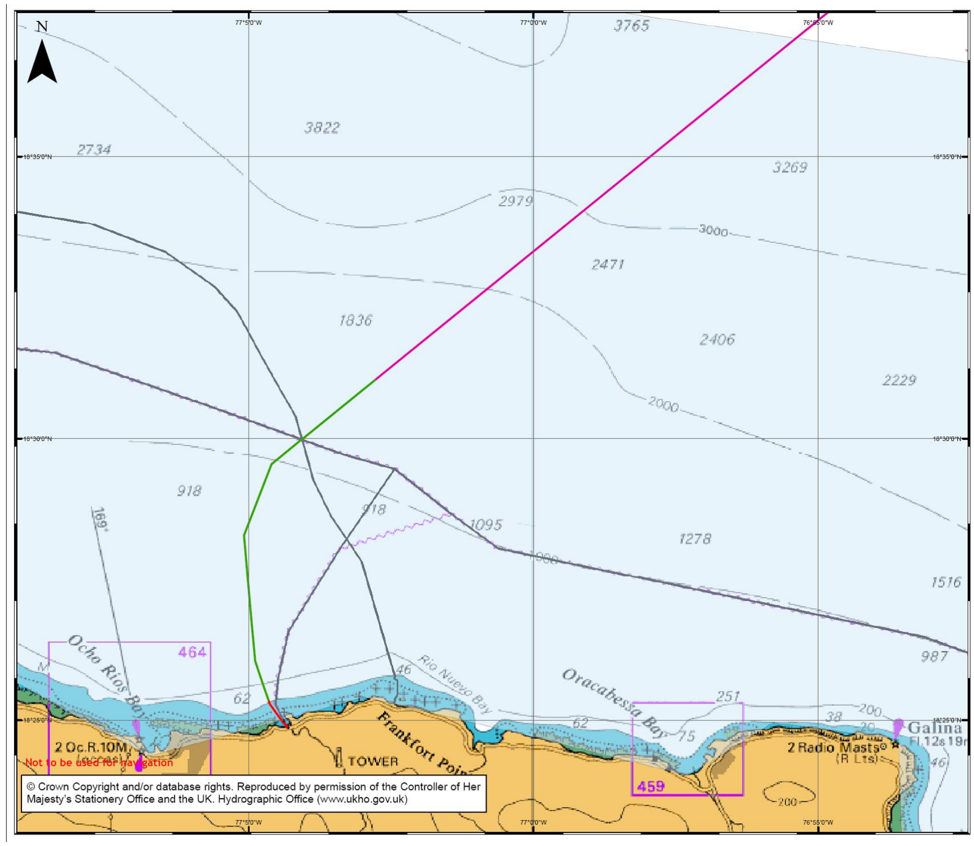
November 2010

Environmental Impact Assessment

For The Proposed Landing of a Fibre-Optic Cable at Golden Sands Beach Cottages, Ocho Rios, St. Ann, Jamaica

ALBA-1 FIBRE OPTIC CABLE SYSTEM

[Prepared for Alcatel-Lucent Networks]



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ENVIRONMENTAL IMPACT ASSESSMENT

FOR THE LANDING OF A

FIBRE-OPTIC CABLE

AT GOLDEN SANDS BEACH COTTAGES IN THE PARISH OF ST. ANN, JAMAICA

ALBA-1 FIBRE OPTIC CABLE SYSTEM

Rev. 02

Prepared for:

Alcatel·Lucent

Alcatel-Lucent Networks (ASN)

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November 4, 2010

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Acronyms

CBD – Convention on Biological Diversity

CDMP – Caribbean Disaster Mitigation Project

dB – Decibel acoustic

dBA – Decibel A-weighting

ED – Enumeration District

EHU – Environmental Health Unit

EIA – Environmental Impact Assessment

JNHT – Jamaica National Heritage Trust

LIME – Land | Internet | Mobile |Entertainment

NEPA – National Environment & Planning Agency

NRCA – Natural Resources Conservation Authority

ODPEM – Office of Disaster Management

STATIN – Statistical Institute of Jamaica

ToR – Terms of Reference

WRA – Water Resources Authority

EXECUTIVE SUMMARY

1 Executive Summary

1.1 Introduction

Telecomunicaciones Gran Caribe SA of Venezuela has been granted a licence to install and commission a fibre optic cable in Jamaica. Alcatel Submarine Networks (ASN) a sub-contractor of Telecomunicaciones Gran Caribe SA has commissioned Conrad Douglas and Associates Limited (Jamaica) to undertake an environmental impact assessment for the proposed cable installation in Jamaican waters and secure the necessary environmental permits and licences. The proposed cable lay will be known as the ALBA-1 Fibre Optic Cable System.

The ABLA-1 system comprises two segments: Segment 1 from Siboney, Cuba to Camurí, Venezuela and Segment 2 from Aguadores, Cuba to Ocho Rios, Jamaica. Segment 2 is to be of an unrepeated type and is to be installed between Aguadores, Cuba and Ocho Rios, Jamaica and at the CRS stage has a system route length of 221.09 km.

This fibre optic cable installation will provide a high-capacity fibre-optic connection between the Jamaica, Cuba and South America. The project will see an efficient communications system being put in place that improves on quality and reliability. The project is designed to minimize network contingencies such as potential data transmission disruptions due to network cuts and outages, and natural disasters such as hurricanes, through a redundant network.

The project will provide an unrepeatered spur to Jamaica and improve the existing physical diversity. This proposed fibre-optic connection will improve and provide additional data transmission capability, increased suppliers and reduced costs, and supply the increasing demand for electronic communications (phone, facsimile, email, Internet) to the eastern end of the island.

As a result of falling into the National Environment and Planning Agency (NEPA's) prescribed categories of projects requiring Environmental Impact Assessments (EIAs), NEPA directed that an EIA be done in keeping with the Natural Resources Conservation Authority (NRCA) Act of 1991. This EIA Report documents the studies and processes involved in conducting the EIA and the findings of the various environmental and socio-economic assessments conducted.

1.2 Project Objective

To maintain network diversity and reliability, a telecommunications licence will allow a spur of the ALBA-1 Fibre Optic Cable System to be anchored in Jamaica. This will increase Jamaica's physical diversity. The proposed landing area in Jamaica will share landing with a fibre optic cable that was installed in 1997 at the Shaw Park Beach and will terminate on the local network of LIME Jamaica, a subsidiary of Cable & Wireless.

The proposed cable will be connected to LIME's network via a newly constructed underground duct system. This aspect of the project is not being analysed as part of the EIA. However, it should be noted that LIME currently has arrangements with various Parish Councils and the

National Works Agency regarding construction or modification of trenches to house cables along roadways. It is possible the cable may also be pulled through road conduits that currently exist between Shaw Park Beach and Ocho Rios, the location of the cable house.

1.3 Approach & Methodology

Standard and creative approaches and methods were used by a highly qualified and experienced project development team working in collaboration with the environmental assessment team. The approaches and methods involved a combination of desk, literature and field studies, meetings and investigations, leading to analysis, assessment and preparation of the EIA report.

Some of the studies undertaken were as follows:

- Review of the plans and designs
- Analysis of alternatives
- Bio-physical surveys (terrestrial and marine)
- Socio-economic surveys
- Baseline studies on water quality, noise and dust
- Natural hazard vulnerability and assessment
- Review of the regulatory framework
- Impact identification
- Impact mitigation
- Identification of the parameters for and outline of an environmental monitoring plan

Several government agencies were contacted as well as various public interests throughout the EIA process. This was done to present all parties with information on the project to determine areas of potential conflict, and to encourage open dialogue on this very important development project. Further, the project team has made the commitment to provide the appropriate authorities with As-Laid positions and charts for notification to the appropriate mapping agencies in the island for onward transmission for hydrographic charting in London later.

1.4 Policy & Legislative Framework

The relevant policies and legislation that are critical to this project have been identified and analyzed as follows:

- The NRCA Act of 1991
- Natural Resources (Permit and Licence) Regulation (1996)
- The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

- The Watershed Protection Act of 1963
- The Wildlife Protection Act of 1945
- The Water Resources Act, 1995
- The Underground Water Control Act of 1959
- The Clean Air Act, 1964
- The Town and Country Planning Act of 1957
- The Jamaica National Heritage Trust Act 1985
- The Public Health Act, 1985
- The Disaster Preparedness and Emergency Management Act of 1993
- The National Solid Waste Management Act of 2001
- Occupational Safety and Health Act of 2003 (DRAFT)
- Agenda 21
- United Nations Convention on the Law of the Sea

1.5 Impact Identification & Mitigation

The potential negative environmental impacts of this study have been thoroughly addressed and our findings indicate that those potential impacts identified can be considered negligible and of short duration. These potentially negative impacts have been identified mainly during the cable laying activities phase of the project and with good project management will be sufficiently mitigated.

No new or unfamiliar major negative impacts or risks were identified. Additionally, several potentially beneficial impacts have been identified that can be realized from the implementation of this project.

The potential impacts identified for the pre-construction, construction and operating phases of the proposed project include:

Negative

- Minimal suspended solids during cable laying
- Minimal noise and vibration during cable lay activities
- Minimal aesthetics and transient change of land and marine use

Positive

- Improved broadband access by commissioning new connections

- Potential vast increase in investment revenue and job creation due to improvements in the telecommunications industry from this project.
- No loss of biodiversity
- No loss of archaeological and historical heritage resources

Any negative impacts identified will be effectively mitigated using traditional and state of the art methods, as necessary, such as the use of a curbside trencher.

1.6 Environmental Management & Monitoring Plans

Critical parameters for environmental monitoring and management will be formulated to ensure that the project complies with the regulatory framework and the impact mitigation actions that have been outlined. These will be further developed for strict implementation, in the event that the project is permitted by NEPA.

1.7 Conclusion

The project has carefully integrated the features of the natural environment and the non-conflicting baseline and setting of the area to enhance the project, conserve on natural resources and protect the environment. In so doing as proposed, very little or no negative environmental or adverse socio-economic implications are anticipated and this will ensure sustainability and protection of the investment.

PROJECT DESCRIPTION

2 Project Description

2.1 Introduction

Telecomunicaciones Gran Caribe SA of Venezuela has been granted a licence to install and commission a fibre optic cable in Jamaica. Alcatel Submarine Networks (ASN) a sub-contractor of Telecomunicaciones Gran Caribe SA has commissioned Conrad Douglas & Associates Limited (Jamaica) to undertake an environmental impact assessment for the proposed cable installation in Jamaican waters and secure the necessary environmental permits and licences. The proposed cable lay will be known as ALBA-1 Fibre Optic Cable System.

Pursuant to Section 13 and Section 78 of the Telecommunications Act, 2000, a license for the construction and operation of a Submarine Fibre Optic Cable Network was granted to Telecomunicaciones Gran Caribe SA of Venezuela by the Prime Minister of Jamaica, the Honourable Bruce Golding on 17th November 2009 (a copy of the agreement showing licence agreement and signature pages are enclosed in Appendix V).

The ABLA-1 system will be comprised of two segments; Segment 1 from Siboney, Cuba to Camurí, Venezuela and Segment 2 from Aguadores, Cuba to Ocho Rios, Jamaica. Segment 1 of the system is to be of a repeated type and will be installed between Siboney, Cuba and Camurí, Venezuela and at the CRS stage has a system route length of 1537.77km. Segment 2 is to be of an unrepeated type and is to be installed between Aguadores, Cuba and Ocho Rios, Jamaica and at the CRS stage has a system route length of 221.09km. The following table outlines these locations and approximate coordinates for the cable landings.

Table 2-1: Landing Sites and Coordinates for ALBA-1 Fibre Optic Cable System

Location	Proposed Beach Manhole Location
Siboney, Cuba	19° 57.6155N 075° 42.3094W
Camurí, Venezuela	10° 36.5591N 066° 52.5680W
Aguadores, Cuba	19° 58.0429N 075° 49.9376W
Ocho Rios, Jamaica	**18° 24.8710N 077° 04.5360W**

The installation of fibre optics is the preferred method of carrying voice, video, and data communications. Its superior information-carrying capacity enables the use of applications that require large amounts of bandwidth.

Fibre-optic cable allows for optimization of transmission equipment because it lacks the delay found in satellite connections. Further, unlike satellite communications, fibre-optic cables are insensitive to electromagnetic and/or atmospheric interference and offer a secure link because of their relative immunity to eavesdropping.

Following on the significant loss of broadband service to the island during Hurricane Ivan in September of 2004, the need for additional and redundant fibre optic linkages to the island was realized. To maintain network diversity and reliability, a telecommunications licence has been granted to allow a spur of the ALBA-1 Fibre Optic Cable System to be anchored in Jamaica. This will increase Jamaica's physical diversity. The proposed landing area in Jamaica will share landing with a fibre optic cable that was installed in 1997 at the Shaw Park Beach and will terminate on the local network of LIME Jamaica, a subsidiary of Cable & Wireless.

The proposed cable will be connected to LIME's network via a newly constructed underground duct system. This aspect of the project is not being analysed as part of the EIA. However, it should be noted that LIME currently has arrangements with various Parish Councils and the National Works Agency regarding construction or modification of trenches to house cables along roadways. It is anticipated that the cable may also be pulled through road conduits that currently exist between Shaw Park Beach and Ocho Rios, the terminal site of the cable house.

The ALBA-1 system will comprise of wholly new equipment manufactured by Alcatel-Lucent Submarine Networks (ASN) based on the specific design requirements resulting from the CRS and cable route survey. The cable will be of repeated type OAL-C5 for Segment 1 and unrepeated type URC-2 for segment 2; both cable types have the following cable armouring options:

- Light Weight (LW)
- Light Weight Protected (LWP)
- Single Armoured (SA)
- Double Armoured (DA)

Timing of the marine survey and marine installation for the ALBA-1 system is critical to avoid the hurricane season that normally lasts from June to November with the highest frequency of hurricanes between August and October.

The following sub-sections of the Project Description are largely informed by a Cable Route Study developed by ASN for the entire ALBA-1 cable system. These subsections will detail aspects of the project specifically in relation to Jamaica and generally in regards to the system.

Plate 2-1 below outlines the segment of the ALBA-1 cable system that enters Jamaica. Figure 2-1 outlines the geographic scope for the entire ALBA-1 Cable System.

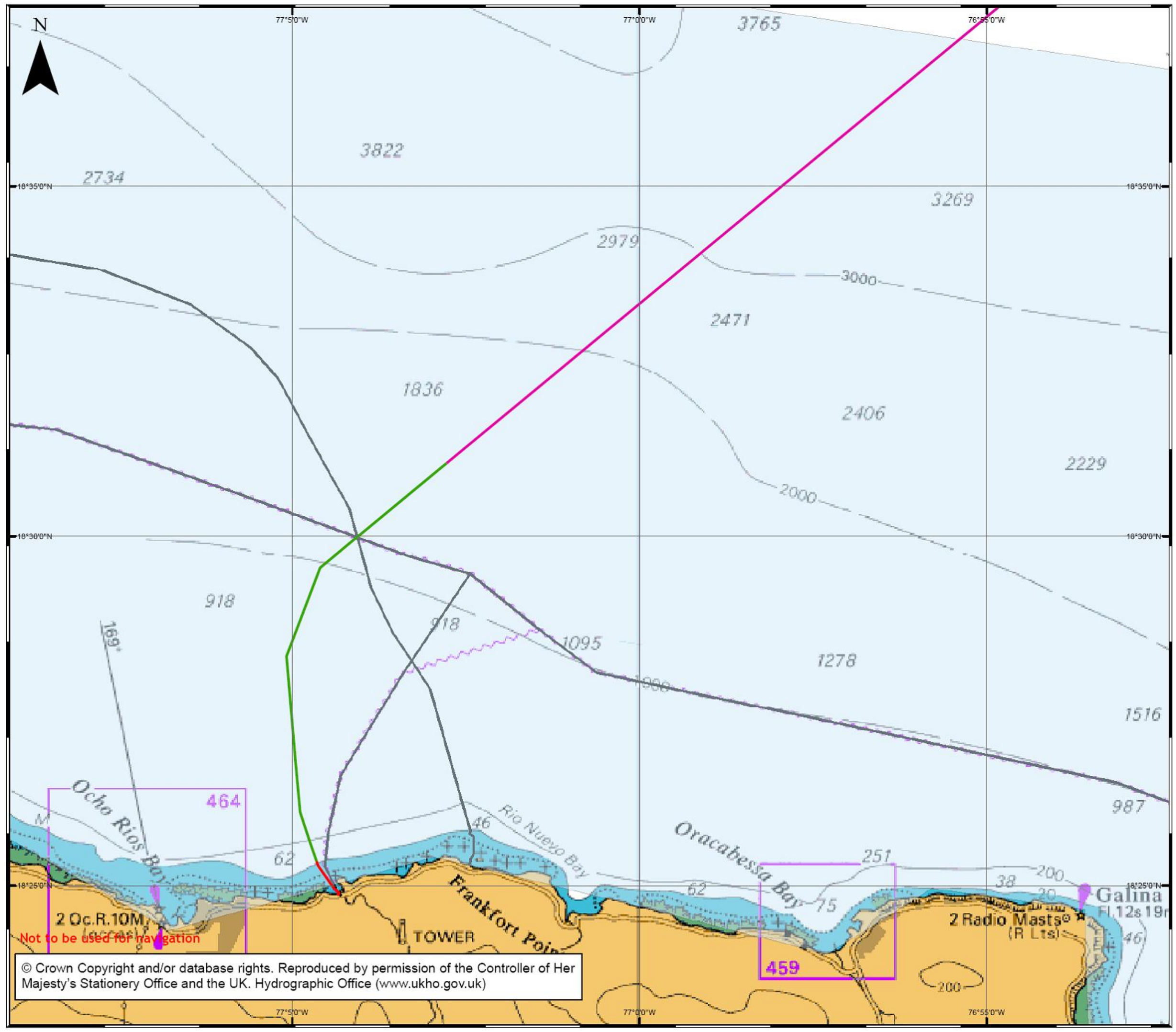


Plate 2-1: Proposed ALBA-1 Cable Route [Dark Blue lines – Existing CJFS Cable System, Green & Red lines – Proposed ALBA-1 Cable System]

