

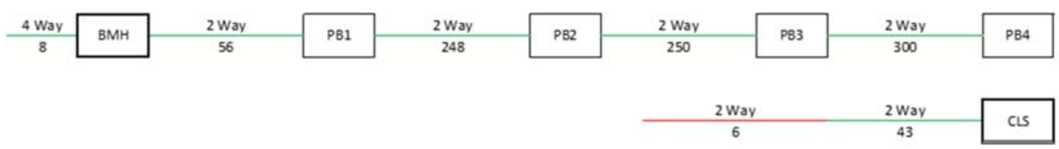


Image 2.9.1.3.2

Table 2.9.1.3.1 below shows a summary of the front haul infrastructure at the Conference landing point. Note: the total duct length includes the seaward facing ducts from the BMH.

Description	Existing	New Build
Total Duct Length	0m	911m
No. of BMH	0	1
No. of JC's	0	0
No. of PB's	0	4
4 Way Duct – Soft Dig	N/A	8m
4 Way Duct – Hard Dig	N/A	0m
2 Way Duct – Soft Dig	N/A	897m
2 Way Duct – Hard Dig	N/A	6m

Table 2.9.1.3.1

Table 2.9.1.3.2 below shows the geographical co-ordinates of the BMH, PB's and CLS.

Description	Co-ordinates
New BMH Location	12^{O} 9.673'N 61^{O} 36.387'W
PB1	12^{O} 9.645'N 61^{O} 36.385'W
PB2	12^{O} 9.632'N 61^{O} 36.521'W
PB3	12^{O} 9.631'N 61^{O} 36.658'W
PB4	12^{O} 9.614'N 61^{O} 36.823'W
CLS	12^{O} 9.639'N 61^{O} 36.825'W

Table 2.9.1.3.2

3 References

3.1 Geographical Locations

All geographical locations given in this report are listed as Latitude and Longitude in Degrees Minutes/Decimal Minutes (DD MM.MM) and are shown in WGS84 (World Geodetic System 1984), accuracy of these locations was shown as being +/- 5m on the equipment used.

3.2 BMH's

The construction of the BMH shall be either;

- Constructed in situ and of a poured concrete construction.
- Constructed in situ and of a brick-built construction.
- Modular Construction.

The construction of the BMH shall be suitably reinforced to withstand vehicular traffic and the walls shall allow for the fitting of a suitably designed AWAC (Armour Wire Anchor Clamp), cable furniture and have internal dimensions that allow for the marine and land cables to be coiled vertically without compromising the MBR (Minimum Bend Radius) of the cable.

The BMH shall have a suitable frame and covers that are rated to vehicular traffic loading, are flush with the surrounding ground and have the facility to be locked for security.

The BMH wall construction shall allow for the fitting of cable bearers and if required wall mounted steps or a ladder. The BMH shall preferably be fitted with a drainage sump and a suitably fitted grate with the construction of the floor designed so there is a fall away towards the sump.

As part of the BMH provision it is required that there will be duct lead outs on both the seaward and landward sides, these ducts and their position in the BMH shall comply with the following requirements.

i. Maximum of four (4) 100mm HDPE (High Density Polyethylene) or PVC (Polyvinyl Chloride) seaward ducts, the length of which are detailed within this report.

ii. Maximum of two (2) HDPE or PVC landward ducts, leading back to the CLS or terminating point.
iii. All ducts shall be left roped with a 6mm Polypropylene draw rope following construction.
iv. All external duct ends shall be sealed to prevent the ingress of water/dirt.
v. The internal duct spacing/positioning shall be as follows.
    - For the BMH, the ducts shall be a minimum of 350mm from the floor, 350mm from the side walls and 450mm from the ceiling and with centres no less than 225m from each other to allow for the installation of AWAC's.
    - For larger jointing chambers, the ducts shall be a minimum of 150mm from the floor, top and side walls and with centres no less than 225m from each.

3.3 Pulling Boxes

The construction of the PB's shall be either;

- Constructed in situ and of a poured concrete construction.
- Constructed in situ and of a brick-built construction.
- Modular Construction.

The construction of the PB's shall be suitably reinforced to withstand vehicular traffic, have cable furniture and have internal dimensions that allow for the front haul cable to be coiled vertically without compromising the MBR (Minimum Bend Radius) of the cable.

The PB's shall have a suitable frame and covers that are rated to vehicular traffic loading, are flush with the surrounding ground and have the facility to be locked for security.

The PB's wall construction shall allow for the fitting of cable bearers and if required wall mounted steps or a ladder. The PB's shall preferably be fitted with a drainage sump and a suitably fitted grate with the construction of the floor designed so there is a fall away towards the sump.

3.4 Ducts

The ducts in the front haul shall be of a 100mm HDPE or PVC design with a maximum of (4) four seaward ducts from the BMH and a maximum of (2) two landward ducts, leading back to the CLS or terminating point.

All ducts shall be left roped with a 6mm Polypropylene draw rope following construction with all external duct ends sealed to prevent the ingress of water/dirt. The internal spacing of the ducts in the front haul shall be centralised in the entry and exit walls of each chamber.

3.5 Excavation Activities

During the construction of the infrastructure for the CARCIP submarine cable system there will be areas where excavations will be required, these are as follows.

1. Beach Manhole construction.

2. Pulling box construction.
3. Front haul duct construction.
4. Cable Landing Station TP construction.

All excavation activities will be carried out within the local authorities recommended guidelines and best industry practices and in accordance with the established Digicel standard operating procedures and risk assessments.

3.5.1 Beach Manhole Construction

For the CARCIP project it is proposed that the BMH will have the following approximate dimensions, 1790mm (Length), 880mm (Width) and 1650mm (Depth).

Depending on the type of construction method used for the BMH the excavation process may slightly change, but in general the following generic process will be followed.

1. The location of the proposed BMH will be marked out to the dimensions of the BMH and also allowing a suitable additional area around the chamber to allow for back filling of sediments. In no case shall the width of the excavated trench be greater than is reasonably necessary for the satisfactory execution of the works.
2. The hole will be excavated to the required parameters with a mechanical excavator where possible, or if not possible then manually.
3. All excavated material will be monitored and segregated and any material not suitable for backfill will be removed from site and disposed of in accordance with local requirements.
4. The base of the excavated trench will be compacted using a suitable compacting device to eliminate any soft areas.
5. For Concrete Poured Construction
    a. The base section will be poured in concrete into the base of the excavated trench, to the desired thickness.
    b. Once the base section concrete has sufficiently cured the shuttering for the wall sections will be installed, including any reinforcing bars if required. The shuttering will be installed to the desired height below ground level to allow for the correct flush installation of the frames and covers.
    c. The wall sections will then be poured in concrete.
    d. Once the wall sections concrete has sufficiently cured, the shuttering is removed, and the trench is back filled around the chamber and compacted using a suitable compacting device until the back fill is level with the top of the chamber walls.
    e. On completion of the back filling the frames and covers are installed onto the chamber walls using a mortar bed, ensuring that the covers are level with the surrounding ground level.
    f. Once the frames and covers have been installed the final reinstatement around the frame and covers to the sides of the excavated trench can be completed using the same material as the surrounding area.

b. For Brick Built Construction
    a. The base section will be poured in concrete into the base of the excavated trench, to the desired thickness.

b. Once the base section concrete has sufficiently cured the brick/block work will be constructed using mortar bedding, including any reinforcing bars if required. The brick/block work will be constructed to the desired height below ground level to allow for the correct flush installation of the frames and covers.
c. Once the wall sections mortar has sufficiently cured, the trench is back filled around the chamber and compacted using a suitable compacting device until the back fill is level with the top of the chamber walls.
d. On completion of the back filling the frames and covers are installed onto the chamber walls using a mortar bed, ensuring that the covers are level with the surrounding ground level.
e. Once the frames and covers have been installed the final reinstatement around the frame and covers to the sides of the excavated trench can be completed using the same material as the surrounding area.

c. For Modular Chamber construction the following will apply.
   a. The first base section will be installed into the excavated trench.
   b. The additional wall sections are then installed until the desired height is achieved below ground level to allow for the correct flush installation of the frames and covers.
   c. Once the wall sections are completed the trench is back filled around the chamber and compacted using a suitable compacting device until the back fill is level with the top of the chamber walls.
   d. On completion of the back filling the frames and covers are installed onto the chamber walls using a mortar bed, ensuring that the covers are level with the surrounding ground level.
   e. Once the frames and covers have been installed the final reinstatement around the frame and covers to the sides of the excavated trench can be completed using the same material as the surrounding area.

Any waste generated from excavation and construction activities will be managed in accordance with Digicel’s established waste and environmental management plans.

3.5.2 Pulling Box Construction

For the CARCIP project it is proposed that the PB’s will have the following approximate dimensions, 1310mm (Length), 610mm (Width) and 750mm (Depth).

The construction methods for the PB’s will be the same as for the BMH’s as detailed in Section 3.5.1 of this document.

3.5.3 Front Haul Duct Construction

Excavation for the duct portions of the front haul will be carried out as below.

a. The location of the proposed duct front haul will be marked out ahead of any excavation works.

b. The hole will be excavated to the required parameters with a mechanical excavator where possible, or if not possible then manually.
c. The excavation of the trenches shall ensure that the side walls are where possible vertical and have a squared off shape. If required, the side walls of the trenches shall be supported to prevent collapse.
d. All excavated material will be monitored and segregated and any material not suitable for backfill will be removed from site and disposed of in accordance with local requirements.
e. The base of the excavated trench will be prepared using a duct bedding material.
f. The duct sections will be either joined together above ground and then laid into the excavated trench or joined together within the excavated trench.
g. Once the ducts are installed, the excavated trench will be backfilled with approved materials and the surface reinstated to the same conditions and level as before the excavations.

3.5.4 Cable Landing Station and TP construction.

3.5.4.1 CLS Base Slab

Each of the five new CLS compounds required to complete the CARCIP network will require the following Civils Works:

a. Excavation of vegetable soil to a firm, inert sub-strata and regrading with specified fill material to Formation Level – nominally 100mm below existing Ground Level.
b. Provision of underground [UG] ducts (as required by the particular site arrangement) terminated with long slow bends for the Fibres and Mains Power / generator cables at designated positions in the slab to match MCLS entry points.
c. Construction of a reinforced concrete [RC] slab nominally 200 mm thick sized to exceed the footprint of the MCL by 1000mm of three sides and 2000mm on the elevation containing the entrance door.
d. Slab to be provided with corner anchor points to secure the MCLS against Hurricane CAT.V winds.
a. Surface water disposal will be by natural drainage onto the surrounding ground level.

3.5.4.2 CLS Generator Base Slab

Each of the five new CLS compounds required to complete the CARCIP network will require the following Civils Works:

a. Excavation of vegetable soil to a firm, inert sub-strata and regrading with specified fill material to Formation Level – nominally 100mm below existing Ground Level.
b. Provision of an underground duct(s) between the Generator slab and the MCLS slab - terminated with long slow bends for the generator cables, at locations as described above.

c. Construction of a separate RC slab nominally 150mm thick sized 2000mm x 3000mm to support the FGW generator, tank and enclosure.

3.5.4.3 CLS General Compound Surface

Each of the five new CLS compounds required to complete the CARCIP network will require the following Civils Works:

a. Clear vegetation and topsoil to a minimal depth, apply weed killer and lay a barrier membrane across the entire site area. Apply a minimum 100mm coarse angular gravel fill material to provide a surface on which vehicular and pedestrian traffic can move freely.

3.5.4.4 TP (Terminating Point)

The two new TP's required to complete the CARCIP network will be delivered by either utilising an existing telephone pole or by the installation of a new telephone pole.

a. Existing telephone pole – No civil engineering works will be required, the TP will be installed on the existing telephone pole.
b. New telephone pole – A hole will be excavated either manually or with a specialist pole erection unit equipped with an auger drill. To enable the telephone pole to be installed, this hole will typically be slightly bigger than the diameter of the telephone pole (approximately 170 – 265mm) and depth will be dependant on the pole diameter and height. Once the pole has been installed in the hole it will be backfilled.

3.6 Product Specifications

This section outlines the high-level specifications of the following items.

a. Modular CLS
b. CLS backup generators
c. TP's
d. Modular jointing chambers

3.6.1 Modular CLS

For the five sites where a modular CLS will be installed, there are a number of different manufacturers offering solutions.

The CLS comprises a containerized "Walk In Cabinet" [WIC] constructed similar to a small sea container but with superior thermal insulation and external finishes. Entry is via a standard personnel door in the end which is secured by physical / electronic access control mechanisms. These units are predominantly unmanned

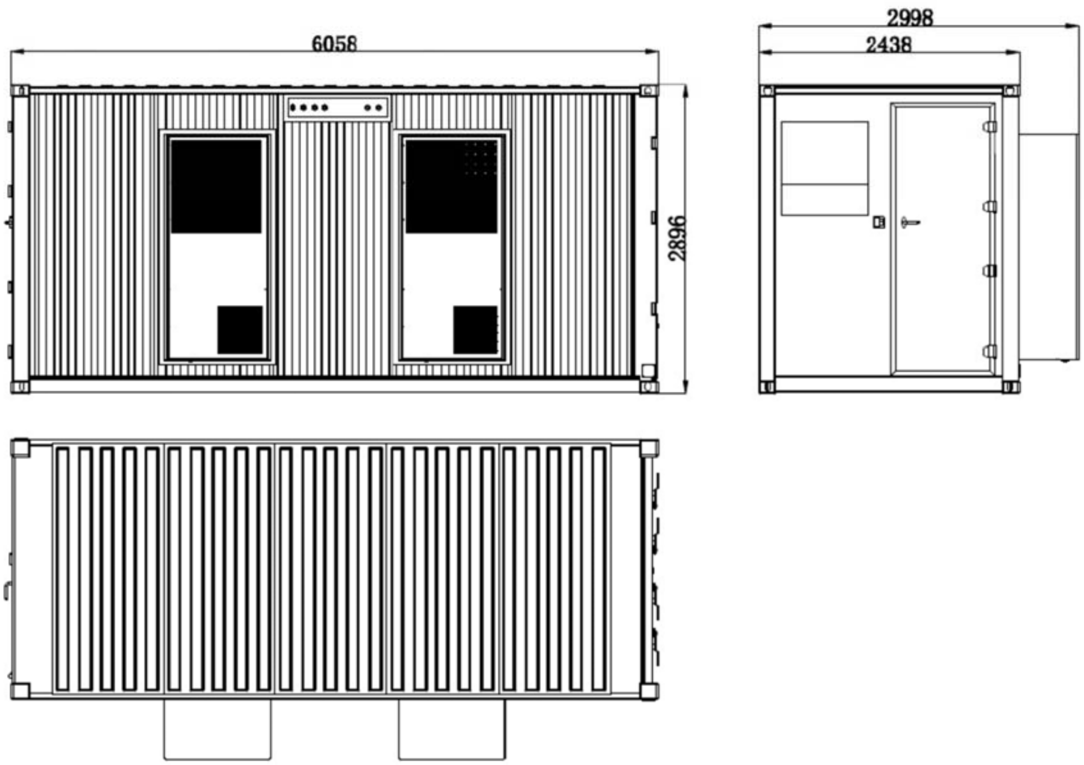
The module is equipped with AC / DC Power modules; a Fire Alarm & Suppression (inert gas type) system; a cooling system; CCTV and remote environmental monitoring equipment; Terrestrial and Submarine termination equipment in racks; and, other support services installations. The external evaporators for the two cooling units will be securely affixed to the face of the MCLS of sit on an adjacent RC slab.

The size of the unit is nominal 20'L x 8'W x 9'H sitting on a ground bearing RC slab to which the unit is mechanically affixed to withstand displacement by Hurricane Cat. V winds.

The external finish of the unit is marinized to resist corrosion from the local coastal environment and can be coloured Grey, Tan or Off-White to suit Local Planning preferences requirements.

The specification for a typical solution 20x8ft solution is shown.

1) Dimensions: L * W * H = 6058 * 2998 * 2896mm
2) Total Weight: 4900kg



Each CLS site shall be fenced with a robust 2400mm high chain link (or similar approved) fence with an angled barbed wire anti climb top section. The compound will generally be 15m x 10m with double gates for vehicular entry and a single personnel gate.

Should the site be considered a high-risk location - vulnerable to external aggression, the fence may be upgraded to standard palisade type fencing.

The finish of the fencing shall be plain galvanized unless a colour-coated finish is dictated by the relevant Local Authority.

An access control and CCTV monitoring system will be installed on the CLS to remotely record the activities on the site and persons entering and exiting the facility. The CCTV monitoring will not be invasive to any local inhabitants.

There will be a system of PID activated external lights at the entrance doorway to provide safe access around the working area, but these units will be strategically located so as not to cause nuisance to Local Residents. In the case of Airport locations, the suitability of the lighting performance shall be dictated by the Airport Authority

The proposed form of construction has minimal impact on the environment during construction (because it is a pre-built module) and the installation programme on site is very short, thereby creating minimal disruption to the Local Community.