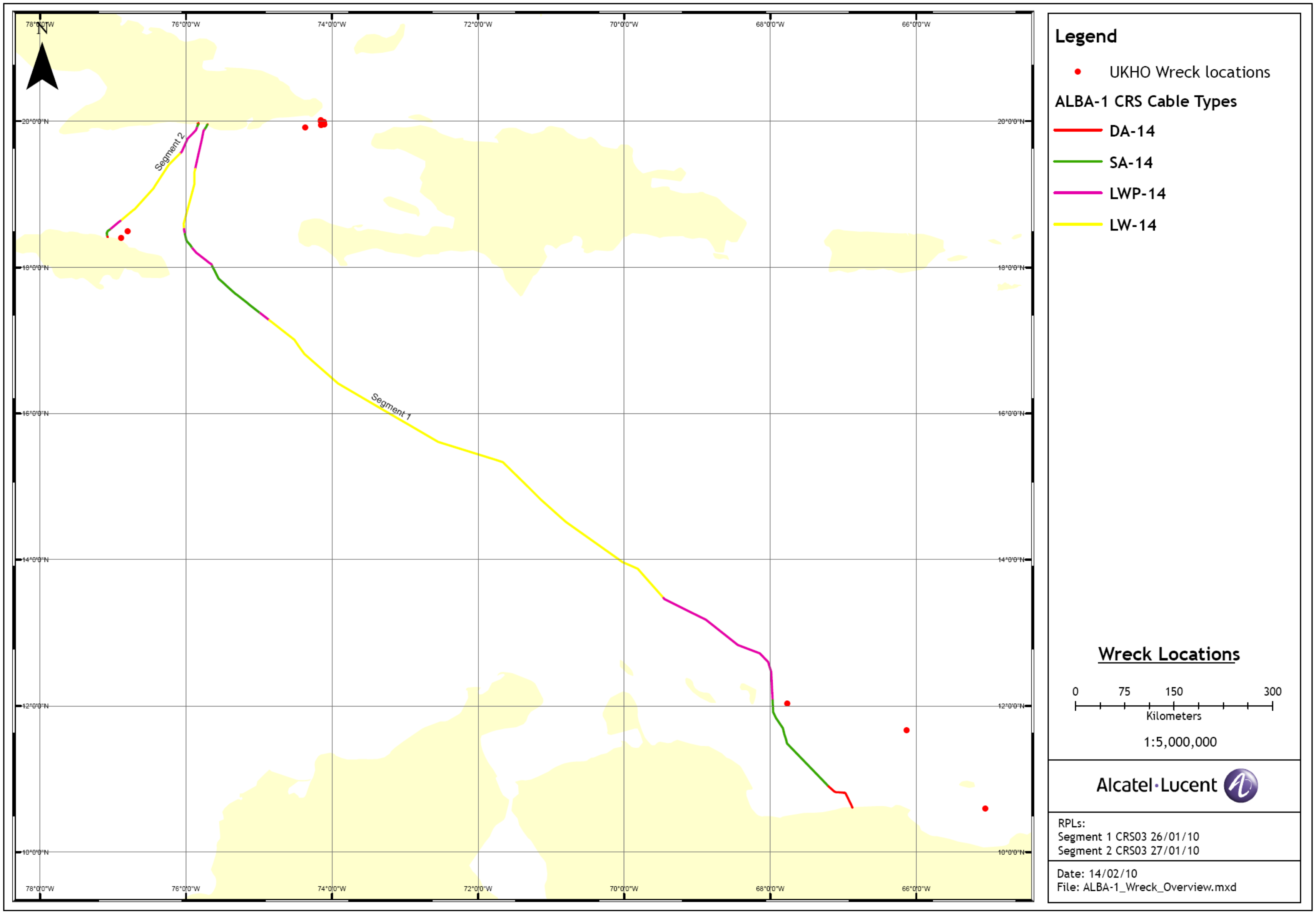


Figure 2-1: ALBA-1 Cable System - Overall Layout

2.2 Project Site Description, Location & Layout

The proposed landing site is Golden Sands Beach Cottages in the parish of St. Ann on Jamaica's north-coast. The landing site is characterized by a sand beach and adjacent to (west) the Shaw Park Beach Hotel property and the White River estuary.

The beach has limited access via land due to the ownership status of the land but can be accessed up to the high tide mark via the sea or the White River.

The proposed landing point is located at the eastern end of a 500 m long sandy beach composed of fine sand with a small river tributary running out to the sea behind it. The river is used by the White River fishermen, a small local fishing group, with fairly small boats to gain access to the sea for daytime fishing.

The beach slopes very gently down to the sea with no marked gradients and the observed tidal range appears to be <1m. There is no evidence of any rock outcrop on the beach. Plate 2-1 and below outlines the geographic extent as well as images of the site.

Plate 2-2: Overview of Proposed Landing Site for the ALBA-1 Cable System in Jamaica

Plate 2-3: Cable Landing Point on Golden Sands Beach Property (View of beach at landing point looking south from end of jetty)

2.3 Cable Characteristics & Installation Method

The installation method will probably be by direct landing and it is expected that the installation vessel will be able to get to within a few hundred metres of the shore.

2.3.1 The Fibre Optic Cable

The cable will be of repeated type OAL-C5 for Segment 1 and unrepeatered type URC-2 for segment 2; both cable types have the following cable options:

- Light Weight (LW)
- Light Weight Protected (LWP)
- Single Armour (SA)
- Double Armour (DA)

Two fibre pairs are housed within a steel tube which is filled with a non-hygroscopic compound to protect the optical fibres. The aluminum tube is protected by steel wires that are wrapped around the tube, which is then housed in a copper tube and covered by an insulating, polyethylene cover. This cable has a diameter of 14 mm and is called lightweight (LW) cable.

LW 19.6mm Lightweight cable is installed in deep water (up to 8000m), where the risk of damage to the cable is low. LW cable is then covered with an additional metal tape to form Lightweight Protected (LWP) cable that is deployed in deep water, but where seabed conditions direct further protection is required.

Armored cable uses LW cable as its central core with additional external protection where seabed conditions or external risks are considered a threat to the cable (such as fishing activities). Single armor (SA) cable has a single layer of high strength galvanized steel wound around LW cable. Double armor (DA) is constructed by winding a second layer of galvanized steel wires around the SA cable. The SA or DA cable is then flooded with a bituminous compound and covered by polypropylene yarns. SA cable has a diameter of 26 mm and DA has a diameter of 35 mm.

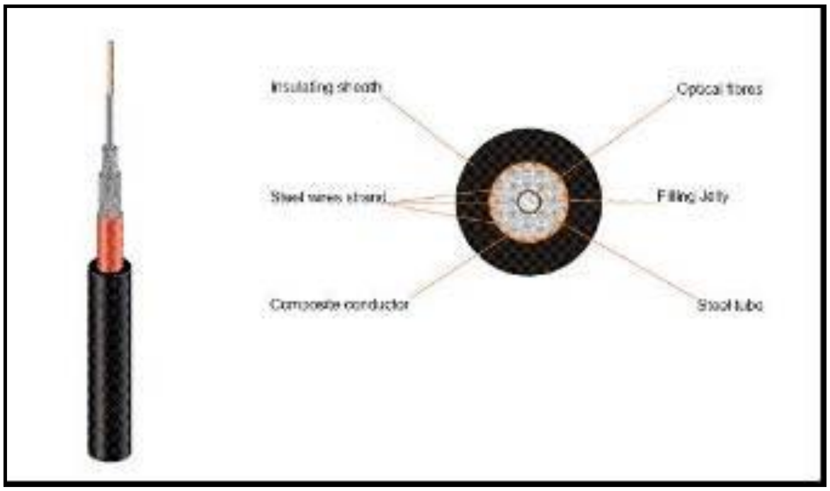


Figure 2-2: OALC5 Cable Cross Section- LW

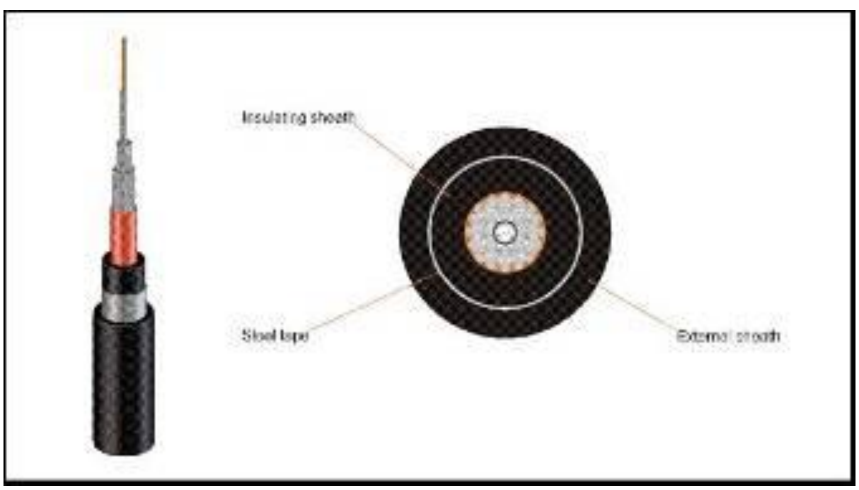


Figure 2-3: OALC5 Cable Cross Section- LWP

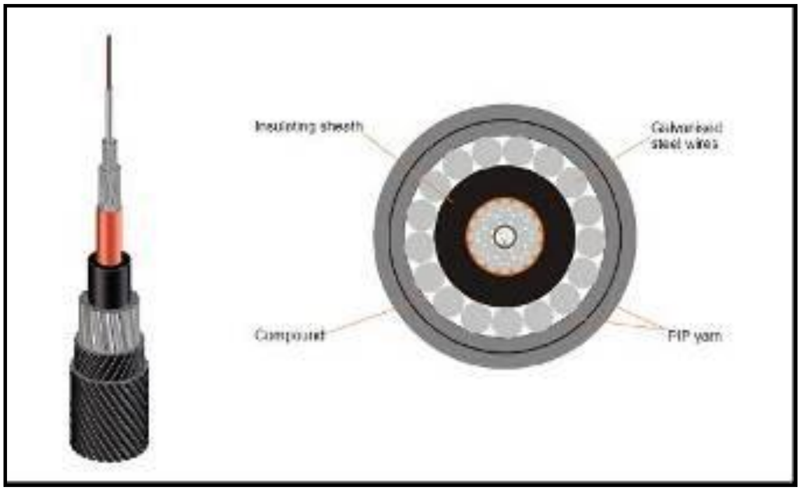


Figure 2-4: OALC5 Cable Cross Section- SA

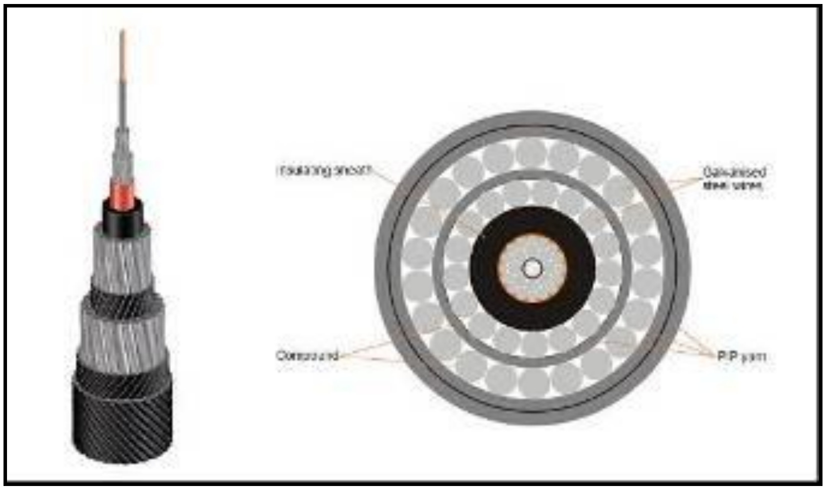


Figure 2-5: OALC5 Cable Cross Section- DA

The construction is designed for a minimum 25-year operational life. All submarine cables for telecommunications use in current production by Alcatel and others use Polyethylene for insulation. This material is exceptionally stable and hydrophobic. It is typically used in the transportation of water for human consumption in construction and domestic installations. It has no components that leach. The armour wires typically used are carbon steel with a zinc coating to minimize the corrosion of the steel. Minimal chemical dissolution of the zinc can be expected at a very slow rate when exposed to the sea. The outer layers of the cable are designed to keep the galvanized wires protected from the seawater and consist of several layers of polypropylene yarn impregnated with bitumen. Polypropylene (like polyethylene) is a very common material used for the storage of potable water and similarly does not leach any material. The yarn is similar to that used in agricultural binding twine and some fishing netting.

2.3.2 Cable Protection Considerations

In addition to the post survey selection of cable armour further consideration will be given to the application of articulated piping in the surf zones and over rock and coral outcrops. Articulated piping serves to increase cable protection against chafing caused by wave action and will be of particular importance where the cable cannot avoid routing over rock or coral in area of shallow water wave action. There is no consideration for this in Jamaica because the cable will be laid within a fairly wide sand channel between coral outcrops.

Jamaica is in the hurricane belt of the Caribbean and as such articulated piping is recommended for protection crossing the bay and breakwater area of Shaw Park Beach.

2.3.3 The Beach Manhole (BMH)

The landing point is located on a private beach that is part of a residential property. The beach manhole is to be constructed to the south of the property adjacent to the north side of the road (.

It is proposed that the beach manhole is constructed with the long wall running north-south (that is, perpendicular to the sea). This will mean that the beach manhole will also be a turning manhole with the land cable exiting through the adjacent wall to the seaward facing wall. Recommendations provided to Lime are that the beach manhole footprint should be 4m x 2m. It was stated during the survey that a beach manhole 3m x 2m would suffice if the larger manhole could not be accommodated.

The beach area is entirely enclosed by walls and fencing. To enable the beach landing works and construction of the seaward ducts from the beach manhole, it is proposed that one of the walls is taken down to give access for excavators and construction equipment. Proposed section of the wall through which access will be given is shown Plate 2-4. The wall could be rebuilt on completion of works or replaced with gates that will facilitate future access.

Plate 2-4: Proposed Section of enclosed area through which access to the BMH will be given

Plate 2-5: Beach Manhole Location View of beach property perimeter fence seaward of proposed BMH position

There are two significant alter courses (AC) close to the beach that give a turn of 96 degrees to avoid a reef close to the beach (see Plate 2-6).

Plate 2-6: Approach to landing point showing reef to be avoided by cable route

The ALBA-1 shore end landing in Ocho Rios will be a second, bighted, shore end operation.

In order to get the cable into position around the reef, it is possible that all the cable from the ship can be hauled ashore in a straight line to release the cable ship. The cable can then be pulled into position around the alter course using small boats whilst the flotation is still on the cable. It does not appear that it will be possible to utilize other sections of the beach that are in a direct line from the cable ship position.

Alternatively the shore end cable could be discharged onto a small boat from the main lay vessel at its holding position and laid from the small vessel to the beach around the reef and the alter course positions. Anchors could be positioned along the cable route to assist with manoeuvring of the small boat whist laying the cable to the shore.

The beach area is approximately 75m long and 15m deep (Plate 2-7). In order to haul the cable ashore by conventional pulling with an excavator and quadrant a length of 50m could be pulled at each attempt.

Plate 2-7: Beach Extent

It is proposed that seaward ducts are laid from the beach manhole towards the beach to avoid complete excavation of the beach to the beach manhole during cable installation activities. A drawing showing a proposal for this arrangement is shown Figure 2-6.