3.6.2 CLS Back Up Generators

Each site will be connected to the Utility power grid by an overhead power line, each site will have a Standby Generator nominally rated as between 10KVA and 30KVA, which will be housed in a bespoke acoustic enclosure to reduce the sound levels to comply with Stage 11 levels of the European Community Directive 2000/14/EC which became effective 03 January 2006. These units will thereby have minimum noise impact on the local environment.

The Standby generator(s) will be sited on an independent ground bearing RC slab close to the MCLS unit. The ATS will (where possible) be installed inside the MCLS unit.

In order to satisfy requirements for resilient power services for a minimum of 6 Days in the event of a mains power failure, diesel fuel storage tanks with a nominal capacity of 300 to 1000 Gallon sub-base tanks will be incorporated in the generator design.

These “extended integral sub-base tanks” will be of double wall construction to prevent contamination by surface perforation and will be bunded with a capacity allowance of 110% of the tank capacity and will be constructed in accordance with Digicel’s established waste and environmental management plans. If required by the Local Authority with jurisdiction over each particular site, each generator will be provided with an Oil Spill Recovery kit.

There are a number of different manufacturers offering solutions. The specifications for a typical solution are shown in Sections 3.6.2.1 (Conference) and 3.6.2.2 (Remaining Sites).

3.6.2.1 Conference

A single external generator set is planned to be installed at the site within the compound, the proposed unit is similar to the one specified below in Image 3.6.2.1.1.

Image 3.6.2.1.1

This unit will be enclosed in an acoustic enclosure rated at Level 1 and including a bottom fuel tank, the details of this are shown below in Image 3.6.2.1.2

Image 3.6.2.1.2

The physical external dimensions for the Level 1 acoustic enclosure are 1550mm (length), 935mm (Width) and 1055mm (Height), the unit has a weight of 494Kg. The acoustic performance of the unit at 100% load at a distance of 15m is 67/68dBA.

3.6.2.2 Remaining Sites

A single external generator set is planned to be installed at the site within the compound, the proposed unit is similar to the one specified below in Image 3.6.2.2.1.

Image 3.6.2.2.1

This unit will be enclosed in an acoustic enclosure rated at Level 1 and including a bottom fuel tank, the details of this are shown below in Image 3.6.2.2.2

Image 3.6.2.2.2

The physical external dimensions for the Level 1 acoustic enclosure are 1864mm (length), 898mm (Width) and 1253mm (Height), the unit has a weight of 846Kg. The acoustic performance of the unit at 100% load at a distance of 15m is 63dBA.

3.6.3 TP (Terminating Points)

At the Owia Bay and Chateaubelair sites a TP will be installed in the place of a CLS, it is proposed that a standard telecoms fibre optic enclosure will be used and mounted to a telephone pole, a typical enclosure is shown below in Image 3.6.3.1.

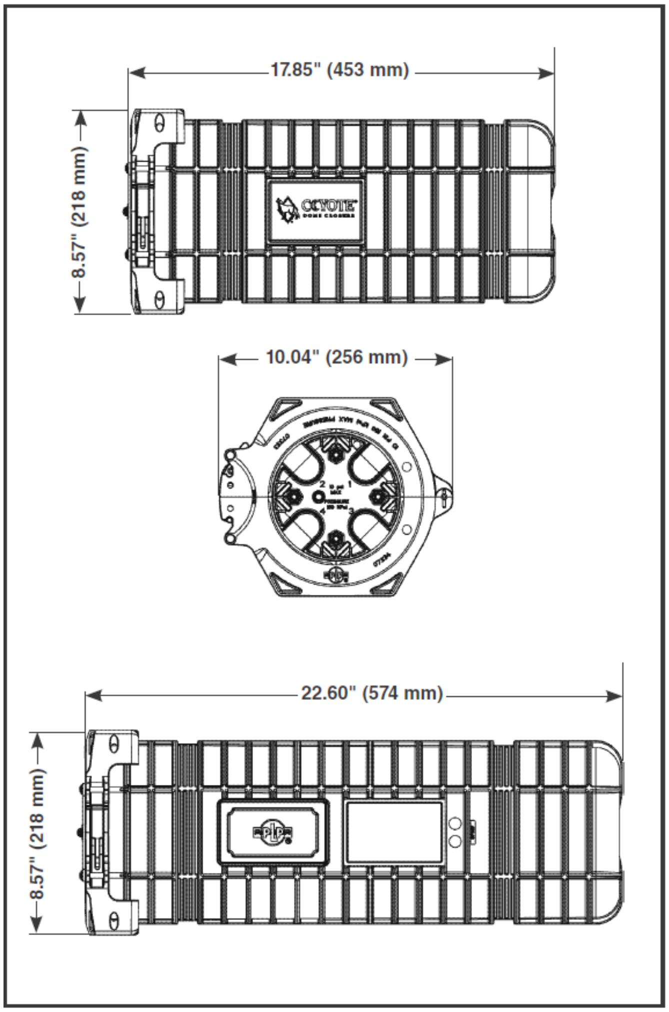


Image 3.6.3.1

3.6.4 Modular Jointing Chambers

One of the potential solutions for the modular jointing chambers are a product manufactured by CUBIS called the STAKKAbox, these come in modular section as shown in Image 3.6.4.1 below.

Image 3.6.4.1

The potential frames and covers for the modular solution would be a composite option with carriageway ratings up to Group 3: Category C250 Classification, these are shown below in Image 3.6.4.2.

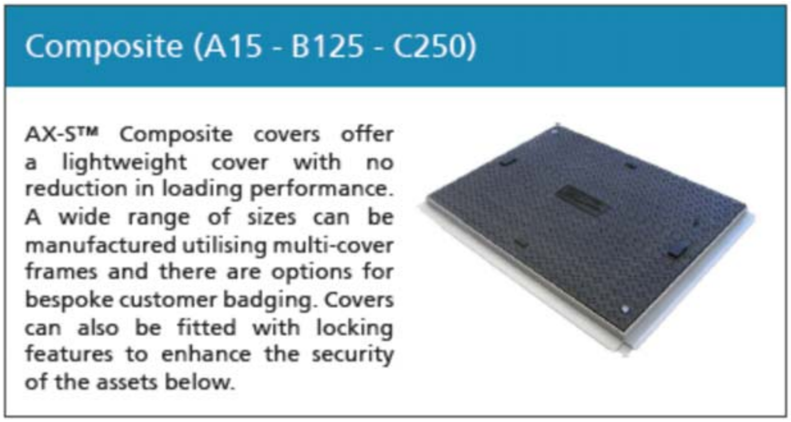


Image 3.6.4.2

For further details on these products the manufacturers website is shown below.

http://www.cubis-systems.com/uk/products/

3.7 Health & Safety

All operations being conducted in the construction of the front haul infrastructure will be carried out by Digicel and their sub-contractors in accordance with the established Digicel standard operating procedures.

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11.5 APPENDIX V: ECOLOGICAL RESCOURCES ASSESSMENT

C A R C I P

Undersea Cable System

E C O L O G I C A L R E S O U R C E A S S E S S M E N T

Nen's Bay, Canouan

COASTAL MANAGEMENT CONSULTING

December 2018

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I. INTRODUCTION

The Caribbean Regional Communications Infrastructure Programme (CARCIP) is a communications improvement program initiated by the World Bank and coordinated by the Caribbean Telecommunications Union. 'CARCIP' would modernize and fill gaps in the region's Information and Communications Technologies infrastructure to improve development opportunities and public service efficiency.

The proposed works are fully described in detail in the "Environmental and Social Impact Assessment for the Caribbean Regional Communications Infrastructure Program: Installation of a Fibre Optic Cable Between St. Vincent and the Grenadines and Grenada" (referred within this document as the 'ESIA').

In summary, the Digicel Group proposes to lay and operate a modern, 225km submarine telecommunications cable on the sea floor between St. Vincent (Arnos Vale) and Grenada (Conference) with cable landings on the intervening islands of Bequia, Mustique, Canouan, Union Island and Carriacou. An additional submarine cable link would be installed between Chateaubelair and Owia on St. Vincent. The shoreward ends of the cable would extend across fore reef and back reef (lagoon) zones, landing on beaches in nine locations and connected at a small, pre-constructed beach manhole (BMH) well above the high-water mark and in some instances, across a coastal road running parallel to the shore (i.e. Carriacou and Bequia).

Connections for high-speed internet access would be provided to Government and infrastructural buildings (i.e. schools, police, fire, airports, etc.).

II. APPROACH & METHODOLOGY

Coastal Management Consulting (CMC) was sub-contracted under International Telecommunications (IT) to carry out the Ecologic Resource Assessment for the nine CARSIP landing sites and is the purpose of this document.

The Terms of Reference (TOR) for CARCIP (16 Nov. 2018) specified what biological data were to be collected and included within the ESIA. This included:

TASK 1: General description of the coastal and marine habitats adjacent to each BMH and along the potential cable alignments as observed during site visits conducted 3-9 September 2018 at each landing site including a qualitative assessment of the terrestrial ecology (vegetation) found within 10m of each proposed manhole site; known avifauna that frequent the general area and distance to any mangrove species and/or wetland from the BMH location

TASK 2: Dominant biotic and abiotic habitat types

TASK 3: Benthic coverage of live coral and seagrass

TASK 4: Data on fish assemblages in nearshore and reefs

TASK 5 Population sizes of key indicator species (*Diadema antillarum, Strombus gigas, Panulirus argus and P. guttatus*)

TASK 6: Recognition of any species listed by the International Union for Conservation of Nature (IUCN) Red List as threatened (vulnerable, endangered or critically endangered) within the cable route

TASK 7: Absence/presence of coral diseases

TASK 8: Water quality testing (nitrates, phosphates, pH, salinity and water temperature).

An initial desktop study (Cable Route Study Report, September 2018: Document No: F0524-12001-00) produced by International Telecommunications (IT) provided the Digicel Group and Deep Blue Cable preliminary guidance to identify preferred and alternative cable landing sites. Over 23 locations were initially identified and were first assessed during a site visit carried out 3-9 September 2018 by the CARCIP team, including CMC.

Ongoing consultations with the Governments of Grenada, St. Vincent & the Grenadines, and the Wider Caribbean Sea Turtle Network (WIDECAST) country coordinators also provided further assistance with narrowing the list of preferred and alternative routes.

The terrestrial resource assessment (Task 1) was carried out during this first site visit by CMC to qualitatively identify key terrestrial ecology (vegetation) for each proposed 'preferred' landing site and beach manhole (BMH). This information is located within the main body of the ESIA but Section "IV. Terrestrial Resources" within this document provides a very brief summary with photos of representative vegetation types and any issues that were identified in the ESIA.

Prior to CMC's second site visit to the Grenadine Islands, preferred and alternative sites were updated based on findings from the first site visit. Only the final preferred routes were used for the shallow water geotechnical marine surveys [carried out by International Telecommunications (IT)] as well as the marine resource surveys carried out 14-26 October 2018 CMC.

Extensive mapping (using ArcGIS software) from the Marine Resources Space-use Information System for the Grenadine Islands (Baldwin, 2012) provided spatial baseline information about coral reef systems (benthic habitat types) within each of the preferred cable routes. This data layer was overlaid by the most recent GoogleEarth™ satellite images available along each nearshore cable route as a means to provide better visual ground cover in choosing representative habitats within specific transect locations. (Maps for each preferred cable route are provided in the following sections). Marine surveys were carried out in the Grenadine Islands, specifically, Bequia, Mustique, Canouan, Union and Carriacou.

Marine habitat surveys were not carried out by CMC on the main islands of St. Vincent or Grenada due to logistical and time constraints. However, benthic habitat maps were found publicly available and are reproduced for visual reference of three landing sites in St. Vincent (Arnos Vale, Chateaubelair and Owia) and one landing site in Grenada (Conference). Images on Coastal Resiliency website (http://maps.coastalresilience.org/gsvg/#) were overlaid onto the GoogleEarth satellite images in ArcGIS. These images are provided to better understand habitat types within cable routes and landing sites.

Additionally, the marine Geotech and dive surveys carried out by IT provided images from grab samples taken to identify sediment types for Arnos Vale and Chateaubelair. Screen grabs were also taken from video during dive surveys in St. Vincent.

Typical reef morphology in the Caribbean has been described as comprising a backreef or shallow lagoon, a reef crest and a forereef with the forereef often being dominated by spur and groove formations (Goreau and Land, 1974). Therefore, for purposes of the marine ecologic assessment, two locations in the fore reef zone (depth between 10-16m) and two locations within the backreef/lagoon (depth between 1-10m) were chosen to identify key habitat types (biotic and abiotic), live coverage (coral and seagrass) and fish assemblages. Transect start points (GPS coordinates) were identified on the maps prior to the field visit (see **Appendix 1** for locations).

During site visits to each of the five islands, local dive operators/vessels were hired to assist locating each of the transect start points as well as provide dive assistance. Habitat types are first quantitatively identified by laying two 50m transects within each of the two zones to identify percentages of: (1) bare sand, (2) submerged vegetation (further identified as sparse, medium or rich seagrass and / or calcareous algae); (3) colonized reef/hard bottom and (4) coral rubble. Secondly, the percentage of live coral coverage is identified by measuring directly under the transect tape the length of the coral and identifying the species. This also allows identification of any species listed under the IUCNs Red List, (see **Appendix 2)** and the absence/presence of coral diseases.

Population sizes of key indicator species *Diadema antillarum, Strombus gigas, Panulirus argus and P. guttatus* were counted within 1m on either side of the transect tape. Fish assemblages (variety and abundance) of target fish [those species identified in the Atlantic Gulf Rapid Reef Assessment (AGRRA) methodology, see **Appendix 3**] were also identified and included angelfish, butterflyfish, grunts, parrotfish, grouper, snapper, surgeonfish, leatherjacket, filefish, triggerfish and durgon.

There was no previous or long-term monitoring data (coral coverage, fish assemblages, indicator species, etc.) within proposed cable routes made available to CMC by the respective Governments. In order to provide a comparison of reefs *along* and *outside* the cable route, publicly available monitoring data was used. The data collected through the XL Catlin Seaview Survey (see **Appendix 4** for further detail) provides coral coverage and macroalgal coverage within nearby reefs (particularly at Union and Canouan) while the Coral Reef Report Cards (Grenada available at: http://caribnode.org/documents/85 and St. Vincent at: http://caribnode.org/documents/88 developed for Grenada and St. Vincent (Kramer, et al., 2016) were used at Carriacou, Mustique and Bequia. The Report Cards were used to provide a general comparison of herbivorous and commercial fish, where data was available.

Tables were created for each of the survey sites and used the same parameters used in the Report Cards (coral coverage, fleshy macroalgal coverage, herbivorous fish (g/100m) and commercial fish (g/100m), as well as the same classifications to measure coral health (critical, poor, fair, good and very good).

Parameters and classification for overall reef health. Adapted from Kramer et al., 2016.

PARAMETER	CRITICAL	POOR	FAIR	GOOD	VERY GOOD
Coral Cover	<5	5.0-9.9	10.0-19.9	20.0-39.9	≥40
Fleshy Macroalgal Cover (%)	>25	12.1-25	5.1-12.0	1.0-5.0	0-0.9
Herbivorous Fish (g/100m)	<960	960-1919	1920-2879	2880-3479	≥3480
Commercial Fish (g/100m)	<420	420-839	840-1259	1260-1679	≥1680

Water quality data was also obtained using the Hach DR900 handheld portable meter to test for temperature, pH, salinity, nitrates and phosphates. These parameters were selected simply as rapid assessment indicator to help detect potential causes for any observed degradation/issues during the survey. No long-term data was made available for comparison over time and is therefore not analysed further than single quantitative values.

III. MARINE RESOURCES

a) Hillsborough Bay, Carriacou (GND)

The benthic habitats fronting Hillsborough Bay were classified specifically as "mixed live hard bottom" and seagrass in the MarSis (Baldwin, 2012). A visual inspection of the satellite imagery provides some initial insight that these habitats are patchy with various sand channels (Figure 1).

The fore reef transects validated the dominant habitat type as live hard bottom (87.4%) with 12.7% sand. Hard bottom is composed of a fairly high percentage of live coral coverage (15.6%) along the cable route. The back reef (lagoon) area is dominated by 56% invasive seagrass interspersed with sand and coral rubble. Figures 3 & 4 provide a snapshot representing the habitats found along fore reef and back reef zones.