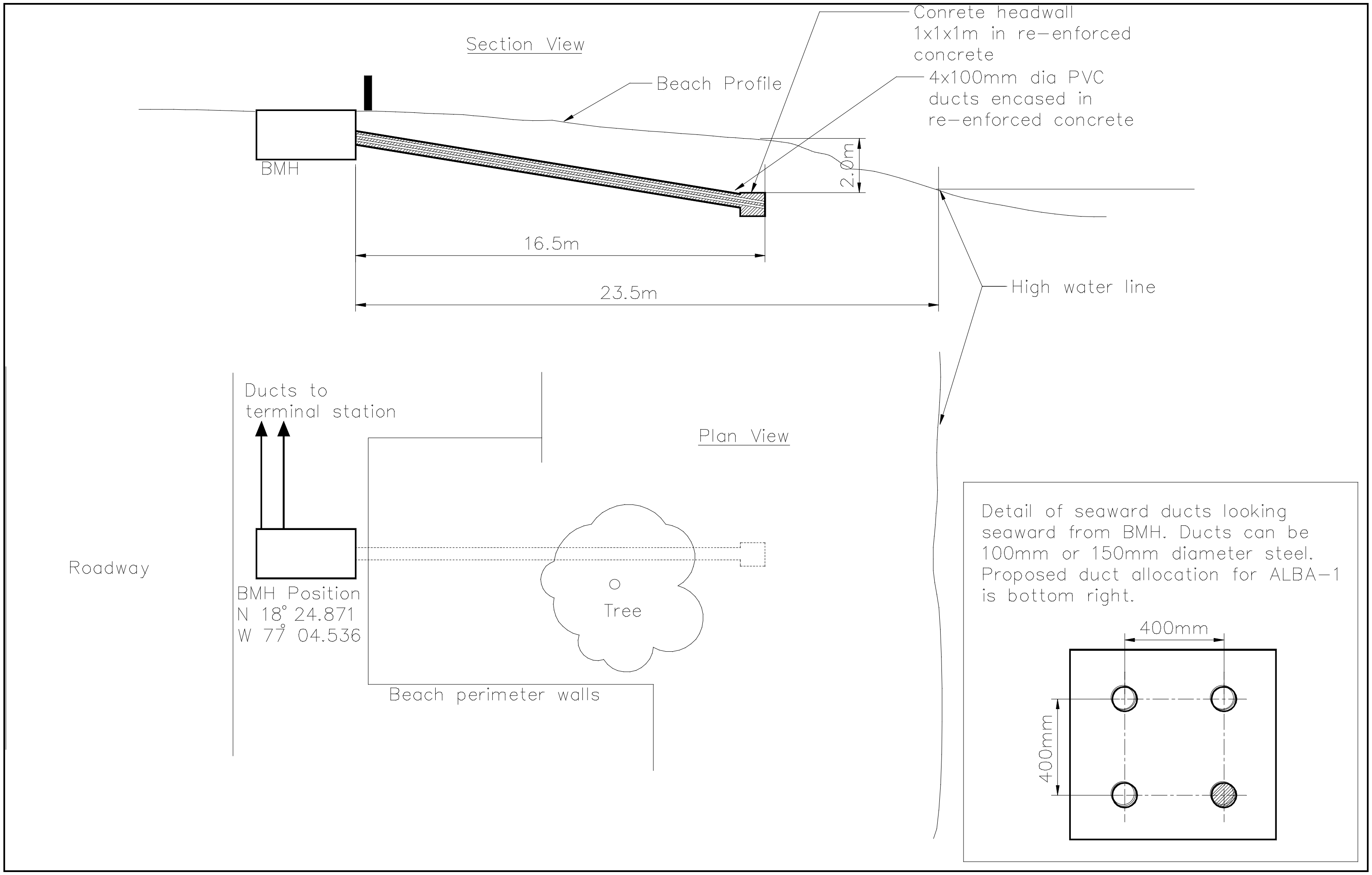


Figure 2-6: Proposed arrangement from the seaward ducts from beach manhole

The tidal range at the beach landing point is approximately 0.5m. The tidal graph at the time of the survey is shown in Figure 2-7

Your EasyTide Prediction (enhanced)

Oracabessa, Jamaica
Port predictions (Standard Local Time) are -5 hours from UTC

Daylight saving: 0 hours

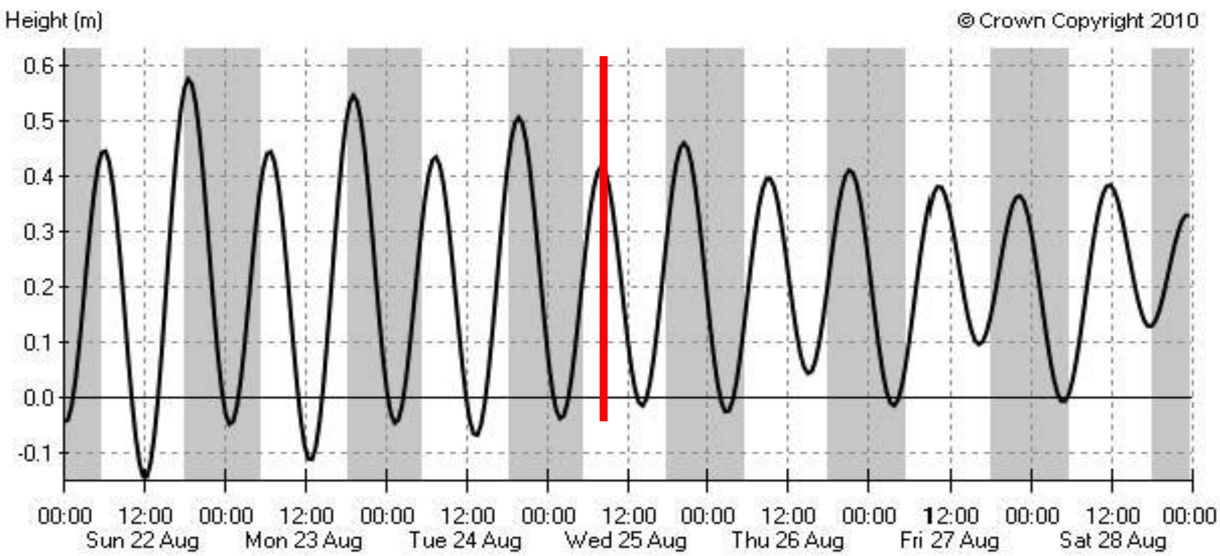
see daylight saving warning

Start Date: Sunday 22nd August 2010 (Standard Local Time)

Duration: 7 days

Units: Metres

Max graph size: 7 days



Sun 22 Aug

LW	HW	LW	HW
00:12	05:57	12:03	18:34
0.0 m	0.4 m	-0.1 m	0.6 m

Mon 23 Aug

LW	HW	LW	HW
00:47	06:37	12:42	19:09
0.0 m	0.4 m	-0.1 m	0.5 m

Tue 24 Aug

LW	HW	LW	HW
01:24	07:20	13:23	19:45
0.0 m	0.4 m	-0.1 m	0.5 m

Wed 25 Aug

LW	HW	LW	HW
02:03	08:07	14:08	20:24
0.0 m	0.4 m	0.0 m	0.5 m

Thu 26 Aug

LW	HW	LW	HW
02:47	09:02	15:00	21:09
0.0 m	0.4 m	0.0 m	0.4 m

Fri 27 Aug

LW	HW	LW	HW
03:39	10:10	16:07	22:03
0.0 m	0.4 m	0.1 m	0.4 m

Sat 28 Aug

LW	HW	LW	HW
04:40	11:30	17:34	23:11
0.0 m	0.4 m	0.1 m	0.3 m

Predicted heights are in metres above Chart Datum

Data approximate

Figure 2-7: Tidal prediction at time of survey indicated by red line. Note tidal prediction is from Oracabessa some 13km east of the landing point.

The coordinates of some components associated with the cable landing and BMH considerations are shown in Table 2-2: Coordinates of feature components associated with cable landingTable 2-2.

Table 2-2: Coordinates of feature components associated with cable landing

Description	Position
End of Jetty adjacent to LP	18° 24.896N 77° 04.516W
East extremity of beach at water line	18° 24.879N 77° 04.517W
West extremity of beach at water line	18° 24.890N 77° 04.561W
East corner of wall to be removed for equipment access	18° 24.873N 77° 04.539W
West corner of wall to be removed for equipment access	18° 24.873N 77° 04.543W
CJFS Beach Manhole	18° 24.873N 77° 04.344W

2.3.4 Scheduling of Beach Manhole Construction and Equipment Usage

There are about fourteen (14) persons who will be involved in the construction of the beach manhole. Their functions are broken out as follows:

- 1 x beach master - (overall beach team responsilbility, key point of contact between cable ship and beach team)
- 1 x rigger
- 1 x dive supervisor
- 4 x divers team
- Up to 5 local labours
- 2 x excavator operators

A list of the equipment to be used in the construction works that will be carried out is provided below :

- Minimum of two excavators
    - One cable pulling Quadrant
    - 1 electrical generator
    - Rope and Cable rigging tool kit
    - Shackles,
    - Steel wire sling
    - 6mm, 10mm, 32mm Polypropylene rope.
    - Soft stoppers
    - Marking Tape (cable and safety warning tape)
    - Consumables package
    - Load cell
    - Locating magnetometer
    - Video/photo equipment

The trench between the BMH and sea will be mechanically excavated using a stand back-hoe. The beach landing site will be prepared two (2) days before the cable ship arrives, and will continue after the shore end is completed with the application of the articulated pipe.

The duration for completion of the beach works is approximately 7-10 days barring inclement and unsuitable weather conditions. Construction activities will only be carried out during daytime hours.

2.3.5 Terminal Station Land Route

The terminal station is an existing building with a room dedicated for the ALBA-1 equipment in the south west corner. 25 m maintenance cable loops can be stored in the turning manhole immediately outside the terminal station.

The land route is new and was under construction at the time of the survey with trenching works visible at the side of the road. Exploratory holes had been excavated at manhole and pull box positions along the route to ensure the depth of the manholes and pull boxes can be accommodated.

The length of the land route is approximately 3km. The route follows the Ocho Rios by-pass for approximately half of the distance as shown Plate 2-8. The route turns left from the Ocho Rios by-pass towards the beach along a less busy residential road for approximately 400m to the beach manhole.

Plate 2-8: BMH to Terminal Station Land Route in Ocho Rios

It is proposed that the new beach manhole be constructed at the side of the street, not inside the adjacent private residential compound where the cable lands. At the time of the survey, apart from the beach manhole, the exact location of manholes along this road had not been identified.

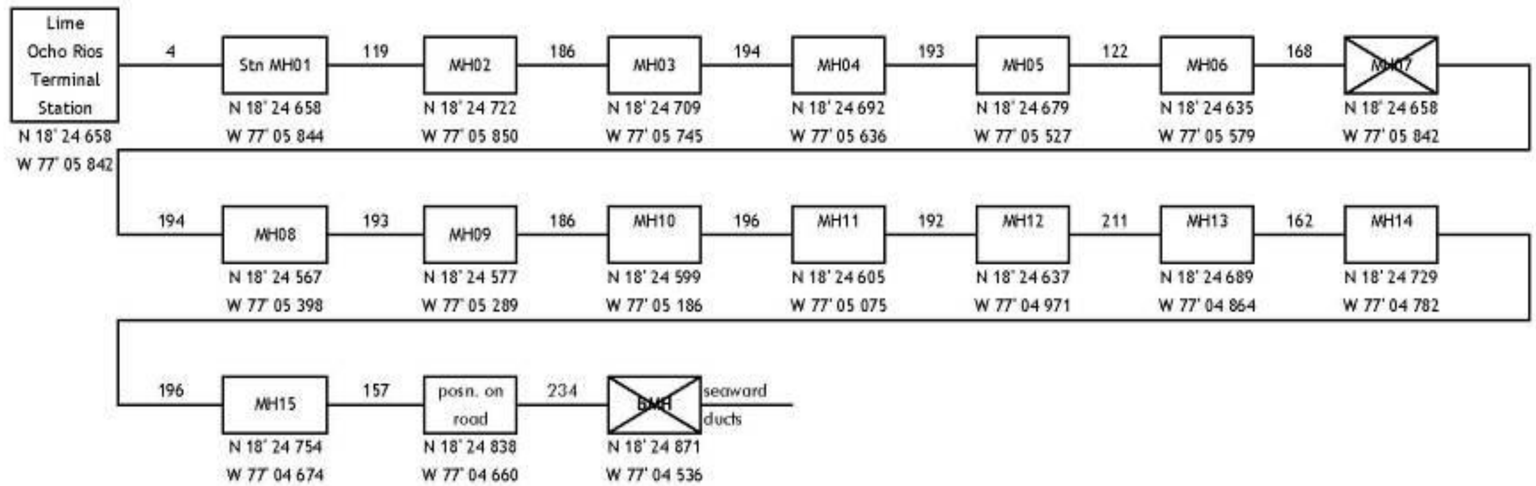
The land route turns right from the Ocho Rios by-pass downhill (North) along Craft Market Road towards Main Street and the terminal station. It is proposed that the corner turning manhole from the Ocho Rios by-pass be of sufficient size to accommodate a joint.

From Main St the land route turns left uphill (south) into Douglas Close for a short distance (170m) to the turning manhole at the entrance to the terminal station.

The land route will be of a conventional duct and manhole type construction. The quality, standard and design of the construction is in line with BT in the UK as is found generally throughout the Caribbean. The coordinates of the land route is shown in Table 2-3

Table 2-3: Route Position List for straight-line distances along land route

No	Label	Latitude			Longitude			Bearing (°)	Distance (km)	Cum Dist (km)
1	Corner of Station	18	24.6580	N	077	05.8420	W			0.000
								270.0	0.004	
2	Station turning manhole # 1	18	24.6580	N	077	05.8440	W			0.004
								354.9	0.119	
3	Turning manhole # 2 jn Douglas Close / Main St	18	24.7220	N	077	05.8500	W			0.123
								97.4	0.186	
4	Box # 3 opposite Delta Supply Co.	18	24.7090	N	077	05.7450	W			0.309
								99.3	0.194	
5	Box # 4 outside Wheels Unlimited	18	24.6920	N	077	05.6360	W			0.503
								97.1	0.193	
6	Turning manhole # 5 jn Main St / Craft Market Road	18	24.6790	N	077	05.5270	W			0.696
								228.4	0.122	
7	Box # 6 on bend Craft Market Road	18	24.6350	N	077	05.5790	W			0.818
								132.0	0.168	
8	Turning Manhole # 7 jn Craft Market Road / Ocho Rios Bypass	18	24.5740	N	077	05.5080	W			0.986
								93.8	0.194	
9	Box # 8 opposite Exmil Security Sign	18	24.5670	N	077	05.3980	W			1.180
								87.2	0.374	
10	Box # 9 opposite Spring Garden Restaurant Sign	18	24.5770	N	077	05.1860	W			1.554
								0.0	0.041	
11	Box # 10 on hill opposite Sandals	18	24.5990	N	077	05.1860	W			1.595
								86.8	0.196	
12	Box # 11 on hill	18	24.6050	N	077	05.0750	W			1.791
								72.1	0.192	
13	Box # 12 opposite Arts Car Mart	18	24.6370	N	077	04.9710	W			1.983
								63.0	0.211	
14	Box # 13	18	24.6890	N	077	04.8640	W			2.194
								62.9	0.162	
15	Box # 14	18	24.7290	N	077	04.7820	W			2.356
								76.4	0.196	
16	Turning Manhole # 15 Main St / Beach Road	18	24.7540	N	077	04.6740	W			2.552
								9.0	0.157	
17	Position at side of Road	18	24.8380	N	077	04.6600	W			2.709
								56.8	0.067	
18	Position at side of Road (entrance to 'Kiyara')	18	24.8580	N	077	04.6280	W			2.776
								67.3	0.057	
19	Position at side of Road	18	24.8700	N	077	04.5980	W			2.833
								95.7	0.037	
20	Position at side of Road (entrance to 'Golden Sands')	18	24.8680	N	077	04.5770	W			2.870
								90.0	0.032	
21	Position at side of Road	18	24.8680	N	077	04.5590	W			2.902
								82.2	0.041	
22	BMH	18	24.8710	N	077	04.5360	W			2.943



Notes:

1. Distances in metres
2. 25m spare cable loop is stored at beach joint, at intermediate joint and at station manhole
3. Jointing manholes shown thus:
4. All cable is to be secured in line with ALSN standard practice.
5. Draka reference for terrestial cable type is ACF040050-RCO-CW-250-D-KAP-F-1ec

All summary table distances in metres

	Drum No.	Cable Type	Drum Length	Installed Length	Duct Length
1	TBA	ALSN / Draka Terrestrial	1200		986
2	TBA	ALSN / Draka Terrestrial	2200		1921
		Totals	3400	0	2907
Spare	TBA	ALSN Terrestrial	2200	N/A	N/A

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01 Oct 10		J A Elliott	J F Clark	

TITLE ALBA-1 - OchoRios, Jamaica Land Route Drawing. Post Survey Inst 11980.LRD

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Figure 2-8: Land Route Drawing

There are overhead power lines visible at the side of the road where the land route passes. These are for local power distribution mounted on wooden poles along with telephone wires. Information regarding buried power cables was not available, but it is expected that there will be some existing buried power cables.