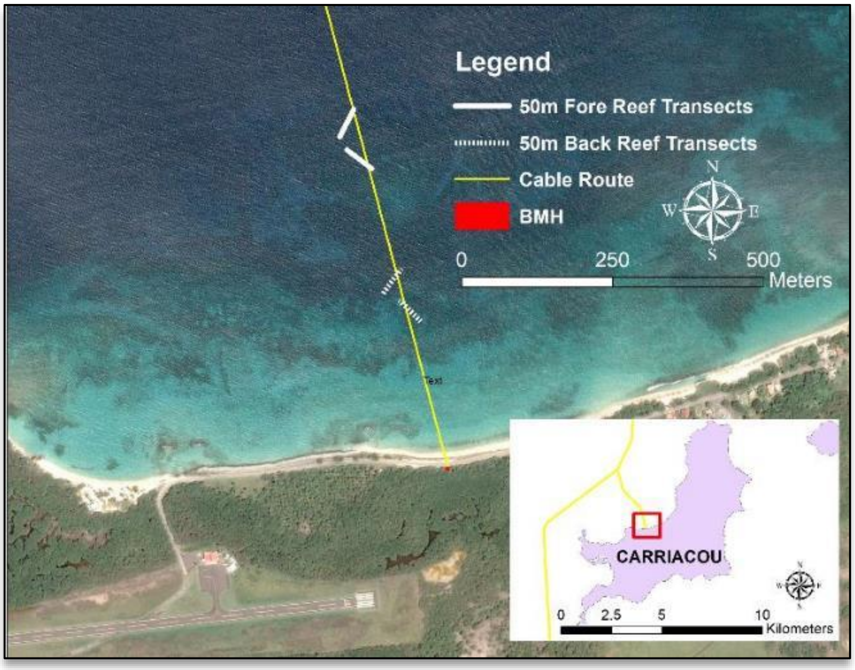

Figure 1. Hillsborough Bay, Carriacou. Cable route & marine survey transects.

Table 1 provides a summary of all other parameters required by the TOR (fish assemblages, indicator species, Red List species, absence/presence of coral diseases and water quality).

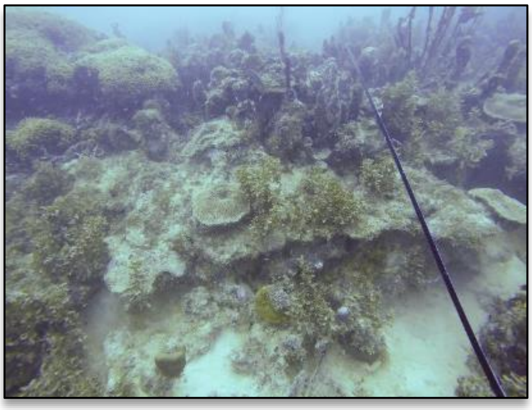

Figure 2. Representative habitat along cable route -Hillsborough Bay, fore reef.

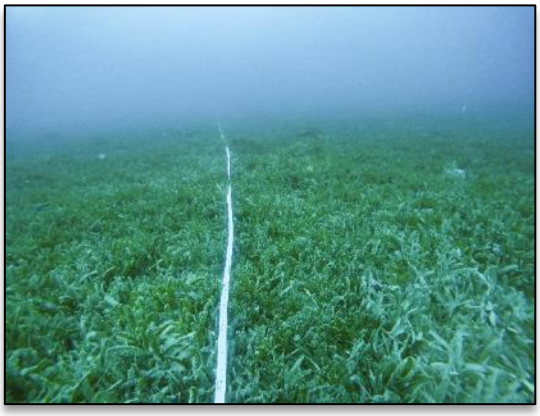

Figure 3. Representative habitat along cable route – Hillsborough Bay, back reef.

The Coral Reef Report Card (Kramer, et al., 2016) was used for comparison. Based on the reef survey completed at Jack-a-Dan, (approximately 1000m from the cable route) live coral coverage is about the same (10-19.9%) but macroalgal coverage (1-5%) is much lower compared to 36% along the cable route.

Table 1. Hillsborough, Carriacou Reef Survey Summary.

HILLSBOROUGH BAY, CARRIACOU

PARAMETER	FORE REEF	BACK REEF	COMPARISON WITH NEAREST REEF MONITORED
HABITAT TYPE	Colonized hardbottom (87.4%) Sand (12.6%)	Dense Invasive seagrass (56%) Coral rubble (24%) Bare Sand (19%)	Jack a Dan Reef North of cable route Kramer et al., 2016
LIVE CORAL COVERAGE	15.60%	<1%	10-19.9%
FLESHY MACROALGAL COVERAGE	36%	Cyanobacteria present	1.0-5.0%
HERBIVEROUS FISH(g/100m)	742	0	960-1919
COMMERCIAL FISH(g/100/m)	130	0	<420
IUCN RED LIST SPECIES OBSERVED	Boulder star coral; Elliptical star coral	0	N/A
INDICATOR SPECIES ABUNDANCE	Diadema - 8 Individuals	2 Individuals	N/A
CORAL DISEASES	White plague	0	N/A
WATER QUALITY	N/A	Temperature: 28.2C pH:7.8 Salinity: 33ppt Nitrates: 2.1mg/L Phosphates: 0.01mg/L	N/A

b) Union Island (SVG)

Benthic habitats at Point Lookout Bay, Union Island are represented (in the MarSis) as being seagrass, sand and coral reef. However, the satellite imagery shows a distinctive sand channel transecting the fringing reef along the shoreline (Figure 4) where the cable route is located.

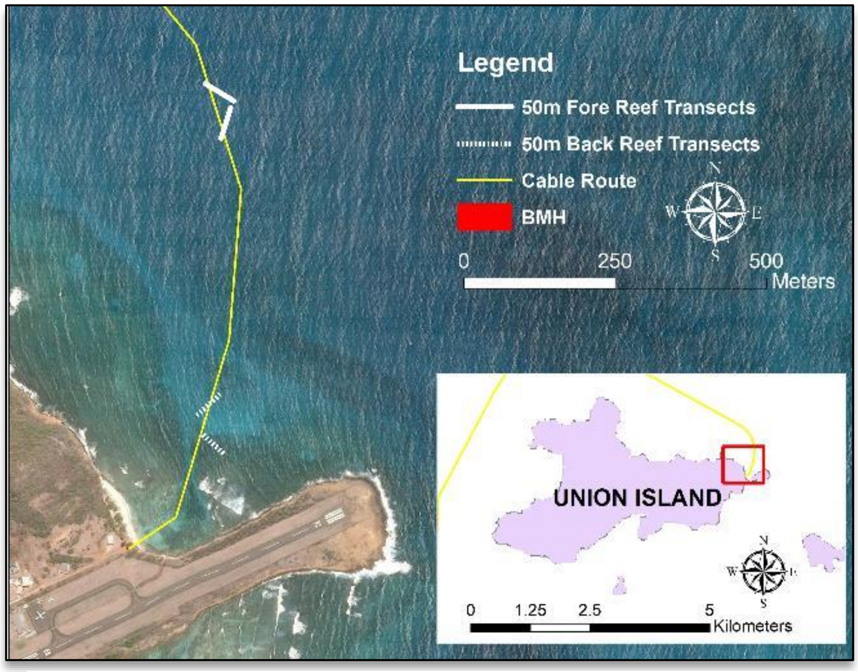

Figure 4. Point Lookout Bay, Union Island. Cable route and marine survey transects.

Marine surveys confirmed the fore reef zone is dominated by bare sand while the fore reef zone is dominated by dead reef with only 3% live coral coverage. Few fish were observed in either location, indicating overall coral health is at critical levels. Of other concern were several individual sea cushions (*Oreaster reticulatus*) found dead in the fore reef zone (Figure 7).

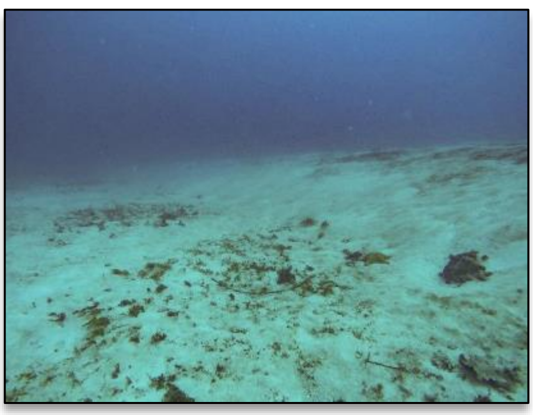
Figure 5. Representative habitat along cable route - Point Lookout Bay, fore reef.


Figure 6. Representative habitat along cable route - Point Lookout bay, back reef.

Table 2 provides a summary of all other parameters required by the TOR (fish assemblages, indicator species, Red List species, coral disease).

Comparison of the reef along the cable route (back reef zone) and the reef fronting Belmont Bay (approximately 1000m to the south) on the north side of the island shows they are similar in live coral coverage (2.9%) (critically low levels) with the reef at Belmont having slightly less macroalgal coverage than the back reef zone.

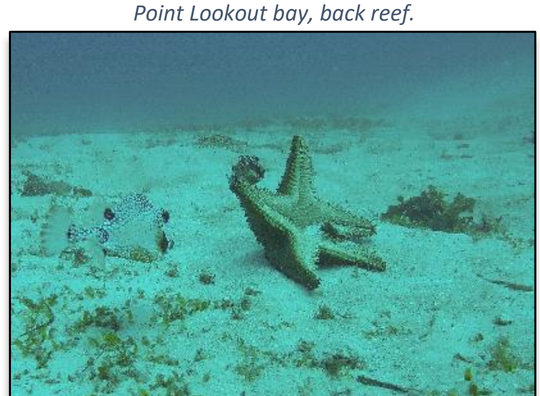
Figure 7. Sea cushion (Oreaster reticulatus) mortality.

Table 2. Point Lookout Bay, Union Island Reef Survey Summary.

POINT LOOKOUT BAY, UNION ISLAND PARAMETER	FORE REEF	BACK REEF	COMPARISON WITH NEAREST REEF MONITORED
HABITAT TYPE	Bare sand (98.3%) Calcareous algae (0.8%)	Coral Rock (87.8%) Coral Rubble (2%) Bare Sand (3.2%) Dense Invasive Seagrass (7%)	Belmont Reef S of cable route Global Reef Survey, 2013
LIVE CORAL COVERAGE	0	3%	3%
FLESHY MACROALGAL COVERAGE	0.90%	64%	10.9%
HERBIVEROUS FISH (g/100m)	0	120	N/A
COMMERCIAL FISH (g/100/m)	10	0	N/A
IUCN RED LIST SPECIES OBSERVED	0	Boulder star coral	N/A
INDICATOR SPECIES ABUNDANCE	0	0	N/A
CORAL DISEASES	0	None	N/A
WATER QUALITY	N/A	Temperature: 27.9C pH:7.9 Salinity: 32ppt Nitrates: 1.4mg/L Phosphates: 0.04mg/L	N/A

c) Nen's Bay, Canouan (SVG)

Nen's Bay benthic habitat is identified by MarSIs as being dominated by a coral reef across the mouth of the bay and seagrass. However, previous dredging in the bay, has left the central part composed of silt with some seagrass closest to the shore (Figure 8).

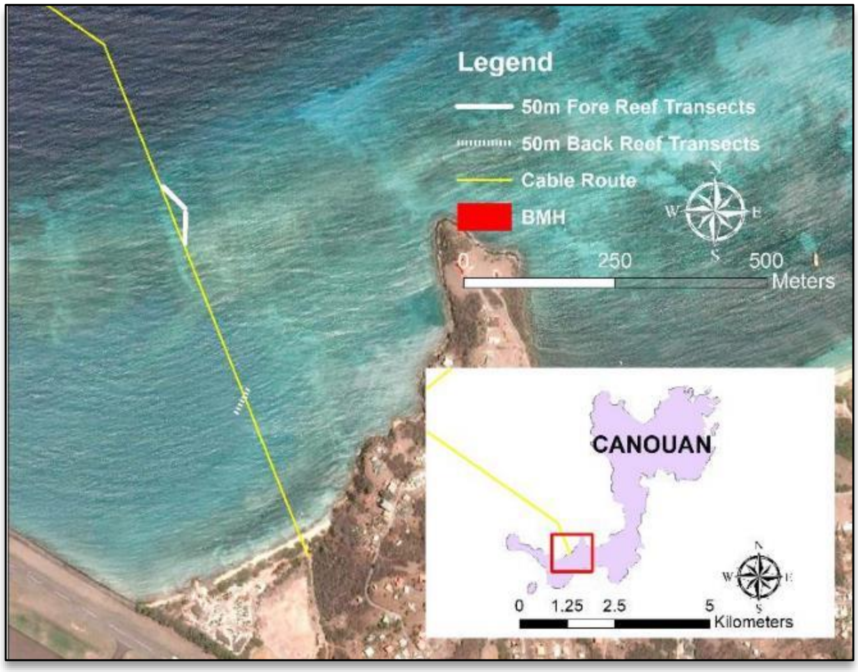

Figure 8. Nen's Bay, Canouan. Cable route and marine survey transects.

Only one transect was completed in the back reef (lagoon) zone due to poor visibility. Most likely the result of rainfall and poor erosion control practices along the shore which caused heavy sedimentation.

Although the fore reef zone was dominated by coral rock, a number of large boulder corals (mostly brain corals) made up the 8.2% live coral coverage.

Figure 9. Representative habitat along cable route- Nen's Bay, fore reef.

Table 3 provides a summary of all other parameters required by the TOR (fish assemblages, indicator species, Red List species, coral disease).

The Global Reef Survey was used for comparison but the reef is located on the southern side of the island. Although a much greater distance from the cable route, both locations indicate critically low levels of live coral coverage with the reef to the south having slightly less macroalgal cover.

Table 3. Nen's Bay, Canouan reef survey summary.

NEN'S BAY, CANOUAN

PARAMETER	FORE REEF	BACK REEF	COMPARISON WITH NEAREST REEF MONITORED
HABITAT TYPE	100% Silt	Coral Rock (91%) Coral Rubble (3%) Sand (6%) Dense Invasive Seagrass (7%)	Canouan South Southern side of island Global Reef Survey, 2013
LIVE CORAL COVERAGE	0	8.20%	1%
FLESHY MACROALGAL COVERAGE	Cyanobacteria present	22.50%	13.7%
HERBIVEROUS FISH(g/100m)	0	550	N/A
COMMERCIAL FISH(g/100/m)	0	380	N/A
IUCN RED LIST SPECIES OBSERVED	0	Boulder star coral	N/A
INDICATOR SPECIES ABUNDANCE	0	0	N/A
CORAL DISEASES	0	Yellow Band; White Plague	N/A
WATER QUALITY	Temperature: 28.1C pH:7.7 Salinity: 33ppt Nitrates: 3.4mg/L Phosphates: 0.0mg/L	N/A	N/A

d) **Endeavour Bay, Mustique (SVG)**

Benthic habitats along the cable route through Endeavour Bay are distinctly composed of 100% sand in the back reef/lagoon area and 100% dense invasive seagrasses in the fore reef zone (Figure 10-12).

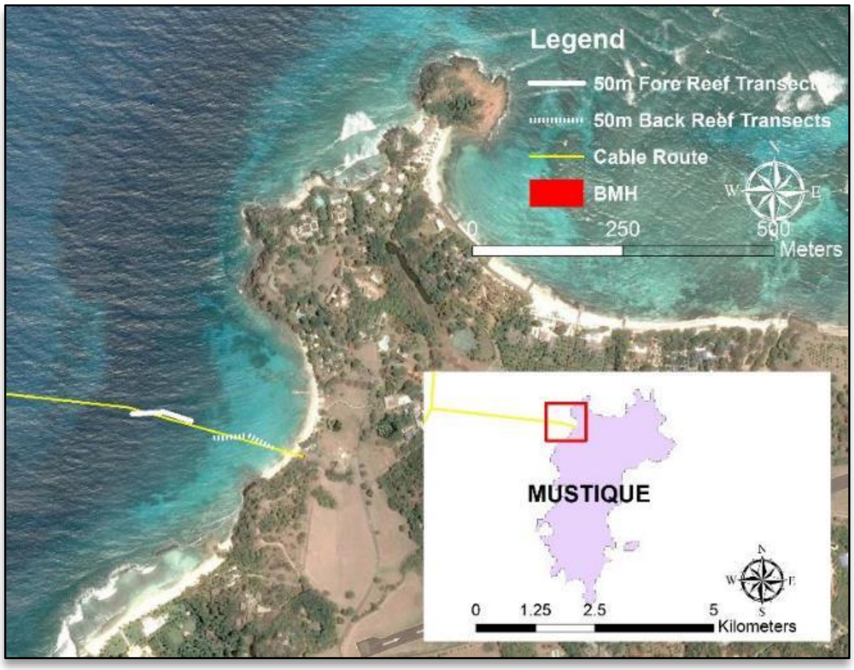

Figure 10. Endeavour Bay, Mustique. Cable route and marine survey transects.

Table 4 provides a summary of all other parameters required by the TOR (fish assemblages, indicator species, Red List species, coral disease). However, lack of coral or fleshy algal does not provide a clear indication of overall health since sand and seagrasses cover 100% of the areas surveyed. The large numbers of juvenile fish found around features (boulders) and around the coral nurseries indicate healthy populations.