It is proposed that cable be supplied on two drums, including contingency for jointing and variation in length of the route during construction. The length of the drums will be 2200m and 1200m. A customer spare length of 2200m will be supplied on a metal drum.

2.3.5.1 Shore End Installation

ASN operates a fleet of dedicated cable installation vessels, namely, *Ile de Sein, Ile de Batz, Ile de Brehat*. ALBA-1 will be installed by the Ile de Batz.

Due to the steep seabed topography of the areas of concern, the ALBA-1 the cable will be surface laid in the Jamaican waters.

Prior to landing a cable, the cable ship will position itself approximately 1.0km directly offshore of the landing site. The minimum depth of water that the ship can enter is approximately 12 to 15 m. This is subject to sea conditions at the time of installation. The cable ship is equipped with Dynamic Positioning that allows her to maintain accurate positioning; as such the cable ship does not need to deploy anchors during any of the installation operations. The cable ship will maintain a clear safety zone (radio warning, etc) around the cable ship.

Plate 2-9: Floats affixed to cable during a cable installation

A line from the shore end will be pulled to the ship and attached to the end of the sea cable. The cable end will be floated ashore by temporarily affixing floats to the cable approximately every 10 metres or closer if necessary (Plate 2-9). A temporary working area near the beach manhole will allow equipment to be staged to pull the sea cables from the beach or the highway.

The cable will be secured in the beach manhole where it will be joined to the land cable from LIME cable terminal station. As the end of the cable comes ashore, divers will remove the floats and guide the cable onto the delineated area of the seabed.

The process of landing the cable takes approximately one day per cable. All shore-based equipment, tools, and waste material will be promptly removed from the site. The beach area will be restored after the cables are pulled and secured.

Once the cable is landed ashore and secured in the beach manhole, divers will ensure that the cable is lying in good condition and in the appropriate location on the seabed.

The cables will be hand placed to minimize any impact to marine organisms or other seabed features.

Once the cable is on the seabed, articulated pipe (Figure 2-9) will be positioned and assembled around the cable by divers. There will be 250m of articulated pipe installed along the cable from the beach manhole seaward. During the construction procedure the divers will be properly weighted and will take precautions to ensure that air hoses, pipe sections and other equipment are not placed on or bumped against the organisms on the seabed. The divers will also avoid kneeling on or hitting organisms on the seabed as they install the articulated pipe.

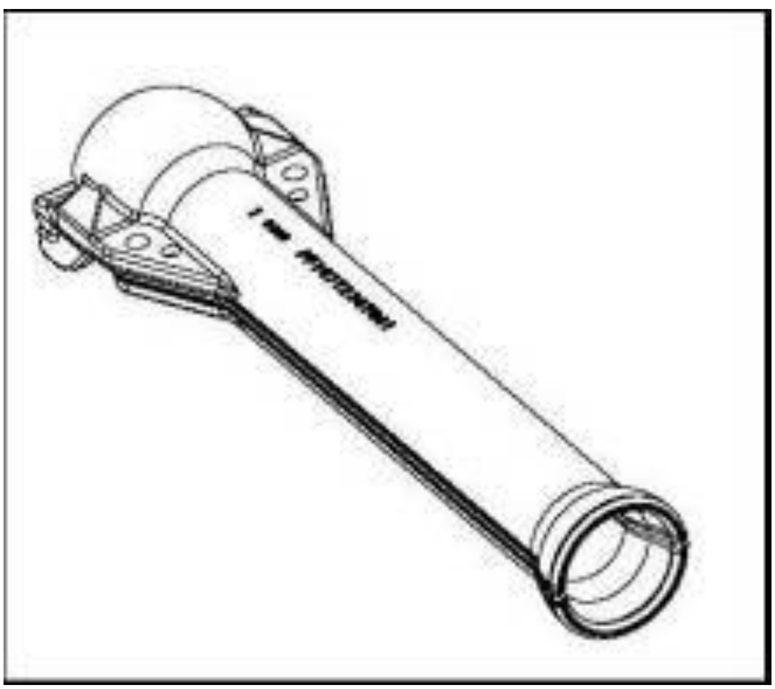


Figure 2-9: Articulated Pipe

Articulated pipe protection will be of the self-interlocking/split sleeve type as shown in Plate 2-10. Stainless steel nut and bolt sets comprised of M12 x 50 mm hex stud complete with two washers and an aero-tight locking nut, all of stainless steel, will be utilized.

Plate 2-10: Articulated pipe protection with self-interlocking/split sleeve

The interlocking design of the articulated pipe secures in place each preceding unit, as the pipe is laid seaward. Thus the pipe can only be removed commencing from the seaward end of the protection. However, additional security of the articulated pipe against unauthorized or damage-induced removal will be required and is achieved by installing pairs of stainless steel self locking nut and bolt sets at 0.5 to 5 metre intervals, depending on the depth of water.

2.3.5.2 Cable Ship

ASN operates a fleet of dedicated cable installation vessels, namely, *Ile de Sein, Ile de Batz, Ile de Brehat*). ALBA-1 will be installed by the Ile de Batz.

Plate 2-11: ASN dedicated cable installation vessel

Due to the steep seabed topography of the areas concerned the ALBA-1 the cable is will be surface laid in the Jamaican waters cable. The cable will only be plough buried off the coast of Venezuela.

2.4 Pre-installation surveys and studies

Project information is refined through 2 main stages:

- A cable route study (CRS), comprising a detailed review of all factors affecting the routing of the cable, including physical, environmental, socio-economic and regularity aspects.
- A marine survey, comprising separate surveys for the inshore and offshore sections. Bathymetric data are collected and analysed in order to define the level of armouring required and the optimum route for cable installation.

The marine survey was conducted in May 2010. The route chosen takes into account seabed features such as underwater canyons as well as other facilities such as pipelines and other submarine cables. The shortest route to deep water (where the cable is best protected from damage caused by anchors and fishing gear) has also been adopted.

2.4.1 Cable Route Survey Methodology

MakaiPlan submarine cable planning software (Makai) has been used to generate the proposed ALBA-1 CRS route included within this study. Makai is a PC software package specifically designed to assist in cable route planning. A number of external database packages have been used in conjunction with the Makai software to provide the required cultural information. These are described below:

- Smith and Sandwell (S&S) Bathymetry Database
- Admiralty, GUNIO and NOAA Raster Charts
- Global Marine Systems Ltd. (GMSL) Cable Database
- United Nations Convention on the Law of the Sea (UNCLOS) Maritime Boundaries Database
- United Kingdom Hydrographic Office Wreck Search Database
- Extensive Internet Searches

2.4.2 General Overview of Physical Route Survey

2.4.2.1 Combined hydrographic and geophysical survey works including gravity coring and grab sampling

This was conducted for nearshore survey works (0-20 metres water depth) and offshore survey works (water depths between 20 and 1000 metres). Deep-water swathe bathymetry was conducted for all water depths greater than 1000 metres.

2.4.2.2 Topographic Survey

At the proposed landing sites a topographic land survey was undertaken to precisely map the high / low water marks, all features and obstructions to 250m either side (if possible) of the BMH and 250m inland (if possible) of the BMH.

2.4.2.3 Nearshore / Diver Swim Survey

In the nearshore zone in water depths too shallow for the operation of survey vessels a diver swim survey was undertaken to ascertain the seabed conditions and positively identify the location of other in service cables and seabed obstructions.

2.4.2.4 Shallow-water Survey

For shallow-water survey works swathe bathymetry, seabed features and shallow geology conditions were ascertained to 1000 metres water depth in a survey corridor of 500m. Adequate seabed samples were collected and analysed, where necessary, to assist in geophysical data integration

Offshore survey works determined the extent of in-service cable crossings in water depths less than 1000 metres. A magnetometer was used where the cables could not be seen on the other survey sensors.

2.4.2.5 Deep-water Survey

In water depths greater than 1000 metres bathymetry only is required. The survey corridor was a minimum of three times the water depth or 10km whichever is the least.

All survey and charting conducted was referenced to WGS84 datum and spheroid, created using a Mercator projection where possible. Land surveys were conducted on the same Mercator projection.

2.4.3 Cable Route Engineering

2.4.3.1 General Cable Engineering Considerations

The International Cable Protection Committee (ICPC) Recommendation No.2 (Recommended Routing and Reporting Criteria for Cables in Proximity to Others) has been used as a primary reference during the design process of compiling the proposed ALBA-1 route.

Where conditions allow, every attempt has been made to ensure a horizontal separation between the proposed route and any existing adjacent cables of three times the water depth. This is a precautionary measure to help ensure the security of the ALBA-1 cable if a fault in another adjacent cable means that the latter cable needs to be recovered by grappling. Likewise the same protection is offered to other existing cable systems in the event that an ALBA-1 section requires recovery for maintenance reasons.

The horizontal separation between cable systems is the subject of Articles 51, 58, 79 and 114 embodied within the United Nations Convention on the Law of the Sea (UNCLOS), which requires that “it is necessary to give due regard to cables already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced.”

At crossings of existing cables it is normally the case that a crossing is designed to be three times the water depth from the nearest repeater or powered equaliser on the existing cable, wherever possible.

It is recognised that the ICPC “recommend that 'crossing angles shallower than 45° should not be implemented in order to ensure operational and maintenance activities related to either cable are not compromised”.

With existing in-service cable crossings care has been taken to avoid a conflict between armoured and un-armoured cable types due to the risk of abrasion on the less protected cable.

In an attempt to offer maximum system security to the ALBA-1 system, a proposed route has been engineered which attains deep water as quickly as possible.

In areas of relatively steep slopes it is important not only that the route stays perpendicular to the slope but also that the number of alter courses is kept to a minimum. This helps provide the installation vessel with a straight run in / run out and optimises the chance of the cable touchdown point being in the desired location. This also reduces the surface area of the cable which would come into contact with material should a sediment slump take place on the slopes dragging the cable into tension, and ultimate failure. In surface laid sections this action also minimises the length of cable exposed on the slope and therefore minimises the associated risk of chafing and suspensions.

2.4.3.2 Cable Types

It is proposed that Alcatel's OAL-C5 suite of cables will be used on the repeated segment 1 and URC-2 on the unrepeated segment 2 of the ALBA-1 system. Table 2-4 summarises the cable types and maximum depth ratings for each type in the OAL-C5 suite and Table 2-5 provides the same details for the URC-2 suite.

Table 2-4: OAL-C5 Cable Types and Maximum Depth Ratings

Cable Type	Maximum Qualified Buried Installation Depth (m)	Maximum Qualified Surface Lay Installation Depth (m)
Double Armour (DA)	500	500
Single Armour (SA)	2000*	2000*
Light Weight Protected (LWP)		7000
Light Weight (LW)		8000

*SA cable may be used down to 2000m provided that the recovery of the transition to LW or LWP cable is made from the SA cable where the depth is greater than 1500m.

Table 2-5: URC-2 Cable Types and Maximum Depth Ratings

Cable Type	Maximum Qualified Buried Installation Depth (m)	Maximum Qualified Surface Lay Installation Depth (m)
Double Armour (DA)	500	500
Single Armour (SA)	2000*	2000*
Light Weight Protected (LWP)		6000
Light Weight (LW)		7000

*SA cable may be used down to 2000m provided that the recovery of the transition to LW or LWP cable is made from the SA cable where the depth is greater than 1500m.

Cable type selection and the depth at which transitions are located (up to maximum qualified depth) are based on the results of the marine route survey and ASN route engineering guidelines.

2.4.3.3 Slack Values, Branching Unit and Beach Cable Allowances

Slack values developed for this project are for total surface slack values which combine 'bottom' slack (also known as 'contingency slack') and 'infill' slack (due to topography). Values have been derived in accordance with standard industry practices for 'bottom' slack and measurements of slopes derived from database bathymetry, as per Alcatel Submarine Networks Route Engineering Handbook (ref. REH Nov 2009).

"Bottom slack" values are determined principally by water depth as detailed in Table 2-6, with "infill slack" automatically calculated by the MakaiPlan software.

At the proposed landing, an additional 50m of DA cable type will be added to facilitate landing operations and BMH cable requirements/spare as per standard REH practice. This is known as the Shore-End (Beach) Allowance.

Table 2-6: Bottom Slack Values

Water Depth Range	Bottom Slack Value
0 –15m	0.8%
15-500m	0.2% Any installation type
500-1500m	0.2% Plough buried areas
	0.5% Surface laid areas
1500-2000m	1.0%
> 2000m –av. Slopes <10°	3.0%
> 2000m –av. Slopes 10°-20°	3.5%
> 2000m –av. Slopes >20%	4.0%

2.5 Personnel Requirements

The personnel requirement for this project is fairly small. The bulk of the workforce is comprised of technical expertise that will be resident aboard the cable laying vessel. As such there is little or no additional personnel requirement necessary.

The additional manpower required may be in the form:

1. Small boat operator – to operate in inshore waters that does not support the cable laying vessel
2. Operators of backhoe and other mechanical devices to construct the trench on land for the cable duct as well as install the pre-constructed beach manhole.
3. A licensed solid waste hauler to remove any solid waste generated such as discarded packing material and food waste.

2.6 Solid Waste Management

Solid waste generated from this proposed project will be disposed of at an approved Dump Facility It is expected that a private solid waste haulage contractor will be utilized to collect and disposed of any waste material generated during the cable lay activities.

ANALYSIS OF ALTERNATIVES

3 Analysis of Alternatives

3.1 Introduction

In considering the development options, the following alternative analyses were conducted.

1. The "No-Action" Alternative
2. The Proposed Landing Site Alternatives
3. Technology Alternatives

3.2 The "No-Action" Alternative

The selection of the "No-Action" alternative would mean the discontinuation of project designs and result in no new additions to Jamaica's existing telecommunications sector. There are major socio-economic implications of this alternative to the security and stability of Jamaica's telecommunications network.

Though Jamaica now enjoys better external telecommunications, the redundant capabilities of the system would not be put in place which would result in loss of service should the existing system be damaged. Any increase in fibre-optic cable connections with the world translates to a more stable network. Also, Jamaica would not realise the potential connection to South America which has become a major trading partner. The enormous economic and social development opportunities for Information Communication Technology (ICT) as well as the investment will be lost, including the potential for job creation. It therefore would be necessary to consider alternative methods of meeting data transmission requirements.

The installation of this cable has the potential to translate into lower cost alternatives to Jamaicans who enjoy the various services such as cable TV, telephone and internet. Without this project the proposed submarine fibre-optic cable would not be installed. No operations and maintenance activities would occur. This alternative would not fulfil the purpose of the project or meet the identified needs for high-speed data transmission throughout Jamaica.

3.3 Proposed Landing Site Alternatives

In consideration of alternatives to the landing site, the proponent investigated various locations along the north-east coast to land the fibre-optic cable. The decision to look at this section of the company was primarily in relation to the origin of the spur to Jamaica which is in Cuba.

Three (3) alternative landing sites were considered:

1. St. Ann's Bay, St. Ann
2. Ocho Rios, St. Ann
3. Tower Isle, St. Mary

The landing sites were selected based on a number of factors. Of primary concern was the type and degree of impact the cable installation would have on the coastal and marine ecology, as well as the quality and adequacy of locations to receive and house the cable safely.

The sites that were investigated in this report represent the best selections from exhaustive considerations of a number of sites. Some of which were disqualified on the basis of:

- Estimated coastal and marine ecological impacts,
- Distance to existing or proposed hubs,
- Impacts to and on cable laying installation, and
- Through consultations.

3.3.1 Alternative Landing Site #1: St. Ann's Bay

St. Ann's Bay provides a fairly good bay area in which to land the cable as follows:

- The location does not enjoy any significant marine activity, very few watersport activities and few fishermen. Limited or no trawl fishing apparent and negligible vessel anchoring
- The nearshore is short in distance, less than 1.5 km from shore to deep water
- Not within the boundaries of the Ocho Rios Marine Park
- In close proximity to a major arterial road

The St. Ann Parish Council lands in the vicinity of the bay were considered for landing the cable. The site is presently the Department of Motor Vehicle assessment location. The ease in which a lease or right-of-way agreement could be achieved was considered more tedious than other locations.

The approach was characterized as having a coarse sand beach with a significant patch reef protecting the shore (Plate 3-1). Though a sand channel exist, the patch reefs were considered to be in very close proximity to the channel reducing its width to approximately 100 m. additionally, small coral heads and a significant seagrass meadow were thought to occupy the bay and parts of the channel based on aerial image interpretation. Little or no protection appears to be offered to the bay from the impact of tropical storms and hurricane activities due to the wide and open nature of the bay. This potential landing site would also represent an area that has not been impacted by any development activities aside from the seawall to protect the road and inland resources. The distance to the cable terminal building in Ocho Rios is also less than ideal since it is more than 7 km away.