Figure 11. Representative habitat along cable route – Endeavour Bay, fore reef.

Figure 12. Representative habitat type along cable route - Endeavour Bay, back reef.

Table 4. Endeavour Bay, Mustique reef survey summary.

ENDEVOR BAY, MUSTIQUE

PARAMETER	ENDEVOR BAY, MUSTIQUE	BACK REEF	COMPARISON WITH NEAREST REEF MONITORED
HABITAT TYPE	Dense Invasive seagrass (100%)	Bare sand (100%)	Plantain North of cable route (SOURCE: Steneck 2014; Kramer et al., 2016)
LIVE CORAL COVERAGE	0	0	20-39.9%
FLESHY MACROALGAL COVERAGE	0	0	>25
HERBIVEROUS FISH(g/100m)	(Juv. Fish not counted)	(Juv. Fish not counted)	N/A
COMMERCIAL FISH(g/100/m)	(Juv. Fish not counted)	(Juv. Fish not counted)	N/A
IUCN RED LIST SPECIES OBSERVED	0	0	N/A
INDICATOR SPECIES ABUNDANCE	0	0	N/A
CORAL DISEASES	0	0	N/A
WATER QUALITY	N/A	N/A	N/A

e) Lower Bay, Bequia (SVG)

Baseline MarSis data indicates Lower Bay, Bequia as sand, seagrass and a small reef running near the cable route. However, the satellite imagery suggests more complexity.

The fore reef was dominated by hardbottom with 12.8% live coral coverage while the lagoon (back reef zone) was dominated by the invasive seagrass.

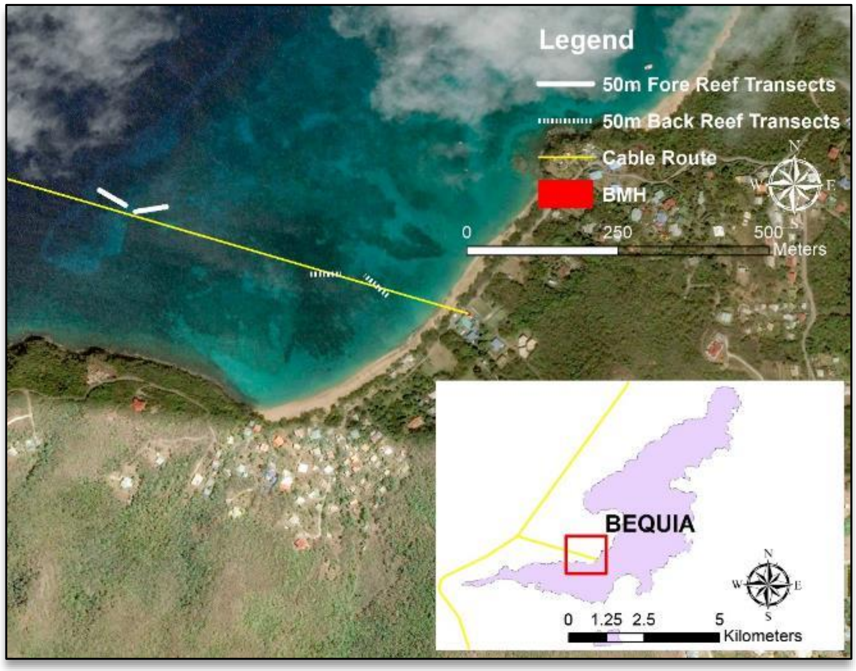

Figure 13. Lower Bay, Bequia. Cable route and marine survey transects.

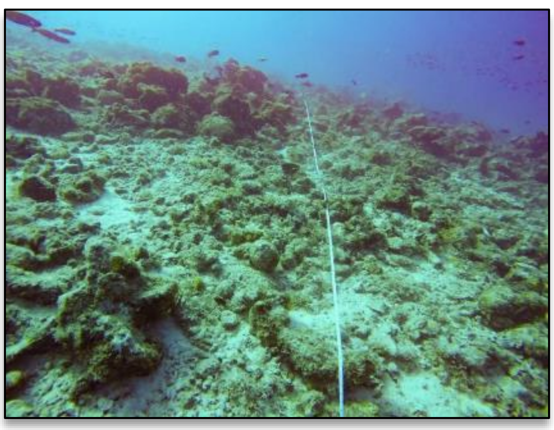

Figure 14. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

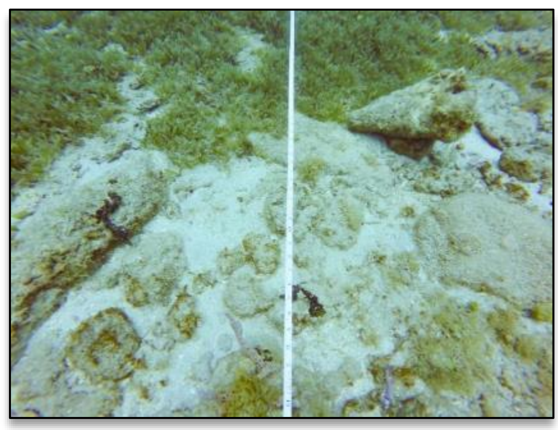

Figure 15. Representative habitat type along cable route – Lower Bay, Bequia, back reef.

LOWER BAY, BEQUIA

PARAMETER	LOWER BAY, BEQUIA	BACK REEF	COMPARISON WITH NEAREST REEF MONITORED
HABITAT TYPE	Hardbottom (77.4%) Coral Rubble (4.4%) Bare Sand (12.6% Dense Invasive seagrass (6.6%)	Dense Invasive seagrass (81%) Bare sand (17%) Coral rubble (2%)	Boulders Reef South of Cable Route (SOURCE: Kramer, et al., 2016; TNC, 2008)
LIVE CORAL COVERAGE	12.80%	<1%	20-39.9%
FLESHY MACROALGAL COVERAGE	23.20%	16%	5.1-12.0%
HERBIVEROUS FISH(g/100m)	980	(Juv. Fish not counted)	960-1919
COMMERCIAL FISH(g/100/m)	435	(Juv. Fish not counted)	420-839
IUCN RED LIST SPECIES OBSERVED	Boulder star coral, Elliptical star coral	0	N/A
INDICATOR SPECIES ABUNDANCE	Diadema 17 Individuals	Diadema 27 Individuals	N/A
CORAL DISEASES	White plague	0	N/A
WATER QUALITY	N/A	Temperature: 28.7C pH:7.9 Salinity: 33ppt Nitrates: 0.1mg/L Phosphates: 0.00mg/L	N/A

f. Arnos Vale, St. Vincent

The Arnos Vale, St. Vincent cable route crosses a relatively featureless area composed of volcanic sediments and seagrasses (Figure 16). A grab sample taken (Figure 17) as well as Figure 18 show the invasive seagrass while Figure 19 shows the colonisation of marine life along one of the pre-existing cables.

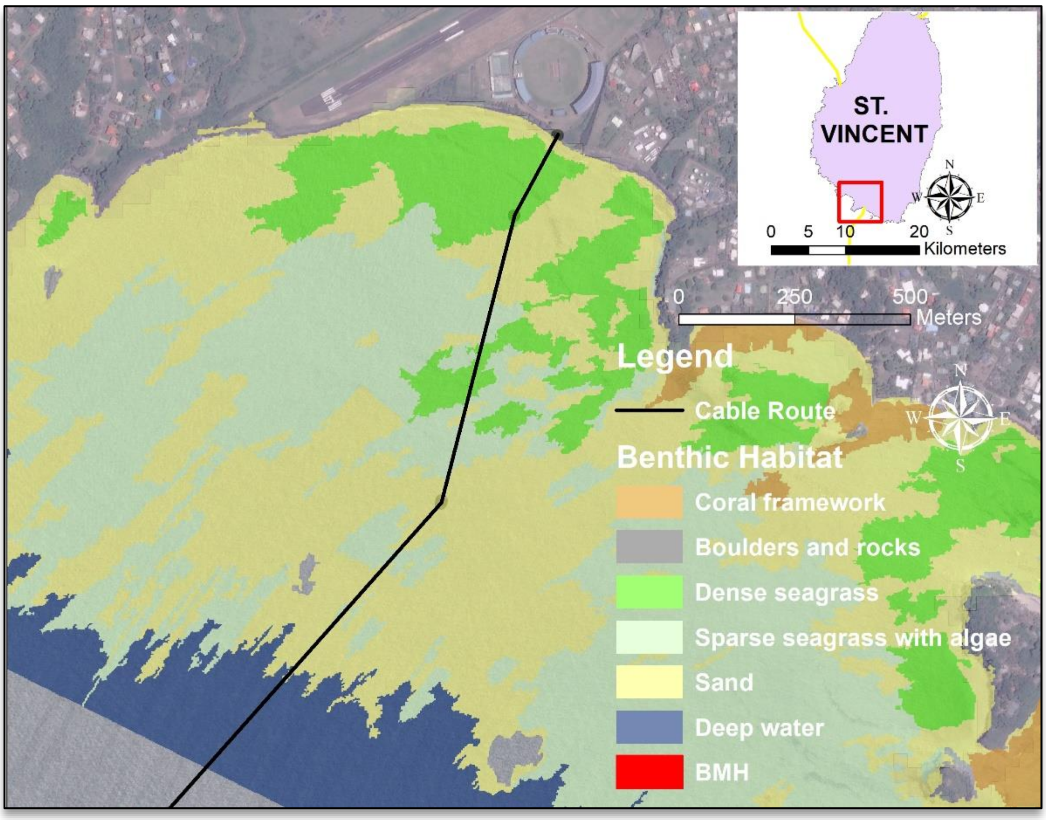

Figure 16. Benthic habitat map of Arnos Vale, St. Vincent. Source: www.coastalresilience.org

Figure 17. Grab sample taken at Arnos Vale.

Figure 18. Dense invasive seagrass found at Arnos Vale.

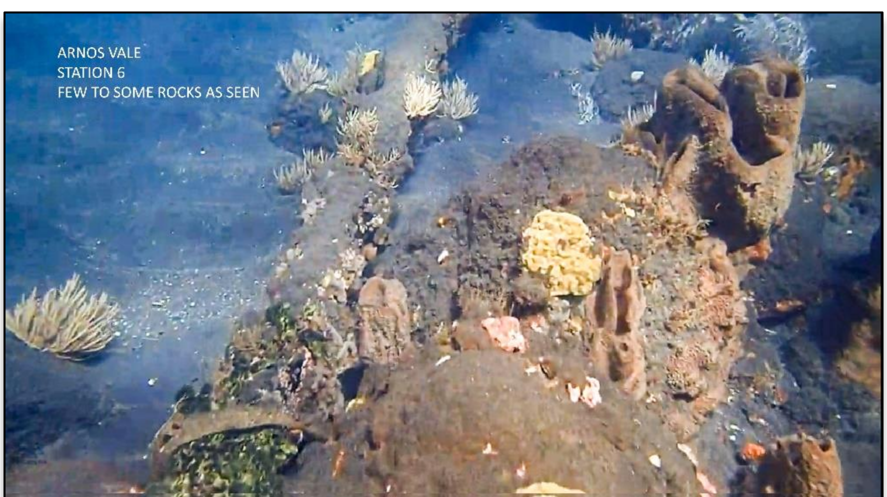

Figure 19. Colonisation of an existing cable at Arnos Vale.

g. Chateaubelair, St. Vincent

Figure 20 provides a benthic habitat map of Chateaubelair and indicates the extensive seagrasses found within the bay. Figure 21 provides an image of the grab sample while Figures 22 and 23 provide images from the dive survey.

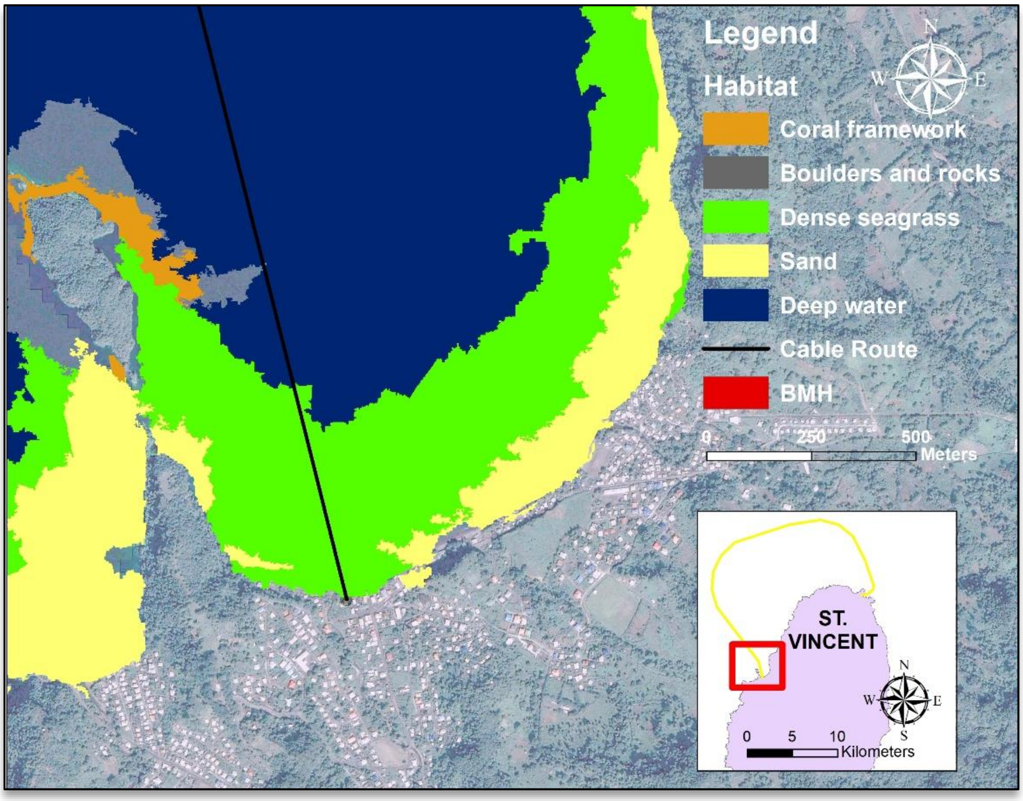

Figure 20. Benthic habitat map of Chateaubelair, St. Vincent. Source: www.coastalresilience.org

Figure 21. Sediment grab at Chateaubelair.

Figure 22. Image from the technical dive survey showing the invasive seagrass.

Figure 23. Image from the technical dive survey indicating sand patches and rock stones are also found along the cable route in Chateaubelair.

h. Owia, St. Vincent

The benthic habitat map for Owia, St. Vincent (Figure 24) indicates extensive coral framework, however, images 25 and 26 show there are extensive boulders along the cable route.

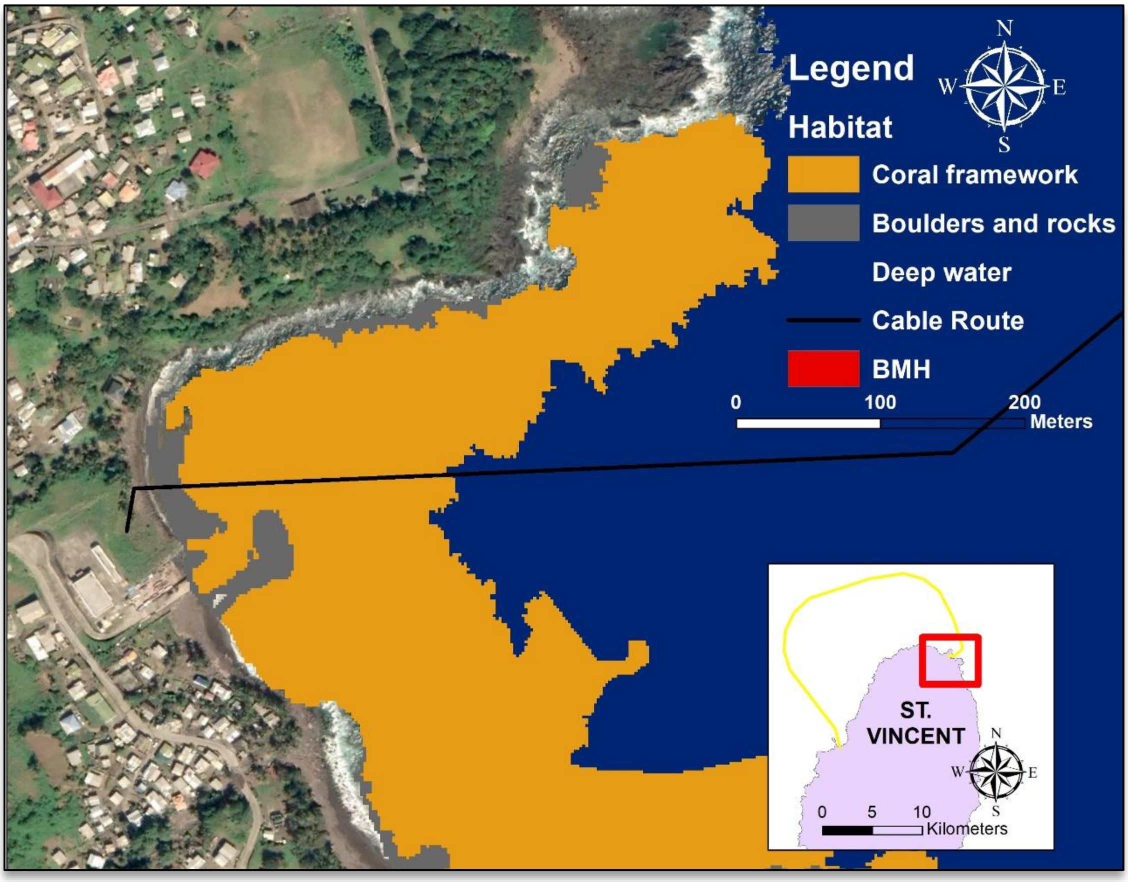

Figure 24. Benthic habitat map of Owia, St. Vincent. Source: www.coastalresilience.org

Figure 25. Representative habitat along cable route in Owia, St. Vincent.