The approximate coordinates for the landing site evaluated is: 18° 26' 20.14" N, 077° 11' 56.97'W

Plate 3-1: St. Ann's Bay - Alternative Landing Site #1

3.3.2 Alternative Landing Site #2: Ocho Rios

Ocho Rios provides a fairly good bay area in which to land the cable as follows:

- The location enjoys a deep water bay that would accommodate the survey and cable laying vessel in close proximity to shore
- The nearshore is short in distance, approximately 1.5 km from shore to deep water
- In close proximity to a major arterial road
- In very close proximity to the cable terminal building situated in Ocho Rios

There are few suitable landing sites within Ocho Rios. The harbour is a very active zone with various watersport equipment, cruise ships and cargo. There are also development plans for the expansion of the pier. The harbour is subject to periodic maintenance in the form of dredging that could impact the installed cable. The ease in which a lease or right-of-way agreement could be achieved was considered tedious based on the nature of business along the waterfront.

The harbour has a good deep water approach with few obstructions, however, the nature and type of activities conducted within the harbour ruled out this option (Plate 3-2). It would require significant efforts at scheduling to not only conduct the route survey but as lay the cable.

Plate 3-2: Ocho Rios - Alternative Landing Site #2

3.3.3 Alternative Landing Site #3: Tower Isle

Tower Isle provides a fairly good area in which to land the cable as follows:

- The location has served as a landing site for fibre-optic cables in the past
- It does not enjoy any significant marine activity, very few watersport activities and few fishermen. Limited or no trawl fishing apparent and negligible vessel anchoring
- The nearshore is short in distance, less than 1.5 km from shore to deep water

- In close proximity to a major arterial road

The ease in which a lease or right-of-way agreement could be achieved was considered to be fairly straightforward due to the numerous private properties in the area.

The approach was characterized as having a coarse sand beach with a significant patch reef protecting the coastline (Plate 3-3). Few sand channels exist, the patch reefs is considered to be in very close proximity to the shore (approximately 500 m) and runs the entire length of the coastline. The channels are narrow and the inshore has substantial seagrass coverage based on aerial image interpretation and anecdotal evidence (fishermen). Little or no protection appears to be offered to the bay from the impact of tropical storms and hurricane activities due to the wide and open nature of the coast.

The distance to the cable terminal building in Ocho Rios is also less than ideal since it is more than 7 km away.

Plate 3-3: Tower Isle - Alternative Landing Site #3

3.4 Technology Alternatives

A number of technological alternatives that either did not fulfill the purpose of the project or did not meet the agreed criteria were evaluated. The major factors that affected the acceptability of those options were potentially adverse environmental effects and problems related to technical feasibility. The following details the advantages of incorporating a high speed data fibre-optic cable in Jamaica, when compared with other technologies outlined below:

- **SPEED:** Fibre optic networks operate at high speeds - up into the gigabits
- **BANDWIDTH:** large carrying capacity
- **DISTANCE:** Signals can be transmitted further without needing to be "refreshed" or strengthened.
- **RESISTANCE:** Greater resistance to electromagnetic noise such as radios, motors or other nearby cables.
- **MAINTENANCE:** Fibre optic cables costs much less to maintain.

3.4.1 Radio

Other high-speed wireless providers, such as those using 24 GHz, 28 GHz and 38 GHz spectrum, have concentrated on the more densely populated urban areas because of transmission distance limitations. Signals using these radio frequencies are generally limited to a one to three-mile radius, or three to 28 square miles, which makes application in less densely populated areas less economical. These frequencies are inherently more susceptible to weather and environmental interference.

The option does not meet the purpose of the project.

3.4.2 Telephony

The telephone industry predominantly uses copper twisted-pair for the delivery of communications services to commercial and residential customers. Plain old telephone systems have been the primary means of communicating both locally and long distance. The problem is that it was designed for the transmission of voice communications. It's a mature technology, but inadequate by design, the amount of bandwidth that can be delivered is restricted by the characteristics of the copper twisted-pairs installed between the customer and central office.

Fibre-optics spans the long distances between local phone systems as well as providing the backbone for many network systems (such as cable television services, university campuses, office buildings, industrial plants, and electric utility companies).

The main difference is that fibre-optics use light pulses to transmit information down fibre lines instead of using electronic pulses to transmit information down copper lines.

Services such as DSL delivered across a local exchange carrier's existing copper wire system are capable of delivering very high speeds. However, DSL suffers performance limitations based on the distance from the customer premises to the serving central office. Distances are limited to about four to five miles from a central office for the lowest speed solutions and 10,000 feet or less for the fastest. Additionally, much of the plant is physically incapable of providing broadband service.

The option does not meet the purpose of the project.

3.4.3 Satellite Data Transmission

A non-cable option of replacing the proposed telecommunication and data transmission services is satellite communications. The use of communications satellites to provide the services identified as necessary would require no construction in the marine environment, but would not provide the capacity or quality of service proposed under the project.

Satellite networks, such as direct broadcast satellite, currently offer only one-way Internet access. Upstream access is limited to existing copper telephone lines. Other alternatives like Low Earth Orbit (LEO) Satellite Systems are not scheduled to be completed for years and have not proven capable of providing "carrier-class" voice or data services. Fibre optic cables transmit voice and data traffic with higher reliability and security at a cheaper rate than satellite. While a satellite call must travel 27,000 miles (35,780 km) from the earth to the satellite and then another 27,000 miles back, a Jamaica to Florida fibre optic call need only travel about 200 miles point-to-point. At the speed of light this helps to eliminate the delays suffered during a satellite telephone call.

The option does not meet the purpose of the project.

3.4.4 Fibre-Optic Cable Data Transmission

Fibre optic cabling offers users:

- High data rate and wide bandwidth
- Immunity to EMI/RFI and lightning damage
- No ground loops
- Low attenuation (data loss)
- Longer distance - 2 and 5 km with Multimode fibre or over 25 km with Single Mode fibre
- Small cable diameter fits anywhere
- Light weight
- No sparks if cut
- No shock hazard
- Secure communications

- Low system cost
- Longer life expectancy than copper or coaxial cable
- Cabling of the future

The option meets the purpose of the project.

3.5 Cable Lay Activity Alternatives

3.5.1 Cable Pull

There are very few options available to conduct a cable pull. The most cost-efficient and environmentally acceptable format previously used in Jamaica will be utilized for this cable lay as indicated in the Project Description section of this report.

The options available are as follows:

- Cable pulled from ship to shore without floating the cable
- Cable pulled from ship to shore by initially floating the cable

This entails feeding a winch rope through the ducting and attaching it to the cable with a compression sleeve or sock. As the cable is winched into the ducting the sock tightens its grip on the cable. On larger cables a cable pusher is used to assist the winch and thus reduce tension in the cable. The first option assumes alignment is perfect and cable is put in place without any consideration of the cable in-situ survey. The second option which is considered for this project allows a cable pulling plan to be initiated during the cable installation. This includes the logistics of cable let-off/pulling equipment, the location of intermediate access points, splice locations and the specific responsibilities of each member of the installation team.

3.5.2 Horizontal Directional Drilling vs. Trenching

The proposed cable lay will utilize trenching from the beach to the manhole. Horizontal Directional Drilling (Guided Boring) is ideal for the underground installation of gas, electric, water, telecommunication or soil remediation lines - without excavation or trenching. Horizontal directional drilling ensures minimal or no environmental disruption and is an excellent choice for installations in diverse rock and soil conditions. However, based on the nature of the site (no diverse rock or soil type) and the distance required, the cost to secure and operate a directional drill far outweighs any benefits to be derived. Both options will result in minor sedimentation issues at the land-water interface. This can be effectively mitigated using existing methods such as silt screens/curtains among others. No rock impediments were observed at the landing site. The sand channel in which the cable will be laid is very wide and no directional drilling is required to bypass the hard rock substrates on either side.

POLICY, LEGISLATIVE & REGULATORY FRAMEWORK

4 Policy, Legislative & Regulatory Framework

4.1 Introduction

The policies, legislation, regulations and environmental standards of the Government of Jamaica (GOJ), which pertain to this development have been researched and analyzed, to ensure that the project complies with all policy, legal and regulatory requirements. The areas examined included environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels, which relate to or should be considered within the framework of the project.

All development applications are submitted for approval to the Town & Country Planning Authority, through the local Parish Council and then forwarded to the relevant authorities including NEPA and the Environmental Health Unit (EHU) of the Ministry of Health.

NEPA, the governing environmental agency, may require an environmental impact assessment (EIA) to be considered along with the development plan for the Authority's approval. The EHU imposes guidelines for air, water and soil standards to be maintained after construction.

In this case, this project triggers an EIA because it falls within the Prescribed Categories (Annex I) pursuant to Natural Resources Conservation (Permits and Licences) Regulations (Amended) 2004 as described by item 3 – Pipelines and Conveyors for Gas Transport, Underground & Underwater Cables. This project concerns the laying of underwater cables.

This section serves to address all applicable policies, legislation, standards, and regulations that may affect this project.

4.2 Applicable Jamaican Policies, Legislations, Standards & Regulations

Legislation relevant to the laying of a Fibre-Optic cable along the seabed of Jamaica's territorial waters and terminating at Golden Sands Beach Cottages in the parish of St. Ann is outlined below.

4.2.1 The NRCA Act, 1991

The NRCA Act (1991) is the overriding legislation governing environmental management in Jamaica. It requires that all new projects, (or expansion of existing projects), which fall within prescribed categories be subject to an environmental impact assessment (EIA).

The regulations and the approved Terms of Reference (ToR) require that ten (10) copies of the EIA Report be submitted to the Authority for review. There is a preliminary review period of ten (10) days to determine whether additional information is needed. After the initial review the process can take up to ninety (90) days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted. In the event that the EIA is not approved, there is provision for an appeal to be made to the Minister.

Specifically, the relevant section(s) under the Act which address the proposed project are:

s.10:(1) Subject to the provisions of this section, the Authority may by notice in writing require an applicant for a permit of the person responsible for undertaking in a prescribed area, any enterprise, construction or development of a prescribed description or category-

(a) to furnish the Authority such documents or information as the Authority thinks fit; or

(b) where it is of the opinion that activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an EIA containing such information as may be prescribed, and the applicant or, as the case may be, the person responsible shall comply with the requirement.

s.18: Enforcement of Controls – threat to public health or natural resources

s.32-33: Ministerial Orders to protect the environment

s.38: Regulations

All the necessary applications have been submitted to the Agency. An application for an Environmental Permit and License was completed and submitted to NEPA as well as a Project Information Form (PIF) and Terms of Reference (ToR). The approved ToR for this EIA is included in the appendix of this document (**Appendix I**). This EIA document satisfies the penultimate review process, mandatory public meeting next, before the required licences and permits can be issued.

Various standards and regulations that apply under this Act are outlined below:

4.2.1.1 The Natural Resources Conservation Authority (Air Quality) Regulations, 2006

These regulations were gazetted on July 12, 2006. This regulation is considered although it was designed primarily for the quality of the airshed within which an industrial entity is discharging emissions (gases or particulate matter).

The environmental impact from any air emissions (gasses or particulate matter) will be influenced by the ambient meteorological conditions within the area, such as wind (speed and direction), and rain.

Table 4-1 below outlines the ambient air quality standards as issued by NEPA.

Table 4-1: Air Quality Standards for Jamaica (NEPA)

Pollutant	Averaging Time	Standard (maximum concentration in µg/m3)
Total Suspended Particulates Matter (TSP)	Annual	60
	24 hour	150
PM10	Annual	50
	24 hour	150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual	80 primary, 60 secondary
	24 hour	365 primary, 280 secondary
	1 hour	700
Photochemical oxidants (ozone)	1 hour	235
Carbon monoxide	8 hour	10,000
	1 hour	40,000
Nitrogen Dioxide	Annual	100

The proposed fibre-optic cable installation has the potential to impact on surrounding commercial and residential receptors particularly during trenching and operation of heavy equipment. All efforts will be utilised to ensure the project will not result in a significant loss in air quality within the sphere of influence of the project. The applicable mitigation strategies outlined further in this report will be monitored during on-site activities to ensure compliance.

4.2.1.2 Noise Standards

Noise Standards for Jamaica have been proposed by NEPA based on the World Bank standards. The guideline for daytime perimeter noise is 75 decibels and 70 decibels for night-time noise.

Environmental management and monitoring policies will be put in place to monitor noise during the construction of this development. This will include ensuring that suppliers and contractors ensure that associated mechanical equipment that may generate noise be fitted with manufacturer specified silencers and other devices to ensure noise levels do not exceed standards.

4.2.1.3 Protected Areas

The ALBA-1 cable system falls within the eastern border of the Ocho Rios Protected Area. The Ocho Rios Marine Park was designated in 1999 by a Natural Resources Conservation Order. The Marine Park designation is not expected to have an adverse impact on the viability of the Ocho Rios landing and the cable routing because the park is a known mixed use zone.

4.2.2 The Watershed Protection Act, 1963

This Act governs the activities operating within the island's watersheds, as well as protects these areas. There are twenty-six (26) watershed management units designated under this Act, including the White River Watershed Management Unit in which this project falls.

Determinations have been made to identify any potential impacts that this project may have on the watershed and mitigative actions proposed where impacts are identified further in this document.

It is not anticipated that this project will have any significant adverse environmental impact on the watershed. The impact area is primarily marine and all efforts have been made to ensure the route taken is the best available.

4.2.3 The Wildlife protection Act, 1945

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. The Act also provides for the protection of animals and makes it an offence to harm or kill a species which is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead is illegal. This Act has to be considered for the proposed project.

The ecological assessment has determined that there are species that may be impacted in the marine environment. A management plan has been outlined to address the avoidance/care of specified species as necessary.

4.2.4 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

This Act governs the restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement.

The proponent does not intend to engage in the trade of endangered species.

4.2.5 Water Resources Act, 1995; Underground Water Control Act, 1959

The Underground Water Control Act of 1959 is the legal instrument. However, the Water Resources Act is expected to provide for the management, protection, controlled allocation and use of the water resources of Jamaica. Thus, the water quality control for both surface and groundwater are regulated by this Act.

Any activity that negatively influences the quality of the existing water, whether ground or surface, would be relevant to this Act. There are no defined activities that are expected to undermine water resources in the area.

4.2.6 The Clean Air Act, 1964

The Clean Air Act speaks generally to aspects of industrial operations such as the stockpiles, conveyors and ship loading. This Act also makes reference to the use of inspectors to inspect any premises, carry out tests, and take samples of any substance that he/she considers necessary or proper for the performance of duties. This development has the potential to discharge particulate matter to the atmosphere through the use of heavy equipment and the generation of fugitive dust. However, the impact is anticipated to be negligible.

This project will be regulated by this Act in accordance with the NRCA (Air Quality) Regulations. The proponent intends to abide by all regulations regarding air quality and intends to put in place best management practices used in similar operations globally.

4.2.7 The Town and Country Planning Act, 1957

This Act governs the development and land use (excluding agriculture) in specified areas, through Development Orders, local planning authorities, development planning processes and Tree Preservation Orders. Under this Act the Town Planning Department is the agency responsible for the review of any plans involving development. The Act allows for specific conditions to be stipulated and imposed on any approved plans. The planning decision is based upon several factors, including;

- Location of the development;
- Land use and zoning;
- Effect of the proposal on amenities, traffic, etc.

4.2.7.1 Development Orders

The Town and Country Planning Act empower the Town and Country Planning Authority to prepare in consultation with the Local Planning Authority, legal documents called Development Orders for specific areas throughout Jamaica.

The aim of these documents is to regulate and control the use of land ensuring that land is not misused. The St. Ann Parish (Confirmed) Development Order (2000) governs development activities within the parish of St. Ann.

The proposed project falls within the ambit of development activities that may be conducted within the parish of St. Ann. No conflicts have been identified as a result of this proposed project. A fibre-optic cable was previously landed at the Shaw Park Beach in 1997 in compliance with the development order.