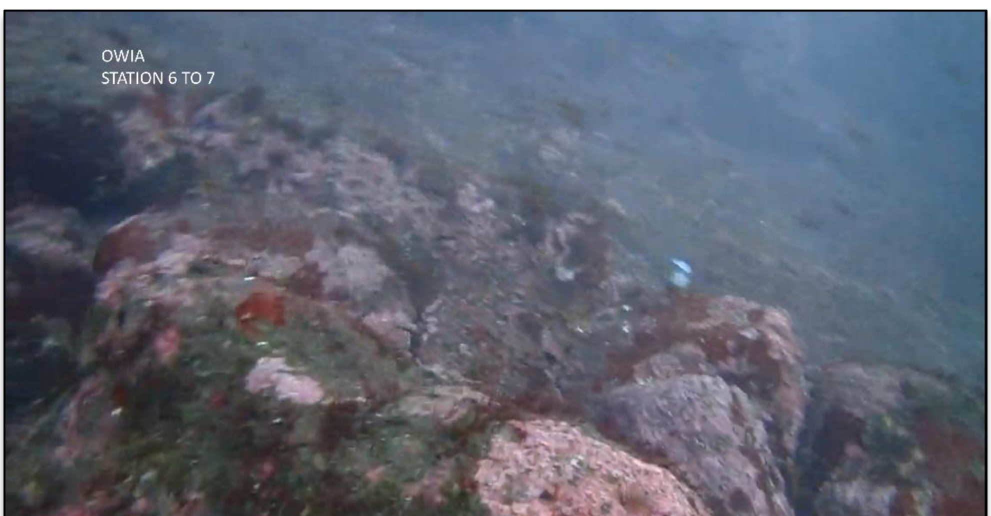

Figure 26. Another image indicating the existence of boulders along the cable route in Owia, St. Vincent.

i. Conference, Grenada

The benthic habitat map for Conference, Grenada (Figure 27) indicates coral reef interspersed with seagrass beds are found along and within the vicinity of the cable route.

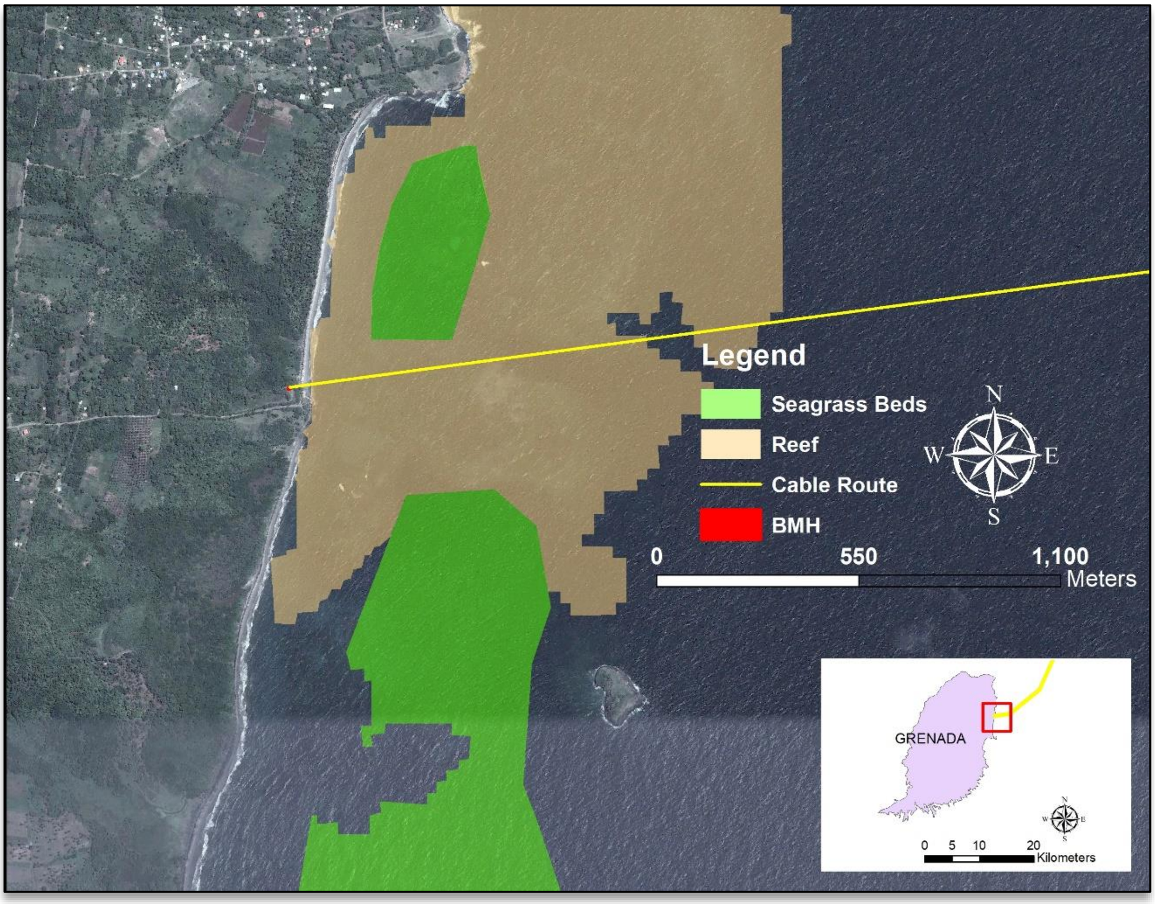

Figure 27. Benthic habitat map of Conference, Grenada.

The ESIA provides a more detailed description of the terrestrial resources while this section provides the photographic documentation of each landing site, and BMH. Additionally, photos are provided of areas with pre-existing conditions (such as erosion) mentioned in the ESIA.

A complete list of avifauna (seabirds and shorebirds) within Grenada, the Grenadines and St. Vincent are also listed within the main body of the ESIA (Sec. 6.2.3 Terrestrial Environment) as well as their status under the International Union for Conservation of Nature's (IUCN) Red List.

a. Hillsborough Bay, Carriacou

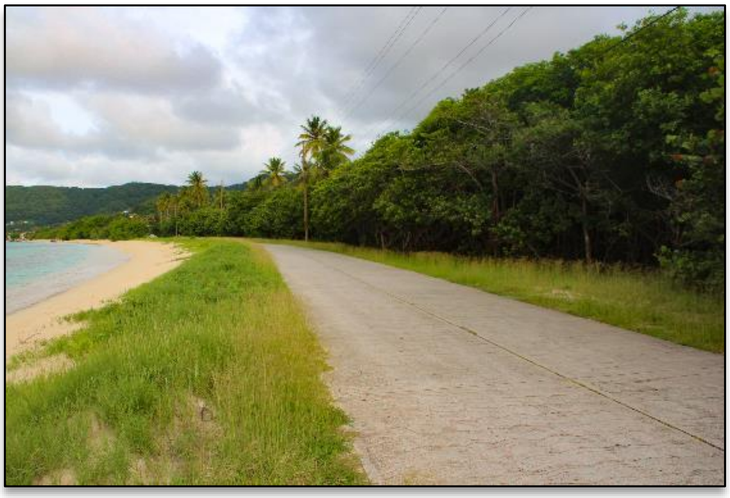

Figure 28. Representative habitat type at shore landing – Hillsborough Bay, Carriacou.

The cable landing site in Hillsborough Bay is nearly featureless with grasses serving as the dominant species (Figure 28). The BMH will be located across the street from the shore where a strip of open land is located. Backing this location are mangroves but their distance from the BMH is great enough to ensure root systems are not disturbed.

Figure 29. Seabirds observed along offshore breakwater – Hillsborough Bay, Carriacou.

Bird species near the cable landing site were more abundant in Carriacou than any other site. Most birds were observed on the offshore breakwater (Figure 29). These included different species of terns, presumed to be roseate (*Sterna dougallii*) and sandwich terns (*Thalasseus sandvicensis*), brown pelicans (*Pelecanus occidentalis*) and brown boobies (*Sula leucogaster*) all of which are considered species of least concern under the IUCNs Red List.

b. Union Island

Vegetation along the shoreline (Figure 30 & 31) at Point Lookout Bay and behind the beach where the BMH is proposed, is generally composed of dry evergreen scrub, herbaceous shrubs and thorn brush. Some of the key species includes sea lavender (*Argusia gnaphalodes*), *portulaca* spp., cow's tongue cactus (*Opuntia engelmannii*), seagrape trees (*Coccoloba uvifera*), coconut trees (*Cocos nucifera*), yellow balsam (*Croton flavens*), beach naupaka (*Scaevola sericea*). Additionally, buttonwood mangroves (*Conocarpus erectus*) are located within close proximity to the BMH (Figure 32), most likely remnants from a pond that once existed but was filled in and now forms part of the airport apron.

A narrow concrete drainage channel has been implemented running parallel to the airport property for stormwater drainage off the airport and from the unpaved road leading to the BMH. Severe beach erosion occurs in this location (Figure 33) on the far southern end of the beach but is adjacent to and within close proximity to the location of the cable landing site.

Figure 30. Representative coastal habitat at shore landing at Point Lookout Bay, Union Island.

Figure 31. General location of the BMH within clearing at Union Island.

Figure 32. White mangroves found near the location of the proposed BMH.

Figure 33. Beach erosion at Point Lookout Bay caused by drainage from a channel upland of the shoreline.

c. Nen's Bay, Canouan

The coastal environment at Nen's Bay has been altered from the airport extension, landfill backing the beach and reclamation along the shore (Figure 34-35).

The area would have once been coastal woodland backed by mangrove forest. Today, the dominant vegetation along the shoreline and within the vicinity of the BMH is manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*) and tropical almond (*Terminalia catappa)* (Figure 36). A number of dead trees were interspersed with live vegetation towards the western end of the shoreline, suggesting changing edaphic regimes related to sediment stockpiling.

Figure 34. View overlooking Nen's Bay, Canouan. Landfill in the foreground and airport in the background.

Figure 35. Shoreline at Nen's Bay being reclaimed as seen with the large pile of sediments.

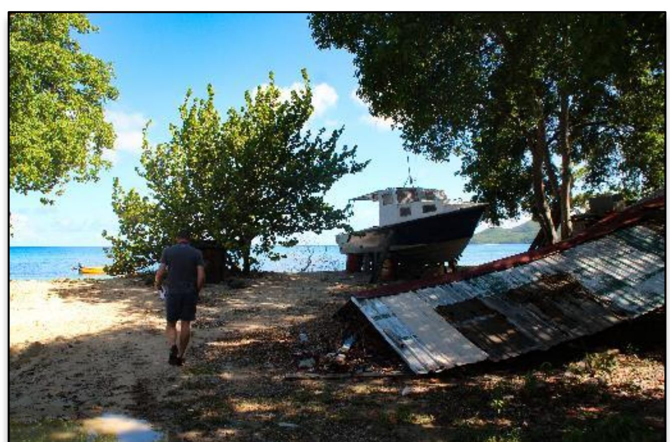

Figure 36. Clearing to the beach from the proposed BMH location.

d. Endeavour Bay, Mustique

Coastal resources along Endeavour are dominated by typical coastal hedge (Figure 37) with vegetation behind the beach berm landscaped with a wide range of native and non-native species, particularly along the cable pathway from the shore to the beach manhole (Figure 38).

Figure 37. Shoreline along Endeavour Bay, Mustique.

Figure 38. Pathway from cable landing site to the proposed BMH location.

e. Lower Bay, Bequia

Most of the land cover near the shoreline has buildings and road networks with a major road running parallel to the entire length of the shore. Between the high-water mark and the road is a vegetative buffer of coastal woodland that extends landward past the road (Figure 39-40). Vegetation where the cable lands on the shore at Lower Bay is limited to a few species and includes manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*) and tropical almond (*Terminalia catappa)*.

Figure 39. Shoreline at the cable landing site– Lower Bay, Bequia, fore reef.

Some erosion is occurring within the vicinity of the cable landing site in Lower Bay. Exposed tree roots on adjacent vegetation (particularly the Manchineel trees) and an erosional gully starting from the roadside flowing seaward (Figure 41). Additionally, several boulders and a dead tree trunk appear to have been purposely placed near the side of a beachside bar/restaurant. Most likely, the combination of runoff down the road running perpendicular to the shore (and the road in which the cable will run towards the landing site) and the proximity of the building to the shore / built directly on the beach are the underlying cause for erosion in this area.

Figure 40. Representative habitat from cable landing site to the BMH – Lower Bay, Bequia, fore reef.

Figure 41. Red arrow points to an erosional stormwater gully from the roadside leading to the shoreline is a pre-existing issue.

f. Arnos Vale, St. Vincent

The coastal vegetation along the rocky shoreline at Arnos Vale (Figure 42) is characterized as secondary vegetation, common in disturbed areas. However, a vegetative buffer exists between the back beach and lands adjacent to the playing field which is composed of common coastal species such as almond (*Terminalia catappa*) and seagrape (*Coccoloba uvifera*).

The existing BMH (Figure 43) lies just at the water's edge.

Figure 42. Representative shoreline near the cable landing site at Arnos Vale, St. Vincent.

Figure 43. Existing beach manhole at Arnos Vale.

g. Chateaubelair, St. Vincent

The area surrounding the cable landing and BMH (Figure 44-45) has almost no natural vegetation due to developments backing the beach, only a few planted species of vegetation. A government dock is located to the northeast of the BMH along with a row of gabion baskets running 33 yd. (30 m) parallel to the shore. Approximately 33 yd. (30 m) to the west of the BMH is a natural watercourse outflow (Figure 46).

Figure 44. Terrestrial habitat around the beach landing site at Chateaubelair, St. Vincent.

Figure 45. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

Figure 46. Arrow points to a natural stormwater outflow near the cable landing site at Chateaubelair, St. Vincent.

h. Owia, St. Vincent

Terrestrial resources in Owia are limited as the area is dominated by buildings, road networks and bare ground. Adjacent to the BMH is the Owia Fishery Center which includes a slipway, tetrapod breakwater, rubble rock mound seawall (Figure 47), a fishery centre building and fishermen's locker buildings. Vegetation is dominated by a single line of coconut palms (*Cocos nucifera*) and grasses (Figure 48).

Figure 47. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

Figure 48. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

i. Conference, Grenada

The dominant ecologic habitat type in Conference is mangrove wetland, north of the cable landing and BMH locations (Figure 49). The location of the cable landing and BMH (Figures 50-51) is dominated by coastal scrub species such as seagrape trees (*Coccoloba uvifera*) and coconut trees (*Cocos nucifera*).

Two species of birds were observed during the first field visit, Semipalmated sandpipers (*Calidris pussilla*) (Figure 52) considered to be near threatened under the IUCNs Red List and the Magnificent frigate bird (*Fregata magnificens*), considered to be a species of least concern.

Figure 49. Wetland area to the north of the BMH.

Figure 50. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

Figure 51. Representative habitat type along cable route – Lower Bay, Bequia, fore reef.

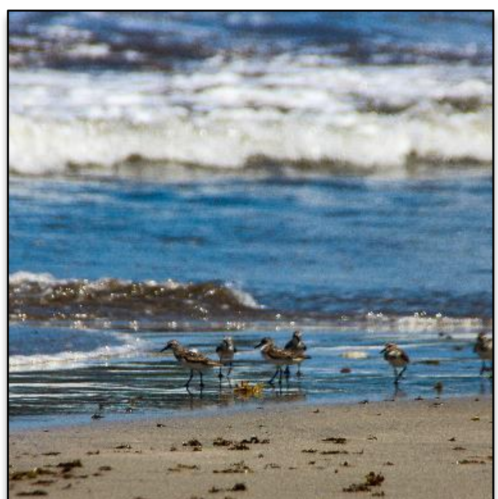

Figure 52. Semipalmated sandpiper (Calidris pussilla) foraging along the shoreline in Conference, Grenada.

IV. SUMMARY OF FINDINGS

This report presents the results of a rapid assessment of marine resources found along the cable route in nearshore habitats, and terrestrial resources at the cable landing site and beach manhole. The assessment is based on site investigations undertaken in September and October 2018.

Marine Benthic Habitats

- Based on CMC's biological surveys and IT's geotechnical surveys, cable routes with live coral coverage (over 8% live coverage) were modified to follow a route dominated by sand. Carriacou, Canouan and Bequia updated cable routes are shown in Figures 53-55. Imagery also includes the multibeam image that shows benthic features that were avoided in the new route. Marine habitats along nearshore cable routes are predominantly composed of sand, coral rock and or the invasive seagrass (*Halophila stipulacea*).

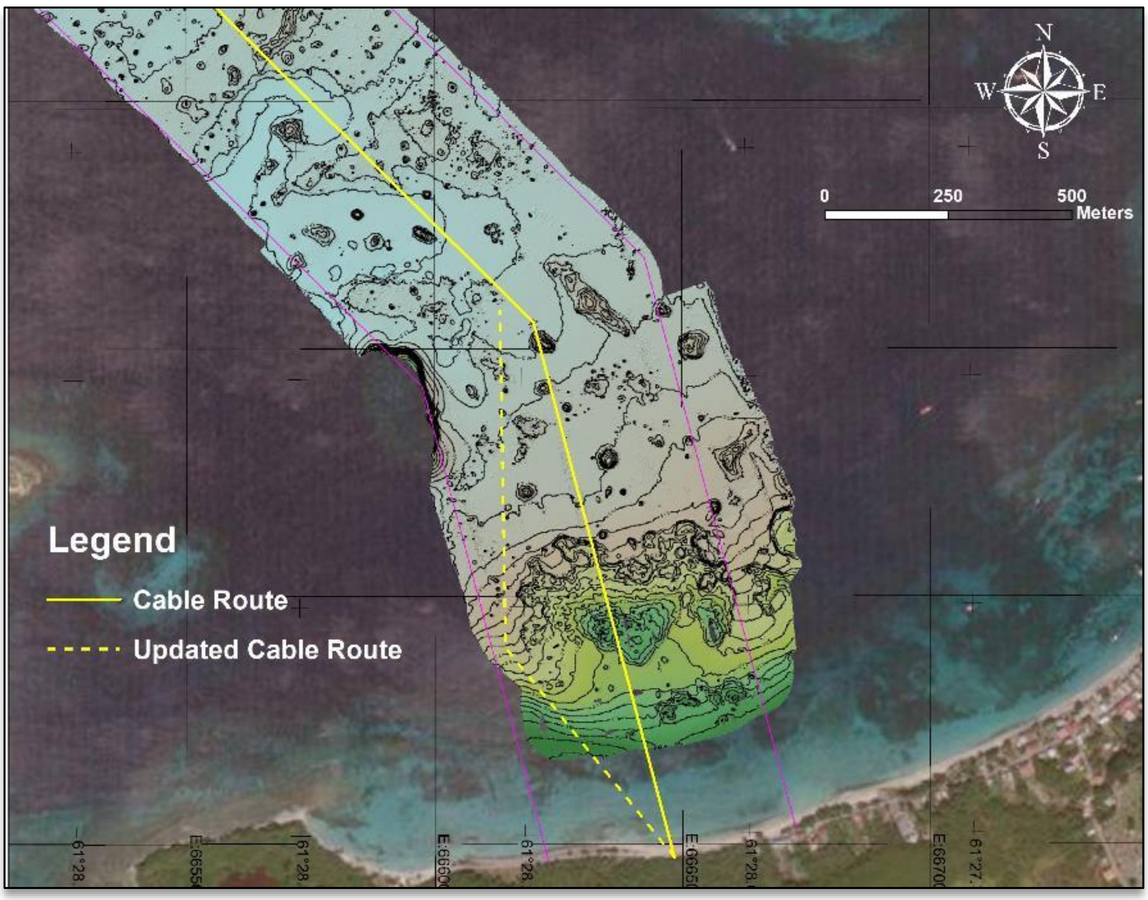

Figure 53. Hillsborough Bay, Carriacou - Red arrow points to a reef picked up by the multibeam imagery and identified during CMC's marine surveys (coral coverage 15.8%). Segmented line shows the new route avoiding this major feature.

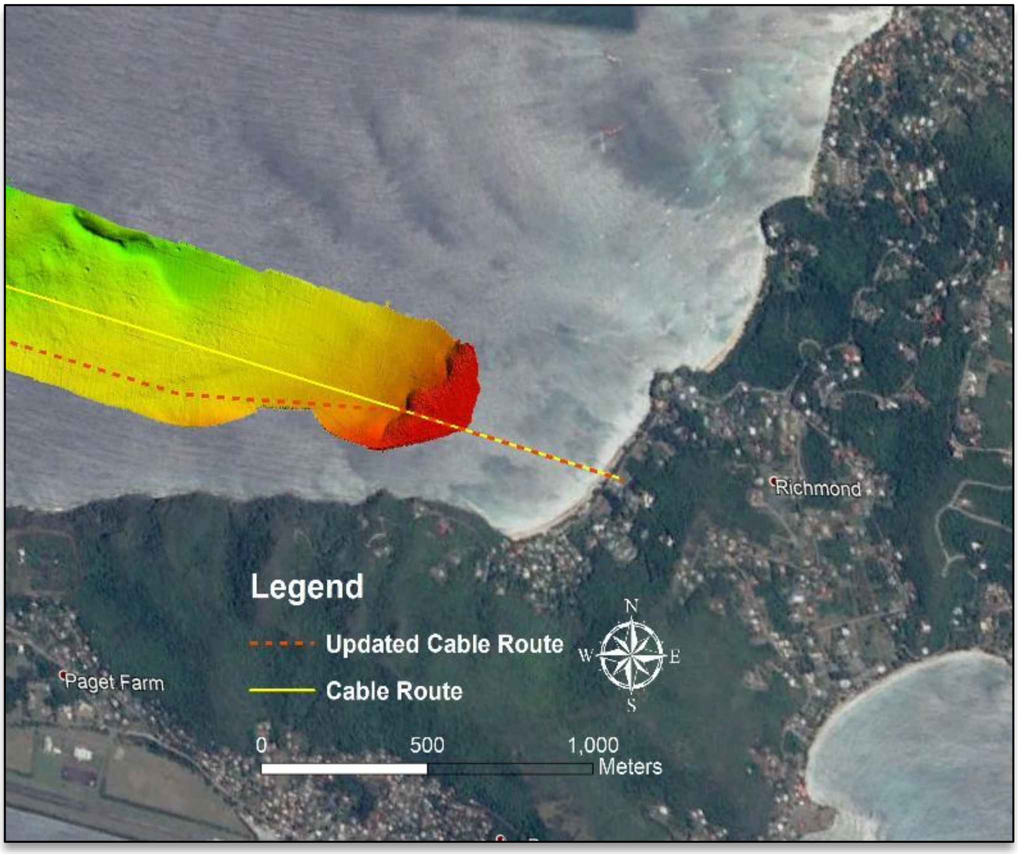

Figure 54. Lower Bay, Bequia updated cable route.

Figure 55. Nen's Bay, Canouan updated cable route.

Water Quality

- The pH levels at all sampling sites fell within acceptable levels of 6.5 - 8.5 for coastal waters (Wenner et al., 2001) and salinity levels at all sites also were typical of normal tropical sea water salinity, 35 ppt. Nitrate levels reach pollution classification when it exceeds 5 mg/L (Chapman, 1992) and all location tested were below pollution levels. Maximum phosphate levels recommended by the United States Environmental Protection Agency (USEPA) for coastal waters are 0.1 mg/L (100 µg/L). All areas tested showed values below this value.

Marine Benthic Communities

- Since cable routes run through abiotic communities (sand, coral rock, rubble) and areas of the invasive seagrass *Halophila stipulacea*, very little biodiversity exists within these environments.
- Of significant concern is the amount of the invasive seagrass found throughout both countries. This particular seagrass is native to the Red Sea and western Indian Ocean but spread to the Mediterranean Sea in the late 1800s, possibly after the opening of the Suez Canal (Lipkin, 1975), and became established in the eastern Caribbean in 2002 (Ruiz and Ballantine, 2004). It is now also found in 19 other Caribbean countries (Willette, et al., 2013). Without extensive research, the ecological ramifications of this invasion are difficult to predict. In particular, more data is required on herbivory rates, selective feeding habits (such as sea turtles), and relative nutritional values of the native and the introduced species. Alternatively, the seagrass could stabilize previously un-vegetated benthic habitats, thereby reducing erosion of nearby coastlines during storm events, which are expected to become stronger and more frequent under climate change (more frequent and stronger under a changing climate (Rogers, et al., 2014).

  Because of the aggressive nature of this particular species, seagrasses will quickly colonise over sand once the cable self-buries.
- Corals found within the cable routes surveyed included two species listed under the IUCN's Red List and included boulder star coral (*Orbicella annularis*) and elliptical star coral (*Dichocoenia stokesii*). Elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*) and boulder star coral were the three major reef building species prior to the region-wide disease-induced mass mortality from the outbreak of white-band disease in the late 1970s (Aronson and Precht, 2001) and the die-off of *Diadema antillarum* in 1983-84 (Carpenter, 1988). The *Orbicella annularis* (complex) may now represent the most important framework coral in the western Atlantic (Bruckner 2003).
- There were no populations of spiny lobster (*Panulirus argus*), spotted lobster (*P. guttatus*), queen conch (*Strombus gigas*) found within the cable route but the spiny sea urchin (*Diadema antillarum*) was found but in low populations. Reduced numbers of this particular urchin allow for fleshy algae to overgrow and was supported by the critical levels of fleshy alga cover found in Bequia, Canouan and Union Island.

Fish Populations

- Fish abundance and biomass across all sites were typically very low. A total of 27 fish species (listed under the AGRRA protocol) were identified along transects with the highest abundance (and biomass) found in Bequia, although still considered "poor" based on the Coral Reef Report Cards.

- Mustique had a very high abundance of juvenile fish, particularly around the coral nursery (well outside of the cable route).

Terrestrial Ecology

- There are no terrestrial ecological resources from the shoreline to the BMH at any of the 9 landing sites that will be adversely impacted.
- Very few birds were observed during the site visits, most likely due to the limited amount of time spent at each site. However, the one species listed as vulnerable under the Red List was identified at Conference, Grenada.

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APPENDIX 1: TRANSECT COORDINATES

Coordinate system:
WGS 84 / UTM ZONE 20

Bequia

Fore Reef	*x*	*y*
T1	689715.5	1437665.0
	689759.6	1437639.8
T2	689775.3	1437629.7
	689826.6	1437637.7
Back Reef		
T3	690064.0	1437526.4
	690116.9	1437256.8
T4	690155.1	1437524.6
	690193.0	1437490.0

Union

Fore Reef	*x*	*y*
T1	672631.2	1394311.9
	672679.4	1394282.9
T2	672673.9	1394272.3
	672657.8	1394220.9
Back Reef		
T3	672656.8	1393798.9
	672617.6	1393763.2
T4	672626.3	1393733.1
	672662.8	1393700.3

Mustique

Fore Reef	*x*	*y*
T1	696608.2	1425654.6
	696657.9	1425657.4
T2	696658.3	1425659.2
	696707.0	1425642.0
Back Reef		
T3	696743.9	1425615.0
	696796.0	1425618.0
T4	696798.3	1425620.0
	696843.2	1425598.0

Carriacou

Fore Reef	*x*	*y*
T1	666332.4	1380561.3
	666309.6	1380515.8
T2	666317.0	1380494.6
	666362.0	1380462.9
Back Reef		
T3	6664070.0	1380295.1
	666378.4	1380256.5
T4	666405.9	1380243.8
	666439.3	1380210.5

Canouan

Fore Reef	*x*	*y*
T1	680106.4	1405150.0
	680144.7	1405113.9
T2	680145.0	1405106.0
	680144.5	1405055.7
Back Reef		
T3	680248.8	1404816.1
	680226.0	1404771.3
T4	N/A	
	N/A	

APPENDIX 2: IUCN RED LIST SPECIES & CLASSIFICATION

CORAL

Common Name	Scientific Name	IUCN Status	Trend
Staghorn Coral	*Acropora cervicornis*	CE	Stable
Elkhorn Coral	*Acropora palmata*	CE	Stable
Lamarck's Sheet Coral	*Agaricia lamarcki*	VU	Decreasing
Pillar Coral	*Dendrogyra cylindrus*	VU	Stable
Elliptical Star Coral	*Dichocoenia stokesii*	VU	Decreasing
Boulder Star Coral	*Orbicella annularis* *(Formerly: Montastraea annularis)*	EN	Decreasing
Star coral	*Orbicella faveolata* *(Formerly: Montastraea faveolata)*	EN	Decreasing
Star coral	*Orbicella franksi* *(Formerly: Montastraea franksi)*	VU	Decreasing
Rough Cactus Coral	*Mycetophyllia ferox*	VU	Unknown
Large Ivory Coral	*Oculina varicosa*	VU	Unknown

FISH

Common Name	Scientific Name	IUCN Status	Trend
Gray Triggerfish	*Balistes capriscus*	VU	Decreasing
Peppermint Goby	*Coryphopterus lipernes*	VU	Unknown
Masked Goby	*Coryphopterus personatus*	VU	Unknown
Bartail Goby	*Coryphopterus thrix*	VU	Unknown
Patch-reef Goby	*Coryphopterus tortugae*	VU	Unknown
Pallid Goby	*Coryphopterus eidolon*	VU	Unknown
Broadstripe Goby	*Elacatinus prochilos*	VU	Unknown
Atlantic Goliath Grouper	*Epinephelus itajara*	VU	Decreasing
Red Grouper	*Epinephelus morio*	VU	Decreasing
Nassau Grouper	*Epinephelus striatus*	CE	Decreasing
Yellowedge Grouper	*Hyporthodus flavolimbatus*	VU	Decreasing
Hogfish	*Lachnolaimus maximus*	VU	Decreasing
Cubera Snapper	*Lutjanus cyanopterus*	VU	Decreasing
Vermilion Snapper	*Rhomboplites aurorubens*	VU	Decreasing
White Marlin	*Kajikia albida*	VU	Decreasing
Blue Marlin	*Makaira nigricans*	VU	Decreasing
Ocean Sunfish	*Mola mola*	VU	Decreasing
Bigeye Tuna	*Thunnus obesus*	VU	Decreasing
Atlantic Bluefin Tuna	*Thunnus thynnus*	EN	Decreasing
Tarpon	*Megalops atlanticus*	VU	Decreasing

SHARK, WHALES, MANATEE

Common Name	Scientific Name	IUCN Status	Trend
Smalltooth Sawfish	*Pristis pectinata*	CE	Decreasing
Whale Shark	*Rhincodon typus*	EN	Decreasing
Silky Shark	*Carcharhinus falciformis*	VU	Decreasing
Oceanic Whitetip Shark	*Carcharhinus longimanus*	VU	Decreasing
Shortfin Mako	*Isurus oxyrinchus*	VU	Decreasing
Scalloped Hammerhead	*Sphyrna lewini*	EN	Unknown
Great Hammerhead	*Sphyrna mokarran*	EN	Decreasing
Sperm whale	*Physeter macrocephalus*	VU	Unknown
Sperm whale	*Physeter macrocephalus*	VU	Unknown
American Manatee	*Trichechus manatus*	VU	Decreasing

APPENDIX 3: SURVEY FISH LIST

TAXON	PRIMARY DIET	RATIONALE
BY FAMILY NAME (regardless of species name):		
Acanthuridae (surgeonfishes)	Herbivores	Eat benthic algae
Balistidae (triggerfishes)	Primarily Invertivores	Eat *Diadema antillarum* + Some are Commercially Significant
Chaetodontidae (butterflyfishes)	Primarily Invertivores	Some are Commercially Significant (for aquaria)
Haemulidae (grunts)	Invertivores	Some are Commercially Significant
Kyphosidae (chubs)	Primarily Herbivores	Eat benthic algae
Lutjanidae (snappers)	Piscivores/Invertivores	Commercially Significant + Eat herbivorous fishes
Muraenidae (morays)	Piscivores/Invertivores	Eat herbivorous fishes
Pomacanthidae (angelfishes)	Invertivores/Herbivores	Some are Commercially Significant (for aquaria)
Scaridae (parrotfishes)	Herbivores	Eat benthic algae + Some may eat live corals and either scrape or erode coral skeletons
Serranidae (sea basses) Only Subfamily Epinephelinae (groupers + graysby, red hind, rock hind, coney)	Piscivores/Invertivores	Commercially Significant + Eat herbivorous fishes
BY SPECIES NAME (regardless of family name):		
In Carangidae (jacks), only: *Carangoides ruber* (bar jack) *Trachinotus falcatus* (permit)	Invertivores/Piscivores	Commercially Significant + permit may eat *Coralliophila* spp.
In Diodontidae (porcupinefishes), only: *Diodon holocanthus* (balloonfish) *D. hystrix* (porcupinefish)	Invertivores	Eat *Diadema*; may eat *Coralliophila* spp.
In Labridae (wrasses), only: *Bodianus rufus* (Spanish hogfish) *Lachnolaimus maximus* (hogfish) *Halichoeres bivittatus* (slippery dick) *H. garnoti* (yellowhead wrasse) *H. radiatus* (puddingwife)	Primarily Invertivores	Commercially Significant + May eat *Coralliophila* spp. & *Diadema*
In Monacanthidae (filefishes), only: *Aluterus scriptus* (scrawled filefish) *Cantherhines macrocerus* (whitespotted filefish) *C. pullus* (orangespotted filefish)	Herbivores/Invertivores	Commercially Significant
In Sparidae (porgies), only: *Calamus bajonado* (jolthead porgy) *C. calamus* (saucereye porgy) *C. penna* (sheepshead porgy) *C. pennatula* (pluma)	Invertivores	Some may eat *Diadema* or *Coralliophila* spp.
In other families: *Lactophrys bicaudalis* (spotted trunkfish)	Invertivore	Eat *Diadema*
Microspathodon chrysurus (yellowtail damselfish)	Herbivore	Eats benthic algae + Commercially Significant (for aquaria)
Sphoeroides spengleri (bandtail pufferfish)	Invertivore	Eat *Diadema*
Sphyraena barracuda (great barracuda)	Piscivore	Commercially Significant + Eats herbivorous fishes
Pterois spp. (lionfishes)	Piscivore/Invertivore	Invasive, venomous alien predators + Can be eaten safely after cooking

Atlantic Gulf Rapid Reef Assessment Protocol version 5.4 (Lang, et al., 2010)

APPENDIX 4: XL CATLIN GLOBAL REEF SURVEY

The XL Catlin Global Reef Record is a research tool aimed at collating and communicating the coral reef science of the XL Catlin Seaview Survey and combining that information with data from other leading sources of ocean research. The free database provides scientists across various disciplines of marine studies with a tool for analysing the current state of reef ecosystems on a local, regional and global scale and monitoring changes that occur over time. It has been designed in partnership with scientists from the Global Change Institute at the University of Queensland with additional data and analysis from World Resources Institute, SCRIPPS and the National Oceanic & Atmospheric Administration (NOAA).