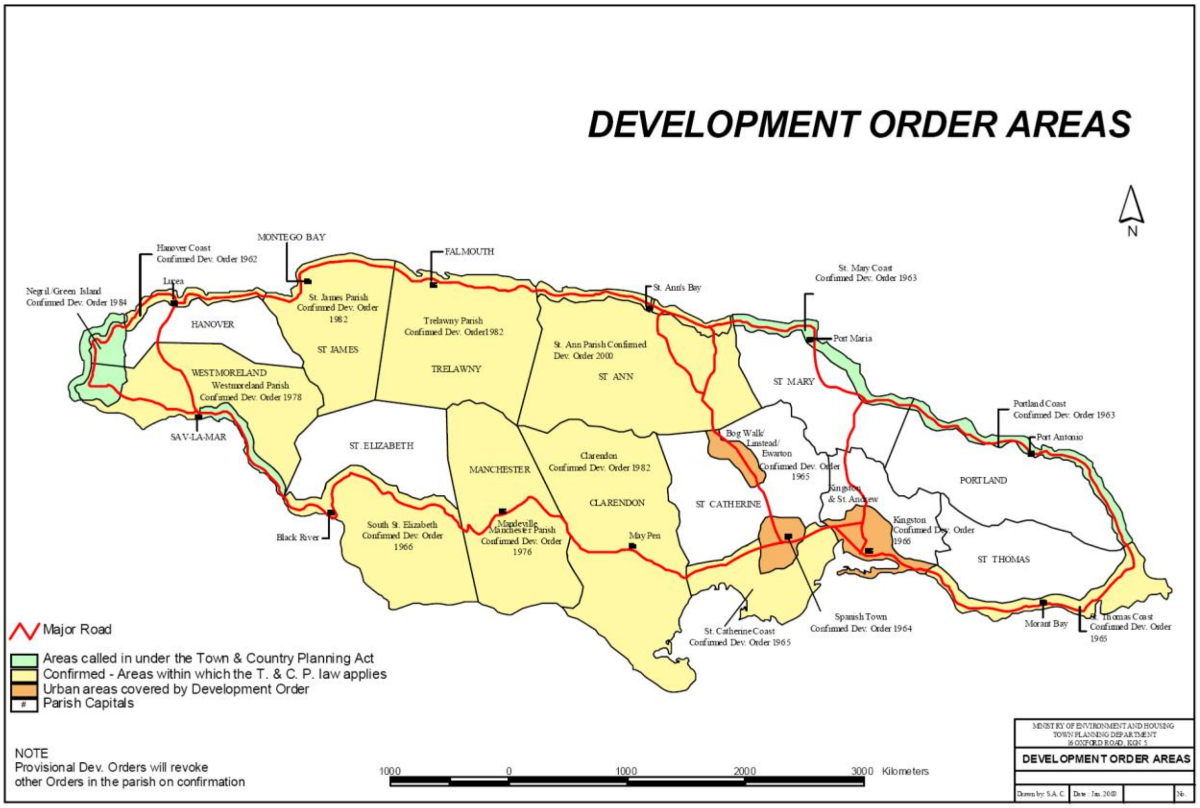


Figure 4-1: Development Orders of Jamaica

4.2.8 The Jamaica National Heritage Trust Act, 1985

The Jamaica National Heritage Trust, formerly the Jamaica National Trust, administers the Act. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, and buildings of historic and architectural importance in Jamaica.

This Act will prove applicable if any structures of archaeological and/or architectural importance stands to be affected by the proposed site activities or unearthed during site activities. The JNHT has record of heritage artefacts of significance at this site. The environmental management plan will also be guided by this Act where any development works that uncovers heritage artefacts will result in the cessation of operations and the subsequent intervention of the JNHT.

4.2.9 The Public Health Act, 1985

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the handling of food material. In addition, provisions are also made under this Act for the activities of the Environmental Health Unit (EHU), a division of the MOH. The EHU has no direct legislative jurisdiction, but works through the Public Heath Act to monitor and control pollution from point sources. The functions of the unit include:

- The monitoring of waste water quality, including regular water quality analysis, using water standards published by NEPA;
- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments;
- Monitoring of air pollutants through its laboratory facilities.

In addition, there are various sections of this legislative instrument which governs and protects the health of the public. Relevant sections under the Public Health Act of 1985, are Sections 7.- (1) *A Local Board may from time to time, and shall if directed by the Minister to do so, make regulations relating to (0) nuisances* and 14.- (1) *The Minister may make regulations generally for carrying out the provisions and purposes of this Act, and in particular, subject to section 7, but without prejudice to the generality of the foregoing, may make regulations in relation to (d) air, soil and water pollution.*

It is not anticipated that there will be any significant impact to the water quality of nearshore waters or land along the route to the cable terminal building via road trenches.

4.2.10 Disaster Preparedness and Emergency Management Act, 1993

The principal objective of the Act is to advance disaster preparedness and emergency management measures in Jamaica by facilitating and coordinating the development and implementation of integrated disaster management systems. The project proponents will establish procedures and guidance documents, as outlined in the environmental management section of this report, in respect of disaster preparedness and emergency management. These measures will be tailored, as necessary, with assistance from various agencies.

4.2.11 National Solid Waste Management Authority Act, 2001

The National Solid Waste Management Authority (NSWMA) under this Act has the responsibility to manage and regulate the solid waste sector. It includes requirements for licences for operators and owners of solid waste disposal facilities (in addition to permit requirements of NEPA).

The necessary arrangements for solid waste management and disposal for all solid waste generated from this proposed project will be implemented. Where possible, the project will recycle.

4.2.12 Occupational Safety & Health Act, 2003 (Draft)

This Act oversees the prevention of injury and illness resulting from conditions at the workplace, the protection of the safety and health of workers and the promotion of safe and healthy workplaces.

Sampling of sections from the Draft Act that are relevant to this project, include:

4. (1) This Act applies to all branches of economic activity and to all owners, employers and workers in all such branches.

18. (1) Provides a description of the duties of employers, outlining the need for quality work areas and work environments, procedures and guidelines that will result in safe and healthy workplaces.

19. (1) discusses the duties of employers at construction sites in terms of employee safety and health during work activities.

25. (1) an employer shall make or cause to be made and shall maintain an inventory of all hazardous chemicals and hazardous physical agents that are present in the workplace.

26. (1) this section provides guidelines and procedures for employers to follow in terms of identification of hazardous chemicals. This includes labelling and identification protocols.

30. (1) Basically, this section of the Act requires an employer to provide training of its employees with a potential for exposure to hazardous chemicals or physical agents.

It is expected that this Draft Act will be Gazetted in the near future. The project proponent has an understanding and appreciation for the contents of this policy. Occupational safety and health policies will be extended to this project as outlined in the environmental management section of this report.

4.3 International Policies

4.3.1 Agenda 21

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED) in Rio de Janeiro, Brazil. One of the main outputs of the conference was a plan of global action, titled Agenda 21, which is a "comprehensive blueprint for the global actions to affect the transition to sustainable development" (Maurice Strong). Jamaica is a signatory to this Convention. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those most relevant to this project, which Jamaica is obligated to follow are outlined below:

- Principle 1: Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.
- Principle 2: States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies.
- Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

- Principle 10: Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes.
- Principle 15: In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- Principle 16: National authorities should endeavour to promote the internationalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.
- Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

The project proponents are cognisant of and will abide by the international treaties and protocols. The principles of Agenda 21 that relate to this project will be applied throughout the project lifespan as necessary.

4.3.2 United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole. Jamaica is a signatory to and has ratified this treaty.

The Convention comprises 320 articles and nine annexes, governing all aspects of ocean space, such as delimitation, environmental control, marine scientific research, economic and commercial activities, transfer of technology and the settlement of disputes relating to ocean matters.

Some of the key features of the Convention that applies to this project are as follows:

- Coastal States exercise sovereignty over their territorial sea which they have the right to establish its breadth up to a limit not to exceed 12 nautical miles; foreign vessels are allowed "innocent passage" through those waters

- Ships and aircraft of all countries are allowed "transit passage" through straits used for international navigation; States bordering the straits can regulate navigational and other aspects of passage
- Archipelagic States, made up of a group or groups of closely related islands and interconnecting waters such as Jamaica, have sovereignty over a sea area enclosed by straight lines drawn between the outermost points of the islands; all other States enjoy the right of archipelagic passage through such designated sea lanes
- Coastal States have sovereign rights in a 200-nautical mile exclusive economic zone (EEZ) with respect to natural resources and certain economic activities, and exercise jurisdiction over marine science research and environmental protection
- All other States have freedom of navigation and over flight in the EEZ, as well as freedom to lay submarine cables and pipelines

DESCRIPTION OF THE ENVIRONMENT

5 Description of Bio-Physical Environment

5.1 Introduction

The project site is located within St. Ann adjacent its border with St. Mary at White River. The landing site is a reserved strip of white sand beach to the west of the mouth of the White River. This beach is primarily used by guest of the Golden Sands Beach Cottages. However, fishermen and marine interest in the area utilise the eastern end of the beach for docking especially as it relates to offering services to guest of Shaw Park Beach hotel, which is east and adjacent to the Golden Sands Beach Cottages Property.

A fibre-optic cable was previously landed at this beach in 1997. Currently there is little or no evidence of the cable in the environment being that is was buried in a trench across the property to the roadway (<120 m) and has buried itself in the marine environment over the years.

This landing site is typical of white sand beaches along Jamaica's north-coast. The impact zone is very minute. There are no vegetated areas between the beach and the roadways that stand to be impacted negatively. The environmental setting of the project site and immediate environs were assessed to determine the existing status of environmental resources prior to the laying of the cable. Aspects of the environment that were evaluated, were selected on the basis of the likelihood of the project impacting on these resources, and are discussed in full in this section of the document.

This section is informed in part by work done by various associates and agencies.

5.2 Physical Environment

5.2.1 Meteorology

Jamaica is surrounded by the Caribbean Sea and is located in the Tropics at approximately latitude 18ºN and longitude 77ºW. Among the most important climatic influences are the Northeast Trade Winds, the range of mountains which runs east-southeast to west-southwest along the centre of the island, the warm waters of the Caribbean Sea, and weather systems such as upper- and low-level low-pressure centres, troughs and cold fronts.

The cold fronts, usually weak after migrating from the North American continent, are evident from mid-October to mid-April; whilst the Tropical Weather Systems, namely Tropical Waves, Tropical Depressions, Tropical Storms and Hurricanes occur from April to December. The official hurricane season is from June to November.

Much of this data is provided by the Meteorological Office[1].

[1] Jamaica Meteorological Service, Climatological Data, Sangster International Airport

While there are variations in the weather patterns between the north and south coasts of the island, it is not envisioned that any of the parameters assessed in this section will have any negative impacts on this project.

5.2.1.1 Rainfall

Rainfall is the most variable of the climatic parameters exhibiting a bimodal nature. The thirty (30) year (1951-1980) average monthly rainfall values highlights the typical rainfall pattern for the region (Figure 5-1). The driest period runs from December to March and is associated with cold fronts migrating from North America. There are two distinct wet seasons, May to June and September to November occurring as regular yearly cycles.

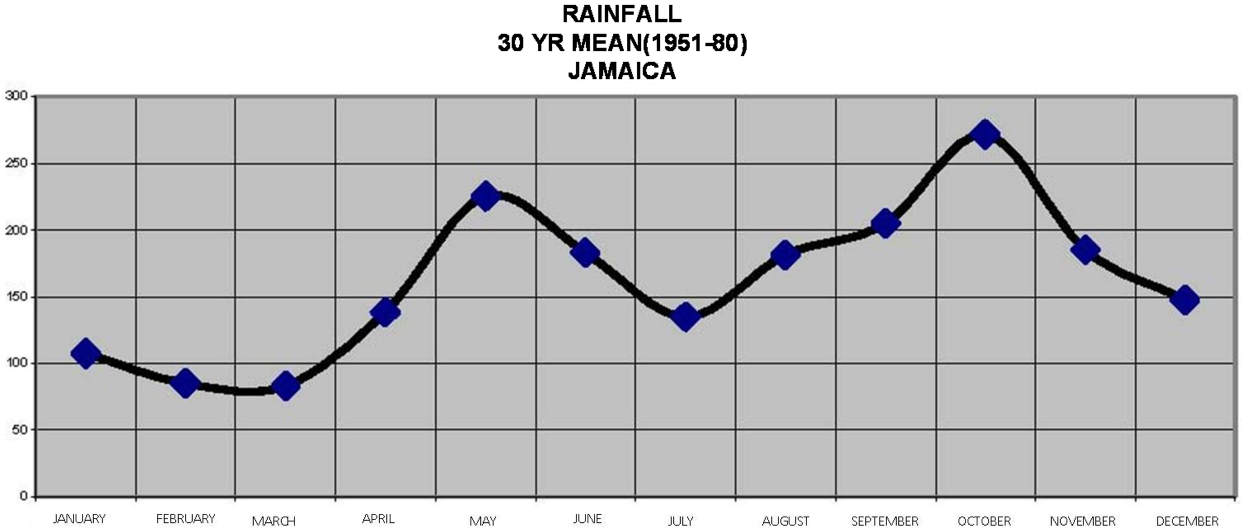


Figure 5-1: Jamaica 30 Year Rainfall Mean (1951-1980)

Of the weather parameters, rainfall is the most variable. Islandwide, during the period 1951 to 1980, annual rainfall ranged from a maximum of 2593 mm (102.09 in) in 1963 to a minimum of 1324 mm (52.13 in) in 1976, with an average of 1940 mm (76.38 in) annually. The hundred-year (1881-1990) mean annual rainfall is 1895 mm (74.61 in). Historically, the wettest year on record was 1933 with an annual rainfall of 2690 mm (116.54 in) whilst the driest year was 1920 with an annual rainfall of 1299 mm (51.14 in). Figure 5-2 shows the mean long-term mean rainfall for St. Ann for 1951-1980.

Weather during the dry or rainy season along with other rain-producing systems are influenced by the sea breeze and orographic effects which tend to produce short-duration showers, mainly during mid-afternoon.

The parish of St. Ann receives an annual average of 1596 mm of rainfall per year mainly during the rainy period, between the months of May and November. The driest period occurs from January through March, with less than 75 mm per month.

Figure 5-3 shows the yearly rainfall totals for the two (2) closest rain stations to the proposed landing site for the period 2000 to 2009. The data shows average annual rainfall for the period 2000-2009 to be 1885 mm and 1934 mm respectively for Cole Gate and Industry. Both stations are within 6 km of the proposed landing site.

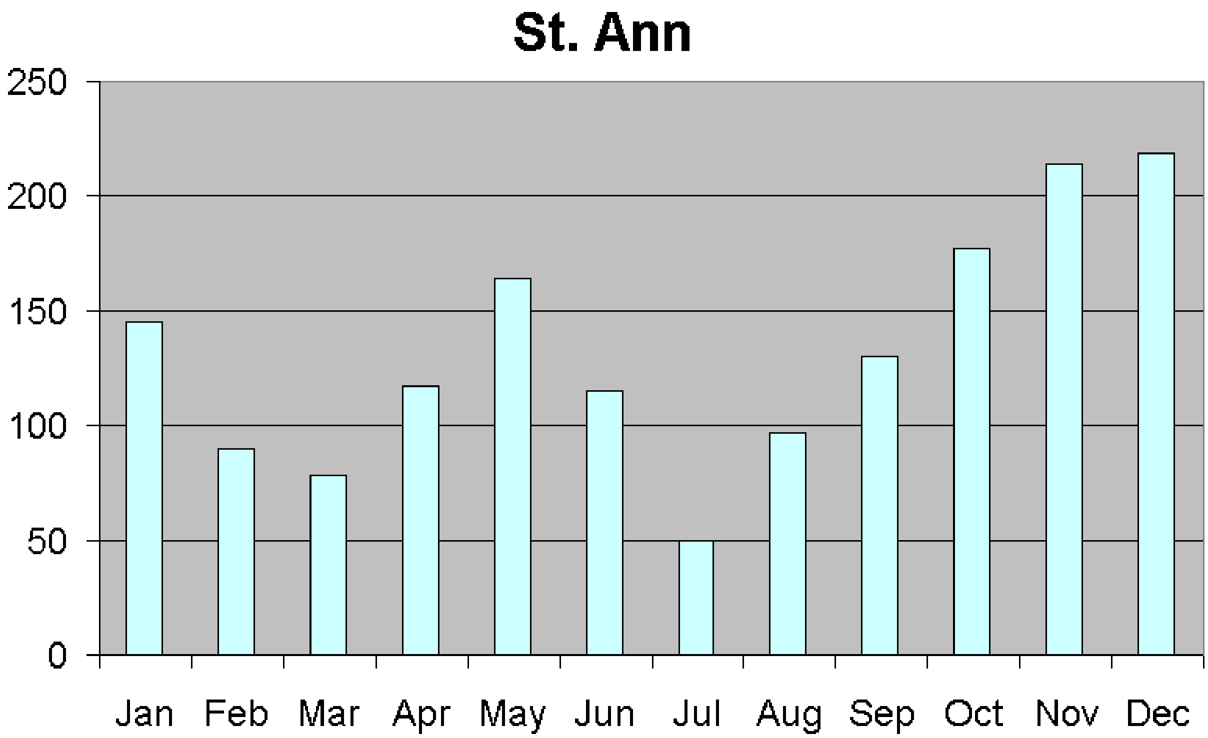


Figure 5-2: St. Ann Long-Term Mean Monthly Rainfall (mm) - 1951-1980

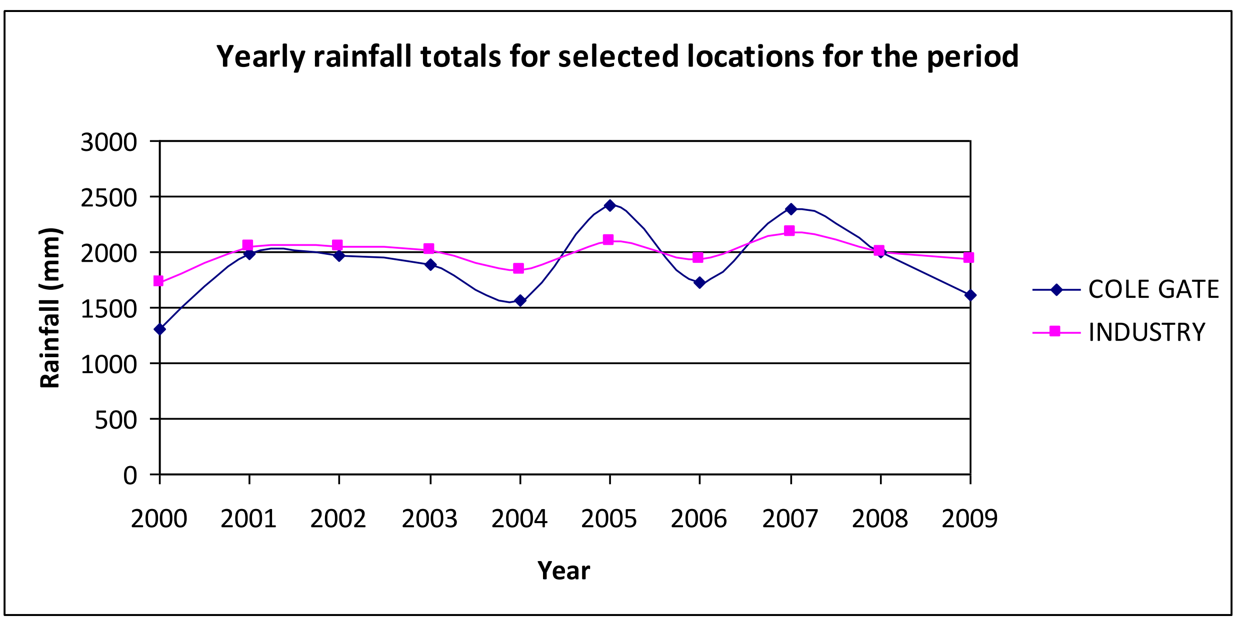


Figure 5-3: Yearly rainfall totals for Cole Gate and Industry in the parish of St. Ann [both stations are within 6 km of the proposed landing site]