The XL Catlin Seaview Survey approach is centred on high definition imagery using the SVII camera capable of taking 360° high-resolution images, every three seconds during a dive along a 2 km stretch of reef. Every image captured has a geographical tag that allows for an accurate location that can be revisited in time and compared against previously available information. (A GPS unit is synchronised in time to the SVII camera and tethered from the surface by the divers).

Every field campaign provides about 30-40 thousand survey images which need to be annotated in order to extract benthic cover estimates (e.g. % cover of coral, algae, & sand). Because manual annotation of a human expert is exceedingly timely (i.e. 30.000 images would take 3 years to annotate), a state-of-the art automated image annotation methods is used.
Automated image annotation is very fast and the analysis of hundreds of thousands of images from a reef region can therefore be achieved in a manner of days. For example; over 190,000 survey quadrats from a survey carried out in the Great Barrier Reef Australia were automatically annotated in one week using a single computational unit (a NVIDIA Titan X GPU).

The Global Reef Record provides two main image data-products. The first product is qualitative 360° panoramas of the reef. The panoramas are created by scaling and stitching the fish-eye imagery and provide an interactive way to explore the complete environment of a reef. The second product is a quantitative analysis of benthic categories (% covers) along the reef transects. These records are freely available at: http://globalreefrecord.org/data

St. Vincent and the Grenadines were surveyed in 2013. Data from St. Vincent & the Grenadines can be found at: http://globalreefrecord.org/regions/details/2

Further methodological details can be found at:

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11.6 APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS

APPENDIX VI: RECORD OF MEETINGS AND CONSULTATIONS WITH STAKEHOLDERS

Social Survey Questions

CARCIP Social Survey
October 12, 2018

Project Description
(Read this description and/or show the slideshow to respondents before questions)

The Grenada to St. Vincent Submarine Cable System is part of the larger CARCIP initiative, to develop and support Information and Communications Technology (ICT) in the region via provision of undersea fiber optic communications infrastructure.

The system will connect St. Vincent and Grenada, who currently have high-speed fiber optic service via Southern Caribbean Fiber, with smaller islands only serviced using microwave radio. The submarine cable will support expansion of 4G LTE wireless services, HDTV, government services, along with high-speed internet for local & tourism users to these islands:

Island, Segment	Site Name
GRENADA	Conference
ST. VINCENT, South	Arnos Vale
BEQUIA	Lower Bay
MUSTIQUE	Endeavor Bay
CANOUAN	Nens' Bay
UNION	Airport - Preferred
CARRIACOU	Hillsborough Bay
ST. VINCENT, North	Chateaubelair (Leeward)
	Owia (Windward)

Construction applications will be submitted to the governments of Saint Vincent and the Grenadines and Grenada in October and an Environmental and Social Impact Assessment will be prepared, submitted to both governments, and available in late November 2018.

Questions
We are interested in your thoughts and ideas on this project so that we can prepare the ESIA with your opinions in mind. Please help us formulate a course of study that will consider your comments by answering the following questions.

1. What is your opinion of the current internet services you now have?
    a. I am satisfied
    b. I not satisfied
    c. I have no opinion
2. What would you like to see improved in your current internet services?

    a. Improved internet speed
    b. Fewer interruptions and less down time
    c. Lower internet service price
    d. I have no opinion
3. What are your primary environmental concerns at the construction sites, if any?
    a. Turtle conservation
    b. Coral protection
    c. Water quality
    d. Hazardous material spills
    e. Other __________________________
4. Do you expect this project would change your life in any way?
    a. No, not at all
    b. Yes, probably for the better
    c. Yes, probably for the worse
    d. I don't know
5. What could we study in our ESIA that would help you understand the environmental impacts of this project?
    a. Social issues
    b. Air or Water quality
    c. Deep ocean sea floor habitats
    d. Nearshore sea floor habitats
    e. I'm satisfied with what the authors will do
    f. Other_____________________________
6. Do any of these anticipated impacts bother or upset you?
    a. Boats and divers near shore laying cable by hand
    b. Large cable laying vessel in sight of land
    c. Small fiber optic cable buried underground on the beach
    d. Beach manhole buried above sea level
7. In Question 6, if you are bothered by any of the selections, how could we minimize or avoid such impacts?
    a. Shorten the presence of marine cable laying equipment at the landing sites.
    b. Shorten the duration of construction on the beach to install an underground beach manhole to house the cable connections.
    c. Change the landing site location
    d. Other _____________________________
8. After seeing a picture or a sample of submarine internet cable, are your views about question 6 changed in any way?
    a. Yes
    b. No
    c. No opinion
9. Are you familiar with any of the proposed landing sites? What kind of ongoing activities might conflict with installing a cable and beach man hole at these sites?
    a. Housing
    b. Recreation
    c. Commercial
    d. Conservation

e. Tourism
f. Other ___________________

10. Are you aware of any internet service discrimination due to your gender, race, or religion?
    a. Gender
    b. Race
    c. Religion
    d. Other _______________

Informal meetings and contacts

STAKEHOLDER	Position/Role	Correspondence Type	Key Info Obtained
Dr. Karen Eckert	Executive Director of Wider Caribbean Sea Turtle Network (WIDECAST)	Phone Call / emails	Provided updated WIDECAST membership list/contacts & 2018 Grenada turtle nesting data
Dr. Kim Baldwin	Consultant / Author of MarSIS dataset	Phone Call & Emails	Provided insight into the MarSIS mapping dataset (descriptions of habitat types); provided input on preferred cable routes
Louise Mitchel Joseph	St. Vincent & the Grenadines Preservation Fund (Coordinator)	Email	Provided contact details for Roseman Adams (runs nesting monitoring programme for Union Isl.); Identified Big Sand at Sandy Bay (St. Vincent) as an index nesting beach for leatherback sea turtles (originally was listed as a landing site)
Raven Hoflund	WIDECAST Country Coordinator (VCG/Mustique)	Email	Identified Britannia Bay as a high-density green turtle foraging ground / low density nesting beach; Identified Endeavor as a very low-density nesting beach
Adam Eckert	WIDECAST GIS Specialist	Email	Identified errors in WIDECAST data for beach names verified location names for cable landings
Kate Charles	WIDECAST Country Coordinator (Grenada)	Email	Identified Conference as a low-density leatherback nesting beach (4 in 2018 / all killed for meat & eggs taken); also identified as an area where some sand mining occurs
Roseman Adams	Union Island Environmental Attackers	Phone call / In-person comms	Guide for site visits in Union; identified Bloody Bay as a nesting beach for Leatherbacks (low density), provided background info (land ownership and issues related to landing site options); provided the socio-economic insight to relations with mainland state (i.e. Grenada/St. Vincent)
Uncle Popo	Local taxi driver- Carriacou	In-person comms	Identified Paradise Beach as the most popular beach in Carriacou based on number of taxi runs to the area
Brianna Pierre	SusGren Ltd (Union Isl)	In-person comms	Introduced the environmental programmes carried out by SusGren, one of the key environmental organizations in VCG & Grenada
Krisma Moore	SusGren Ltd (Union Isl)	In-person comms	Introduced the environmental programmes carried out by SusGren, one of the key environmental organizations in VCG & Grenada
Nakita Poon Kong	Environmental Manager - Mustique	In-person comms	Provided overview of existing and future environmental plans in Mustique as well as provided extensive knowledge about the island and its habitats
Jennifer Cruikshank-Howard	Chief Fisheries Officer, Ministry of Agriculture, Forestry, Fisheries and Rural Transformation, Kingstown VCG	Email	Identified gaps in the turtle nesting data for Arnos Vale & Nen's Bay; also identified hawksbill nesting activity at Chateaubelair Expressed concern about scheduling of landing as this will be the peak of the leatherback nesting season and the beginning of the nesting season for the green and hawksbill sea turtles. The Fisheries Division recommended work be conducted in the December to February period when it is less likely for there to be unwanted interactions with turtle nests.
Glenroy Adams	Grenadine Dive (Owner)	In-person comms	Provided insight to general environmental and socio-economic conflicts amongst the islands
Gary Ward	Deefer Divers (Owner)- Carriacou / Board of Directors on the OBSIMPA	In-person comms	Provided extensive information regarding the reefs in the area and how the MPA is currently managed
Katlynd Trieber-Vajda	Deefer Divers (Dive Instructor)- Carriacou	In-person comms	Provided info on reefs in the vicinity of cable route, activity within and outside of the MPA
James Walker	Dive Bequia (Dive Instructor)	In-person comms	Provided information on proximity to healthy coral reefs and use of the anchorage in Lower Bay, Bequia
Emma Doyle	MPA Connect Coordinator -Gulf Caribbean Fisheries Institute (GCFI)	Email	Provided information regarding MPA networks in VCG & Grenada, shared monitoring data

Meeting Notes, Public Meeting St. Vincent and the Grenadines

Public Consultation of the Caribbean Regional Communications Infrastructure Project (CARCIP)
Fibre Optic Network Project (Lot 3)
14th January 2019

Panel:
KF – Krystle Francis (Program Manager CARCIP Lot 3, Digicel)
NI – Nigel Irvine (Director of Permitting, Deep Blue Cable)
RJ – Roxanne John (CARCIP Project Coordinator, Government of Saint Vincent and the Grenadines)
MJ – Mrs. Marcelle Edwards-John (Deputy Director of Ministry of Finance, Economic Planning, Sustainable Development and Information Technology, GoSVG)
GS – Greg Stoner (Project Manager, IT International Telecom Canada Inc.)

Audience:
-General public (in attendance)
-Live on radio.
-Media houses recording audio/visual to make an edited release.
Start time: 10:07 AM
Finish time:

Proceedings:
KF: Greetings and introduces herself and establishes protocol. Establishes agenda as follows:
Greetings and Welcome
Introduction to Panel
Presentation by GoSVG – Marcelle Edwards-John
Overview of CARCIP
Overview of Lot 3 Subsea – Nigel Irvine
Grievance Mechanism - RJ
-CARCIP Lot 1 & Lot 2 Fibre Network overview, Lot 1 Overview in detail
-GWAN – Full Cisco Network
-IP Telephony – SVG GOV PBX – 1302 devices.
-Program Milestones
-Lot 3 Overview

MJ: Government perspective of CARCIP and subsea network.
-GoSVG sees ICT as the backbone of development.
-Depends on integration within the global economy. This is not possible without the creation of a robust infrastructure.
-Positive trends in Broadband and internet connectivity.
-Businesses leverage and improve competitiveness.
-Governments requested assistance from the World Bank to implement CARCIP

-2012 – Under the Leadership of Dr. Jerrol Thompson (Former Minister of Telecommunications), GoSVG secured investment from the World Bank. Commenced on CARCIP, largest ICT infrastructure project in SVG.
-Fully aligned with the National Social and Economic Development plan; Leveraging ICT to transform the Economy.
-Contribute to extending the government's infrastructure, extending services to serve communities and facilitating faster and easier access to information.
-CARCIP is being implemented by Min Finance, under leadership of Roxanne John
-Component 1 – Regional Connectivity Infrastructure. Enhancement of ICT.
-Component 2 – ICT led innovation, Supports training and incubation of services.
-Broadband expert has studied the gaps in SVG ICT connectivity.
-Grenadines are currently served by Microwave technology.
-Bandwidth requirements of 4G and LTE.
-Most feasible option is to install undersea fibre optic system.
-Competitive bidding process and rigorous negotiations. Digicel won the contract.
-Design, construction, operation and maintenance of the system.
-Establishment of this system will significantly increase the speed and level of connectivity in the grenadines and penetration of broadband.
-Meet the growing demands for Broadband services and bandwidth demands.
-Grenadines has a population of 16,000
-Grenadines is tourism oriented. Tourism product will increase.
-Demand for eGovernment applications to eliminate the need to physically travel to Kingstown for passport, licenses, and other basic services.
-Facilitate the delivery of more easily accessible services.
-Services provided by government will require increases in bandwidth, such as social media, video communication etc.
-Conclude by encouraging Key stakeholders to take part in the successful implementation of the CARCIP project, to be fully engaged.
NI: CARCIP – Lot 3 Subsea Fibre System,
-Submarine fibre optic cables have been the backbone of the internet and Telecoms for years.
-Explain an overview of Lot 3 CARCIP
-Explain background of existing Digicel owned Southern Caribbean Fibre (SCF) which is comprised of the Middle Caribbean network, the Southern Caribbean Fibre Network and the Antilles Crossing Submarine Fibre network (connects Barbados, St Lucia, Saint Croix and USCI).
-Explain the process of the ESIA. The draft was delivered to the governments in December 2018.
-Ministry of housing Approved. Ministry,
-Physical Planning Approval.
-Proposed landing options for the main trunk between SVG and Grenada.
-Conference Beach, Grenada and Great head bay, Saint Vincent (Existing SCF Landing)
-New route was chosen to avoid direct path with Kick 'em Jenny etc.
-Challenging coastal and marine topography led to few route options. The festoon segment 8.6 will be Owia to Richmond.
-The grenadine options are:
-Lower Bay, Bequia (Segment 8.1)

-Endeavour Bay, Mustique (Segment 8.2)
-Nens Bay, Canouan (Segment 8.3)
-Airport, Union (Segment 8.4)
-Hillsborough Bay, Carriacou (Segment 8.5)
-Desk based Cable Route Study analysed all relevant elements of the marine installation. There was a marine geophysical and geotechnical Cable Route Survey, to include topographic and diver surveys.
-Beach manhole Construction -2 m L x 1.8 w x 2 m Deep. (6.5' x 5'9" x 6.5') will be cast in place or precast. All regulations will be followed. BMH installation is scheduled to take place January and February 2019.
-Main Lay Operations:
-Explained the installation operations, and demonstrated a sample of the two types of fibre optic cables.
-Shore End operations (typically 2-day operation per island). All efforts have been made to minimise environmental, social and marine impacts.
-Summary Timeline:
-Contract in Force 8 August 2018 – Commission June 2019

KF: Outline extra items in detail
-Long term partnership with the GoSVG.
-Over 500 jobs will be created throughout the CARCIP project
-Digicel will always give local populations first priority for employment.
-Opens up future employment for Vincentians

RJ: Grievance Redress Mechanism
-Stressed importance of GRM, and notes that it will be in place soon.
KF: reiterates that GRM will be in place before construction starts.

- Question and Answer Session -

Question(Q):

(1) Intellectual Property Rights
(2) Void in ferry system

Answer (A):
(1) KF replies that this project will only increase capacity and efficiency of current process.
(2) The net benefit to the residents will be greater than the transportation costs.

Q: (3) Take into consideration the level of education of the consumers. The speed of data over the system. (Founding member of St. Lucia consumer association). The consumers are concerned that they will get the promised benefits of the upgrades promised by CARCIP. How resilient will be the system when the Caribbean is in the forefront of the Hurricane Belt.

A: (3) Digicel commits to deliver a state of the art and world class product to the people of SVG CARCIP will bring Fibre to the Site. Increases the redundancy and integrity of fibre network. LTE has brought up over 40 sites so far, and improved speed significantly in areas that previously had poor service. Reiterated that Lot 3 was integral because of currently poor service in Grenadines. With regards to resilience to Hurricane, the fibre network would bring resilience.

Q: (4) Has poor mobile coverage currently. When would this be solved? Questioned capacity, and who would be taking over the network after?
A: (4) KF - LTE will solve coverage issue. Consumers will soon be fully covered. The only task on the side of the consumer is to upgrade to the new LTE sims.
RJ – Government will have access rights to the subsea fibre after 15 years.

Q: (5) Wants to know if it is possible for electrical connectivity to be run in fibre.
Also wants to know breakdown of pricing of contract.
Also wants access to EIA
A: (5) NI – Yes, there are fibre that can do that but these were not contracted to do so. The festoon is to connect
KF – Cost breakdown is not on hand.

Q: (6) Is the life span of the cables 25 years.
A: (6) NI – There are many cables around the world that have their lives extended. There isn't much risk.

Q: (7) Will other companies be allowed to use the Cable?
A: (7) KF – Digicel is obligated to make the submarine cable open access. However, with negotiations have to take place and cost associated.

Q: (8) Will an IXP be brought on board?
A: (8) RJ – and IXP is on board but not fully operational as yet.

Comments:
(1) It may make sense for the government to have their own ASN.
(2) Government could consider making a school Intranet
(3) Is there a plan to extend the cables to St. Lucia, Martinique etc.? Answered by NI that there are existing subsea cables serving those countries.
KF – officially closes out meeting.

Sign-in Attendance, St. Vincent and The Grenadines

Digicel

NAME	ORGANISATION	SIGNATURE
Giselle Myers	Ministry of Finance and Economic Planning	G. Myers
Marcelle Edwards - John	" "	[signature]
Roxanne John	" "	[signature]
Jerrol Thompson	PMU	[signature]
Cecelia Hector	PMU	[signature]
Sean Frederick	Focus Entertainment Inc	[signature]
Daniel Campbell	Digicel SVG Ltd CARCIP	[signature]
Alanzo Parris	ITSD	[signature]
Marlon Mayers	ITSD	M Mayers
Mensinson Jack	"	M. Jack
Shernon Chambers	ITSD	[signature]
Lonnie Robinson	ITSD	L. Robin
[illegible] Alexander	ITSD	[signature]
[illegible]	NBC	[signature]
Frankie Haynes	ITSD	[signature]
Lancelot Chapman	SVG AMD	Lancelot Chapman
Rudi Daniel	rudi.daniel@calchub.net	[signature]
Ian Chen	ICDF	Ian Chen
Robertson S. Henry	www.sportcaraibe (Media)	[signature]

Digicel

NAME	ORGANISATION	SIGNATURE
JACINTHA FERGUS	ITSD	[illegible]
Apollo Knights	NTRC	[illegible]
Alex Dickson		[illegible]
Clinton Bostick	A P I	[illegible]
Nadia Slater	API	[illegible]
Cassandra Bonadie	Office Works SVG	[illegible]
Carwallen Duncan	ITSD	[illegible]
Dayle Da Silva	The Vincentian	[illegible]
Shonden Baptiste	NTRC	[illegible]
Desiree Armstrong	ITSD	[illegible]
Keisha Gatley	NTRC	[illegible]
A.K. ANDERSON	Sunshine	[illegible]
Ellison Clarke	Industry	[illegible]
Jacintha Edwards	Leeja's Theatre Alliance	[illegible]
Jaykel Mars	FOCUS Entertainment INC.	JMars
Semesha Corea	SVG Red Cross Society	[illegible]
LES FERDINAND	SVG PORT AUTHORITY	[illegible]
Lurenda Johnson	Public	L. Johnson
MERRICK HENRY		[illegible]

Digicel

NAME	ORGANISATION	SIGNATURE
Jubal Barker	Public	[illegible]
Kate Du-Bamie	"	.
Camillo Gonsalves	Govt of SVG	
GLEN STEWART	STEWART ENG. LTD	[illegible]
Oneil Spratt	BDO Eastern Caribbean	[illegible]
Cleo Huggins		[illegible]
DOWAINE ROGERS	Fiber technician (fiberworks)	[illegible]
COLIN BACCHUS	ITSD	[illegible]
NATASHA HARRY		N Harry
Ricardo Fredericks	Economic Planning	[illegible]
JASON DASILVA	STAR GARAGE	[illegible]
David Boston	ECCAA	David R. Boston

Meeting Notes, Public Meeting Hillsborough, Carriacou

Hillsborough Community Meeting – January 29th, 2019
Rough Notes – Questions, Comments and Recommendations

CARCIP Public consultation and stakeholder Engagement Meeting, Hillsborough in Carriacou, January 29, 2019

1. It is said that microwave from the telecommunication towers impact health. How would the subsea cable limit health problems?
2. What is the rate of deterioration of the cables? (Female)
3. How will this project benefit farmers and fishermen? (Fisherfolk)
4. After the cables are laid, how long after would you prevent fishermen from fishing in that area? (Fisherfolk)
5. Fisherfolk above emphasized that he did not see any benefit of the proposed project to fishermen and farmers. He noted that when the Sandy Island Oyster Bed MPA was been commissioned, no rules were given to fishermen. However, once the MPA was finalized, managers restricted fishing in certain marine areas, which he was not happy with. He is therefore very concerned about the potential for the proposed project to restrict fishing in areas close to the where the cable is laid. According to the fisherman, "The sea water belong to us the fishermen ... you not only to one kind of people."
6. Would customers expect a higher price for telecommunication services once the project is completed? (Male)
7. Initially you stated that the project cost 10 million then you said Digicel co-fund part of the cost. Could you say how much Digicel contributed to this project? Participant was also was interested in finding out the debt that he and the next generation will be responsible for repaying/cost to taxpayers. (Male)
8. One male commended the project highly. He noted that a couple years ago, his team was trying to register fishers and farmers on the island of Carriacou, however, they faced major challenges trying to download the relevant software due to deplorable internet connection on the Government's network. His team resorted to using the services of a private business to assist in this process. The planned improvement to the public sector is therefore welcomed; he believed that stakeholders need to begin to think "outside the box" and envisage the possibilities that improve access to the internet can create for Carriacou. (Male)
9. What approach will be used to run the cable in very steep underwater areas to avoid strumming? (Male Fisherfolk)
10. Recommendation to increase the public's knowledge of the project and its value (e.g. school visits, social media). (Female)
11. At what depth would the subsea cable be laid on the ocean floor? How will fishermen know where the cables are located in light of the fact that it can get caught when we are diving?
12. Recommendation by Environmental NGO/KIDO Foundation – To monitor beach for turtles and eggs a couple of weeks prior to landing the cable. In addition, the beach should be monitored the morning of the planned construction. Any eggs/hatchlings etc.

found should be placed in suitable location to ensure survival. KIDO Foundation offered to support the Team's Turtle Expert in this activity, which they believe is a non-negotiable mitigation measure.

Hillsborough, Carriacou, Meeting Sign-in Attendance

Public Consultation on the Carcip, Hillsborough Carriacou, J

Name	Organization or Community that you Represent	Position/ Title	Age Range Under 35	Age Range Over 35	Tel
Joe Adams	Fisher FOKE	member		✓	406262 419629
Rina Mills	Grenada Tourism Authority	Product Dev. Officer		✓	533-08
Jamal Adams	Information Technology	I.T Tech	✓		417-352
Sebastian Stiell	Division of Sports	Senior Coach		✓	459988
Tahshaka Andrew	Carriacou Farmers Association		✓		538 6691
Williams nadellanse	Public Health	DEHO		✓	443-8-4
Junior McDonald	Ministry OF Carriacou & PM	Fisheries Officer		✓	443-602
Ulah Baker	Fish of Foke	Fish man		✓	535-123
Marina Fastigi	YWF - KIDO FOUNDATION	DIRECTOR		✓	4437936
DARIO SANDRINI	YWF - KIDO FOUNDATION	DIRECTOR		✓	4437936
Sara Mimick	Ywf - Kido Foundation Volunteer	Volunteer		✓	"
Franklyn Scott	Multi-Purpose Centre	Facilities Manager	✓		403-229
Freddy Charles Date	Agro processor	owner		✓	406-22
Bryan Prince	Carriacou H/M Water taxi	President		✓	536-84
Jeff McNUTT	SCUBA instructor			✓	

Name	Organization or Community that you Represent	Position/ Title	Age Range Under 35	Over 35	Tel
MARVIN BOATSWAIN	MINISTRY OF CARRIACOU & PM AFFAIRS	FISHERIES SUPERVISOR FISHERIES	✓		456-2996
DAVON BAKER	CARCIP FOCAL POINT	IT MANAGER		✓	443-602
PS RHODA QUAMINA	MINISTRY of CARRIACOU & PM AFFAIRS	PS		✓	443-602

Meeting Notes, Public Meeting Conference/Tivoli, Grenada

The Tivoli focus meeting was attended by 23 persons representing the local communities of Tivoli, La Poterie, Conference and Hermitage, including a representative from the school at which the meeting was held, Tivoli Roman catholic School. Whilst some of the initial line of questioning was directed at the government representatives due to lack of substantial prior awareness of the CARCIP project, much of the dialogue was a positive engagement whereby the audience were keen to understand the social benefits of the cable installation (and to some degree how this reduced reliance on microwave transmission of telecommunication services). There were no significant environmental issues raised, and other than the need to ensure continued engagement in the run-up to installation operations in order to minimise any impact to local homeowners and users of the road leading to the Conference landing, it was felt that the audience understood the overall benefits fibre, and the CARCIP project, provides, especially to the local schools and the future generations of the local area.

Conference/Tivoli, Grenada Sign-in Attendance

CARCIP Public Stakeholder Consultation, Conference, Tivoli, La Poterie & Surrounding Areas, Tivoli RC School, Jan 31, 2019

	Name	Organization or Community that you Represent	Position or Title	Age Range		Tel	Email
				Under 35	Over 35		
1.	Yoggie Charles Brizan	Tivoli Drummers	Member		—	417-1863 521-6676	Drumgirl 473@gmail.com
2.	Joseph matthew	Conference			—	414-7974	benm740@gmail.com
3.	IAN EDWARDS	Conference			—	420 8735	[illegible]
4.	Rae Thomas	Hermitage		—			raethomas.tja@gmail.com
5.	Samantha Joseph	Conference			—	533 8334	
6.	Anne Vetta Francis	Conference			—	442 8377	
7.	Angela Peters	Conference			—	442 8536	
8.	MICHAEL ROBERTS	CONFERANCE			—	405 3000	
9.	Lillian George	Tivoli			—	456 3433	

CARCIP Public Stakeholder Consultation, Conference, Tivoli, La Poterie & Surrounding Areas, Tivoli RC School, Jan 31, 2019

Name	Organization or Community that you Represent	Position or Title	Age Range		Tel	Email
			Under 35	Over 35		
10. Melena ~~Melena~~ Francique	Tivoli			—	442 8894	
11. Marlane Simon	La Poterie			—	456 5621	
12. Sonia Date	Tivoli			—	438 2992	
13. Tamica Peters	La Poterie		—		422 6755	
14. Violet Peters	La Poterie			—	414 6882	
15. Showndel [illegible]	Tivoli		—		535 9407	
16. Keplin Francois	Tivoli		—		449 3852	
17. Margaret Coutrey	Tivoli			—	438 0930	
18. Laurence Lewis	Tivoli			—	416 3482	
19. Leroy Abraham	Tivoli			—	442 8920	

CARCIP Public Stakeholder Consultation, Conference, Tivoli, La Poterie & Surrounding Areas, Tivoli RC School, Jan 31, 2019

	Name	Organization or Community that you Represent	Position or Title	Age Range		Tel	Email
				Under 35	Over 35		
20.	Christopher Isaac	Tivoli			—	457 2851	
21.	Lyndon George	Tivoli			—	417 3269	
22.	Emon Williams	Tivoli		—		438 2792	
23.	Emmanuel Simon	Tivoli			—	414 1265	

Meeting Notes, Grenville, Grenada, Fisherfolk Meeting

In addition to the public consultation meetings, the CARCIP team met with fisherfolk at Grenville on January 28, 2019. This focused-topic meeting was attended by 12 persons representing local fishing and farming interests as well as a representative from the Wider Caribbean Sea Turtle Conservation Network (WIDECAST).

The CARCIP team welcomed the participation of the part-time fishers their numerous and well considered questions. Many of these questions were based on a lack of understanding of how the cables work (e.g., Why not use satellites?), where they were going to be located (e.g., Outside of any MAPs), and their sensitivity to marine habitats (e.g., The small size of the cable, eventually self-burying). Based on these inquiries, along with other questions presented by the community revealed the need to better educate the community on the basics of how fiber optics work, their size compared to other cables, the minimal impacts they have on the environment and the overall benefits fiber provides.

<u>Notes</u>

CARCIP Public consultation and stakeholder Engagement Meeting with Fisherfolk in the Grenville Bay Area, January 28, 2019

1. One fisherman (Mr. ...) insisted that a summary of the proposed project, findings of the ESIA should be shared with him. (This is something that should be done by Digicel)
2. Why is the subsea cable used rather than satellites for improving telecommunication services?
3. One stakeholder noted that while he welcomes technology, he is interested in the effects of the cable and possible heat emissions on humans in light of the increase in diseases in the populace?
4. Do you have information of any 1st or 3rd world country which used the proposed technology and data on how the technology impacted human health?
5. What happens to the cable after its lifespan ends? Does it remain under the seabed or is it removed?
6. Is the proposed venture a Digicel project? Would Digicel have a monopoly on the technology once the project is completed?
7. Would fishermen be able to “interfere” with the cable?
8. Would the area where the cable is laid be a restricted fishing area?
9. In terms of “underground rough sea” how will this affect the cable?
10. What is the effect of static electricity? Would it affect the cables?
11. Why was Bathway not used as the landing site for the cables?
12. What effects does the cable have on turtles?
13. In deep water does the cable “swing” ...will the cable affect me during diving/fishing?
14. Would we see anything floating or will the cable lie on the ground?
15. One fisher noted that when fishing for Baracouda, they (fishermen) normally use a wire with a piece of lead that sinks to the bottom of the ocean floor. Is it possible that the cable can disturb this fishing practice?
16. On fisher recommended that Digicel use local divers to run the cable so that they can be secure employment through the project.
17. Questions about how the cable will be landed were asked.

18. Do we have any existing cables under the sea from Carriacou to Grenada? One fisher noted that he has seen cables in these areas before.
19. A few fishermen asked about the potential for employment through the proposed project. "Apart from sensitizing the fishermen, what form of employment is there ... what skills do I need to get a job through this project."
20. Why was GRENLEC not involved in using their bucket trucks to run the terrestrial cables?
21. What about maintenance for the poles that are on land? Who will be responsible?
22. On completion of the project, would persons connected to FLOW system experience an improved internet services?
23. Someone recommended that Digicel organize a training session targeting youths on splicing cable.
24. What are the environmental impacts of the laying the cable?
25. Are the materials used to make the cable hazardous?
26. At the end of life, would the cable to hazardous?

PS: From the Conference consultation, it was highly recommended that action be taken to sensitize residents of Bay Road about the proposed project. In addition, one attendee noted that young men from the Conference area, although invited to the consultation, did not attend the session because they were of the opinion that the cables are laid to monitor their activities along the beach. He further stated that some of the young men spoke about cutting the cables if this was the intended plan of the developer.

Grenville Fisherfolk Meeting Attendance

	Public Consultation on CARCIP, Grenville Fish Market, January 28th 2019				
Name	**Organization or Community that you represent**	**Position /Title**	**Age Range**		**Telephone**
			Under 35	**Above 35**	
Sheldon Phillip		Fisherfolk/Farmer		✓	
Gerald John		Fisherfolk		✓	
Anthony Charles		Fisherfolk		✓	
Lyndon Marrast		Fisherfolk		✓	
Ryan Isaac	FAD Organization/Grenville Fisher	President/Member		✓	
Learie Thomas	Soubise Fisherman Cooperative	Board Member		✓	
Anray Marrast		Fisherfolk		✓	
Clifton Harris		Fisherfolk		✓	
Donald Henry		Fisherfolk		✓	
Patrick Chitterman		Fisherfolk			
Phillip Belfon		Fisherfolk		✓	
Kay Charles	WIDECAST				
Missing info was not collected					
**Most fishermen in attendance represented one of the above organizations