5.2.1.2 Wind

The daily wind pattern is dominated by the Northeast Trades. During the day, on the North Coast, the sea breeze combines with the Trades to give an east-north-easterly wind at an average speed of 15 knots (17 miles per hour). In the period December to March, however, the Trades are lowest and the local wind regime is a combination of trades, sea breeze, and a northerly or north-westerly component associated with cold fronts and high-pressure areas from the United States.

By night, the trades combine with land breezes which blow offshore down the slopes of the hills near the coasts. As a result, on the North Coast, night-time winds generally have a southerly component with a mean speed of 5 knots (6 miles per hour). By day, from June to July, mean onshore winds often reach a maximum of up to 23 knots (26 miles per hour) along the North Coast during mid-afternoon.

Specific wind data was not available for the project area. The closest available data that could be considered reliable was from the Sangster International Airport in Montego Bay which is approximately 27 km (17 miles) to the west of the project area.

5.2.1.3 Temperature & Relative Humidity

Apart from rapid fluctuations associated with afternoon showers and/or the passage of frontal systems, the island's temperatures remain fairly constant throughout the year under the moderating influence of the warm waters of the Caribbean Sea.

In coastal areas, daily temperatures average 26.2 degrees Celsius (79.2ºF), with an average maximum of 30.3ºC (86.5ºF) and an average minimum of 22.0ºC (71.6ºF). The warmest months are June to August and the coolest December to February. Night-time values range from 18.9 to 25.6ºC (66 to 78.1ºF) in coastal areas.

Variations of sunshine from month to month in any area are usually small, approximately one hour. Differences, however, are much greater between coastal and inland stations. Maximum day-length occurs in June when 13.2 hours of sunshine are possible and the minimum day-length occurs in December when 11.0 hours of sunshine are possible.

Afternoon showers are the major cause of most daily variations in relative humidity. Highest values recorded during the cooler morning hours near dawn, followed by a decrease until the early afternoon when temperatures are highest.

Although relative humidity in coastal areas average 84% at 7 a.m., temperatures at this time are in the mid 20's (ºC), therefore, little or no discomfort results. At 1 p.m. the average relative humidity on the coasts is 71%.

5.2.2 Geological Resources

Elevations at the site increase gently from sea level along the shoreline to a maximum of 1.5 metres above sea level along the White River to Ocho Rios main road. The site is approximately 5 km east of Ocho Rios.

The beach is made primarily of white sand originating primarily from the coral reefs along the coast. Inland of the beach the soil consists of soft sand with intermittent silty-clay deposits. There is a minimal potential for erosion of soil materials at the site. The topsoil is on strong bedrock of limestone, possibly from the Hopgate Formation. The distance to the old road from the high tide mark is approximately 120 m.

The seabed is composed of sand and deposits of silty-clay brought down by the White River. The river has carved a fairly wide channel that shows overlapping layers of sand and silty clay on top of a hard rock substrate.

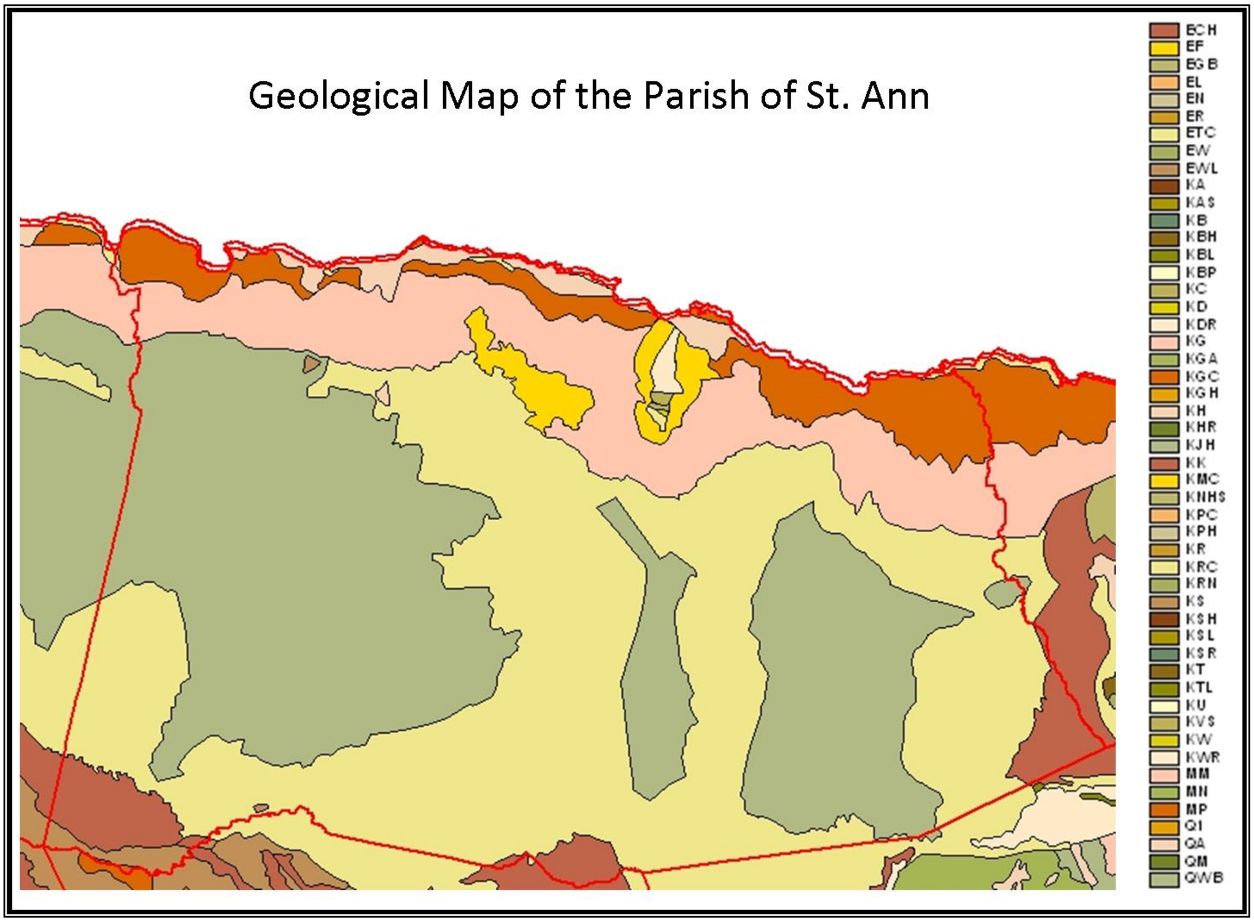


Figure 5-4: Geological Map of St. Ann Parish [Source: Geological Society of Jamaica]

5.2.2.1 <u>Bathymetry</u>

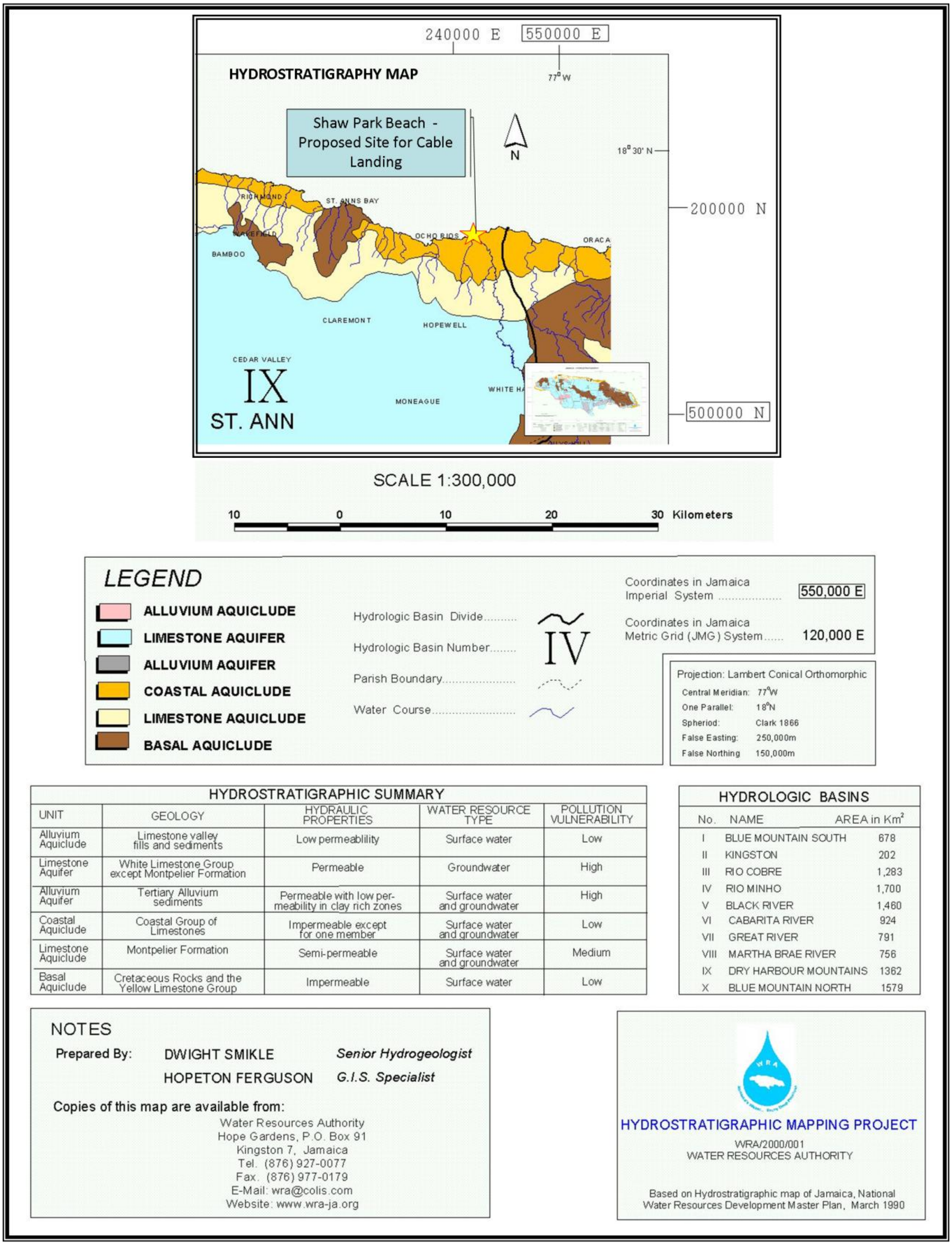
The inshore has a relatively, consistent declining slope substrate of white calcareous sand from near shoreline to approximately 800 m offshore. The area is made-up of soft sandy substrate.

Though a small fringing coral reef is in close proximity, the route alignment proposed will not infringe on this important ecosystem as it will be laid on the sandy channel bottom.

5.2.3 Hydrogeology & Groundwater Resources

The proposed landing site falls within a coastal aquiclude. This is a formation that does not transmit water and does not yield water readily to wells and springs. There is no potential for water resources development at Golden Sands Beach Cottages.

Figure 5-5 below outlines the hydrostratigraphic map of a section of the parish of St. Ann showing the hydrostratigraphic reference for the proposed landing site.



HYDROSTRATIGRAPHIC SUMMARY

UNIT	GEOLOGY	HYDRAULIC PROPERTIES	WATER RESOURCE TYPE	POLLUTION VULNERABILITY
Alluvium Aquiclude	Limestone valley fills and sediments	Low permeability	Surface water	Low
Limestone Aquifer	White Limestone Group except Montpelier Formation	Permeable	Groundwater	High
Alluvium Aquifer	Tertiary Alluvium sediments	Permeable with low permeability in clay rich zones	Surface water and groundwater	High
Coastal Aquiclude	Coastal Group of Limestones	Impermeable except for one member	Surface water and groundwater	Low
Limestone Aquiclude	Montpelier Formation	Semi-permeable	Surface water and groundwater	Medium
Basal Aquiclude	Cretaceous Rocks and the Yellow Limestone Group	Impermeable	Surface water	Low

HYDROLOGIC BASINS

No.	NAME	AREA in Km^2
I	BLUE MOUNTAIN SOUTH	678
II	KINGSTON	202
III	RIO COBRE	1,283
IV	RIO MINHO	1,700
V	BLACK RIVER	1,460
VI	CABARITA RIVER	924
VII	GREAT RIVER	791
VIII	MARTHA BRAE RIVER	756
IX	DRY HARBOUR MOUNTAINS	1362
X	BLUE MOUNTAIN NORTH	1579

Figure 5-5: Extract from the Hydrostratigraphy Map of Jamaica produced by the Water Resources Authority (WRA)

5.2.4 Natural Hazard Vulnerability and Risks

5.2.4.1 Earthquakes & Landslides

The ALBA-1 cable system is at risk of damage from seismic activity owing to the fact that it crosses two plate boundaries and because the landings are all in earthquake prone locations. This risk can be minimised by:

- optimal cable routing to avoid crossing side slopes - this minimises the cables risk of damage as a result of debris flows and avalanches
- careful design of slack in the cable system
- ensuring maximum cable armouring is applied in high risk areas
- earthquake "proofing" of all land structures and ducting

Golden Sands Beach is situated in a moderate earthquake zone in terms of frequency. Between 4 and 5 earthquake events of intensity greater than six (VI; Modified Mercalli Scale) have been reported in this fault area between 1874 and 1978. The probability of intensity VII was 0.39 for the period 1686 – 1986. However, it should be noted that there have been previous cable landings in this area without any adverse impacts due to the effect of earthquakes or other natural disasters. The risk of landslides is remote.

Figure 5-6 below highlights the concentration of earthquakes around the edge of the Caribbean plate boundary. Figure 5-7 outlines a close up for Jamaica.

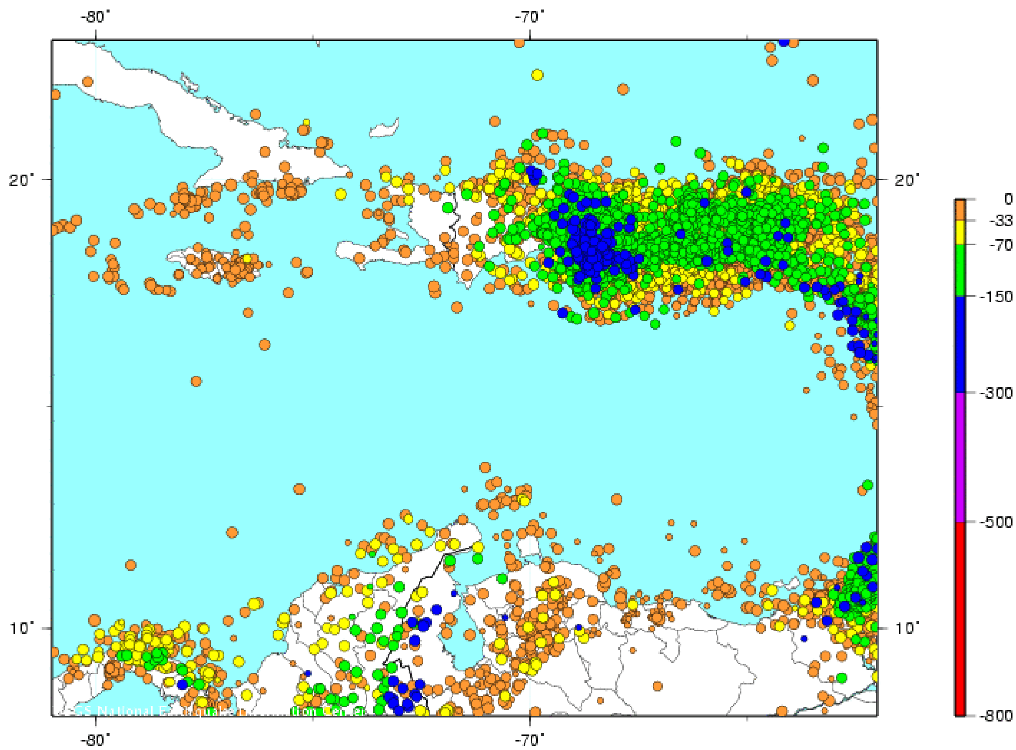


Figure 5-6: Map of significant earthquakes between 1973 and 2009 (scale – depth in meters) [(Source: http://neic.usgs.gov/neis/epic/epic_rect.html)]

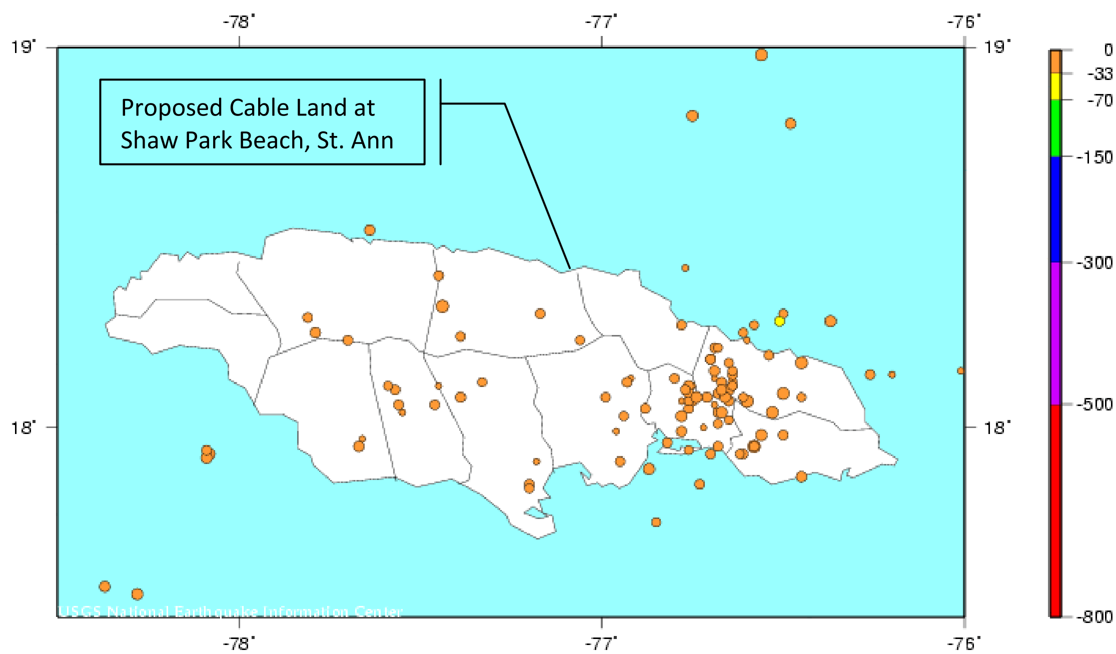


Figure 5-7: Map of significant earthquakes between 1973 and 2009 (scale – depth in meters) [(Source: http://neic.usgs.gov/neis/epic/epic_rect.html)]

5.2.4.2 Hurricanes & Storm Surge Potential

Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. Tsunamis are also a major risk.

Considerations have been given to issues related to storm water and potential for erosion during the construction and operational phases of the development. As such, a storm water management system, involving the use of drains, retention ponds and/or absorption pits has been recommended.

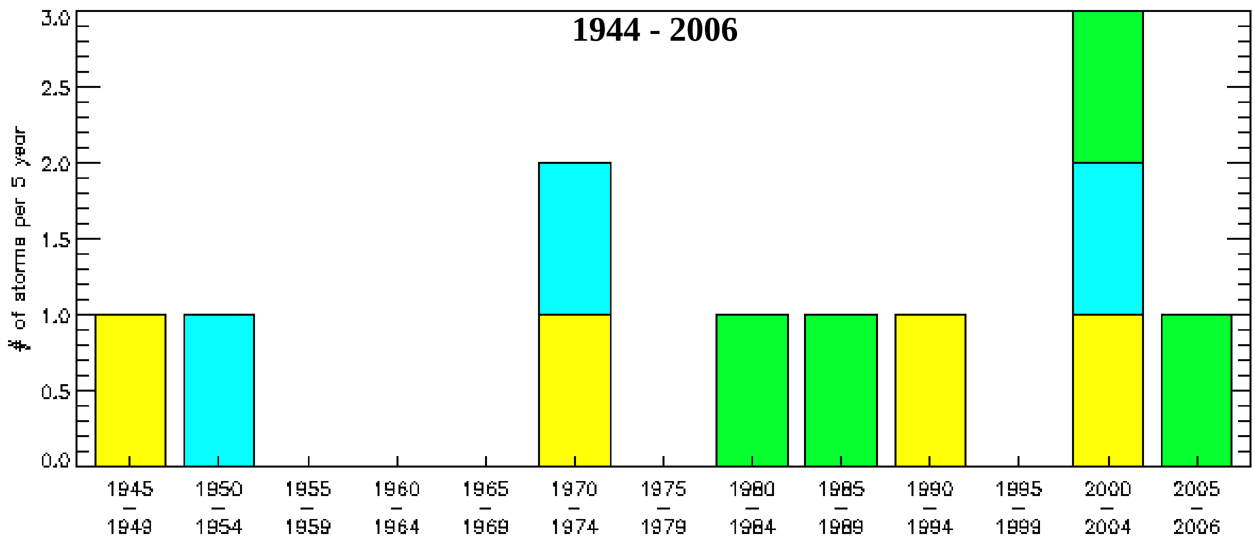
Using Sangster International Airport in Montego Bay as a reference point location: 18.50N 77.92W, all recorded tropical storm and hurricane activity over a period of 100 years are considered to estimate any trends related to the hurricane activity and the return period of such activities to the island[2]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

So far this year, no hurricanes have affected the island neither during 2009. However, the island was last affected during the 2008 cycle by Hurricane Gustav a tropical storm which crossed the island along the southern parishes. No significant storm surge activity was recorded along the north coast from this event. Storm surge is not considered a major problem at the proposed. It should be reiterated here that the cable is projected to be landed prior to the onset of the 2011 hurricane season. The 50 year return period for hurricane winds for the Montego Bay (the closest area modelled) is 49 m/s. This prediction is based on the TAOS predictions for storm surge for the "50-year return storm" by the Caribbean Disaster Management Programme project (1999).

Analyses of tropical systems passing within 60nm (= 60mi.) of the island is shown below. Latitude/longitude coordinates (18.50N, 77.92W) used is for Sangster International Airport, one of the island weather stations. Figure 5-8 shows whether there are more storms lately or which 5-year period in the last 60+ years was most active.

Figure 5-9 highlights the storm track and intensity of storm activity (hurricanes and tropical storms) within 60 miles of Jamaica for the period 2000-2008.

[2] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/



Most active 5 year period since 1944: **category 3-5 hurricanes: green; category 1-2: blue; tropical storms: yellow**

Most storms: 2000-2004 (4)
Most hurricanes: 2000-2004 (2)
Most severe hurricanes: 1980-1984, 1985-1989, 2000-2004, 2005 only (1)

Figure 5-8: Hurricane Activity for the Period 1944-2006[3]

[3] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm

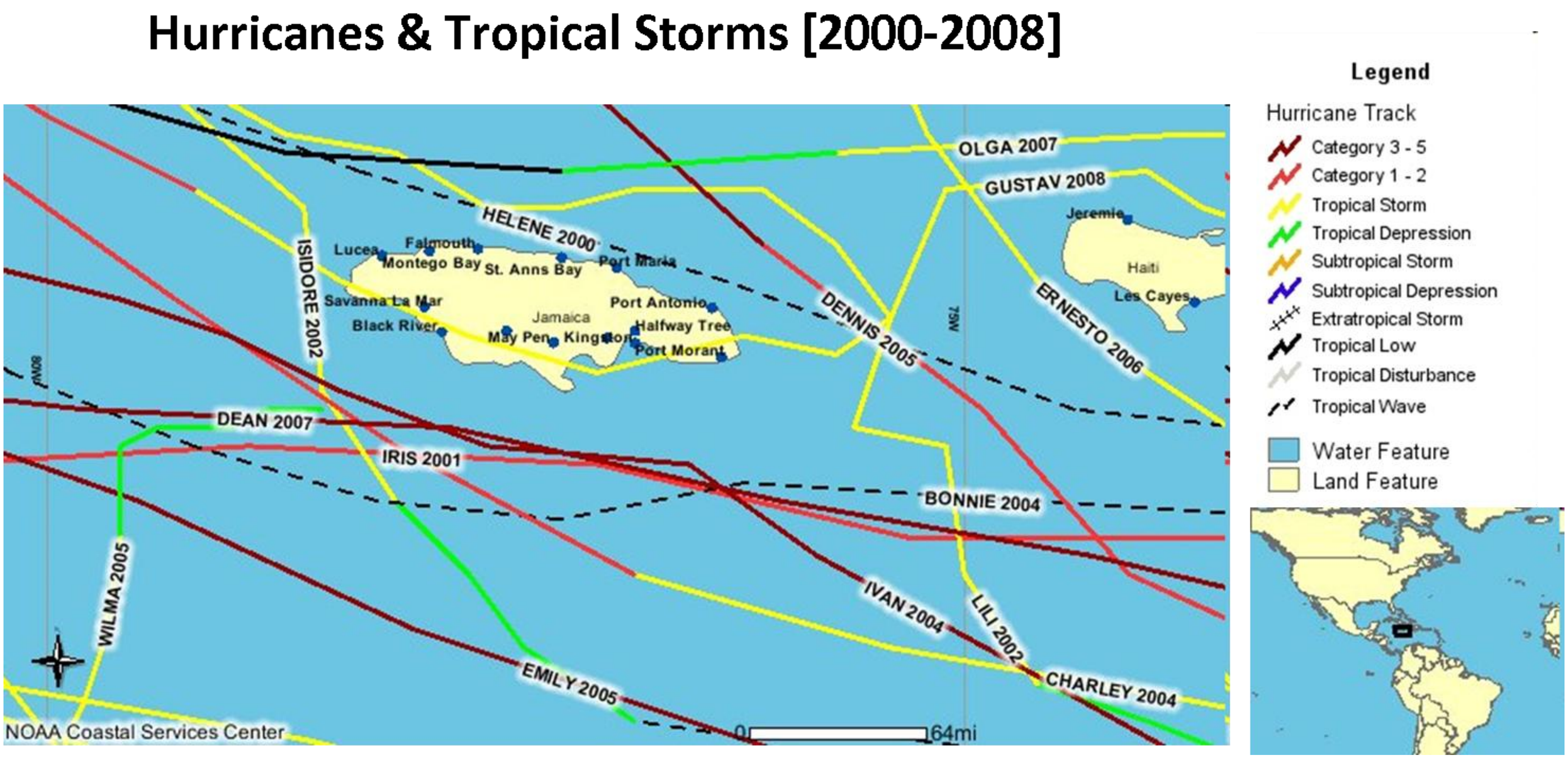


Figure 5-9: Hurricane & Tropical Storms that have passed within 60 mi. of Jamaica during the period 2000-2008[4]

[4] http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html

5.2.4.2.1 Scour

Scour is a lowering of the seabed below a previously determined equilibrium level, due to a localized divergence in the transport rate, around marine structures. Scour can jeopardize the integrity of the installation, where wave and current forces erode sediment.

For many seafloor structures scour is a hazard, for cables it is can often be beneficial. Cables can settle into the seabed due to their own weight aided by scouring of sediment from around the cable by waves and currents.

Cables are of a sufficiently high density (2.8-4.2 kgm^{-3}) to self-bury into the sediment. However, the self-burial by scour is of the order of one to three times the cable diameter, i.e. relatively small but this can help reduce the risk of damage.

Movement of the cable on the seafloor, by current or wave action causes abrasion. It is recommended that, in the surf zones, additional cable protection measures, such as articulated split pipe, be considered. With the addition of split pipe the density of cable is increased to approximately 6.0 kgm^{-3}. With the density of the cable increased the movement of the cable by wave action is drastically decreased, thereby limiting abrasion and risk of damage to the cable.

5.2.4.3 Riverine & Flash Flooding

Assessing whether an area is prone to flooding or not, not only requires a hydrostratigraphic assessment of the area (as presented earlier), but also the collection of physical data such as rainfall run-off patterns, topography and information obtained from actual flooding events (especially as perceived by individuals who reside or frequent the area during such events) over a statistically appreciable period. Such information is not readily available from relevant statutory agencies in a compiled an organized format and is beyond the scope of this Environmental Impact Assessment. However, broad conclusions may be drawn from what is available, including informal reports of flooding, or the absence thereof.

It is estimated that the proposed landing site is located in an area where the soil is permeable to semi-permeable. Permeability or semi-permeability of the areas implies that water should percolate through the ground and drain into the underlying aquifers or aquicludes. Hence, in the absence of extreme weather conditions, namely heavy consistent and prolonged rainfall, the mentioned areas should not flood readily.

No incidence of flash flooding is known to occur at this location

5.2.4.4 Damage to Cable & Damage from Cable

Based on the medium of operation (water) the cable is likely to be affected by any wave action that is generated from aggressive deep water movement due to storm surges and tectonic activity. Extreme occurrences of either of these events could cause unlikely cable failure through abrasion and or instantaneous or gradual extension of the cable beyond the elastic limits of its component materials. However, as with every event, there is a threshold required for noticeable occurrence and also a limit at which the event will cause unfavourable results; therefore, it is arbitrary to assume that any storm surge or tectonic activity will cause any unlikely cable failure. Although there is no pragmatic way to define exactly what level of displacement in the sea floor (vertical and horizontal) or what type of storm surge will generate a certain definable stress on the cable, it is statistically possible to conclude from Table 5-1 that both abrasion and tectonic activity rarely causes cable failure. Implicit in the data, is the fact that these events rarely generate the forces required to exceed the limits of the cable materials' strength. Therefore, one can assume that the combined material strength of the cable materials have been designed to withstand common abrasion forces resulting from water movement, and the effects of common minor plate movement. Keep in mind that there are miles of this type of cable deployed worldwide under a wide variety of marine and seismic conditions that are fully functional.

The deep shore aspect of the cable operations can be generally regarded as unaffected by storm surges. Storm surges do not usually disturb the ocean bottom in deep waters by virtue of deep water depth in relation to the volume of water that is displaced. However, pronounced effects are estimated as likely for near-shore operations as the cable makes the transition to onshore operations. However, as stated earlier, it is difficult to correlate storm surge magnitude with sustainable cable integrity – one can only assume that cable breakage is unlikely to occur due to the design and established track record of the industry. Cable breakage is unlikely in and of itself to result in environmental degradation or negative environmental impacts.

Table 5-1: Percentage of Failure Causes for 380 Reported Cable Faults

Cause	Count	%
Abrasion	18	4.7%
Anchor	49	12.9%
Branching Unit	2	0.5%
Cable or Survey Ship Activity	5	1.3%
Dredging/Drilling and Pipe Installation	12	3.2%
Earthquake or Seabed Movement	10	2.6%
Equaliser	1	0.3%
Fatigue	1	0.3%
Fishing Activity	184	48.4%
Impact by Hard Object	5	1.3%
Insulation Failure	3	0.8%
Jointing Box	5	1.3%
Manufacturing Defect - Cable	4	1.1%
Repeater	17	4.5%
Unknown - Cable Deliberately Cut	1	0.3%
Unknown - Cable Mauled	6	1.6%
Unknown - Cable not repaired	1	0.3%
Unknown - Fibre Attenuation	5	1.3%

Cause	**Count**	**%**
Unknown - Kinks, Twists, Loops	9	2.4%
Unknown - Shunt Fault	31	8.2%
Unknown - Tension Break	11	2.9%
TOTAL	**380**	

5.2.5 Fishing Related Risks

Various fishing efforts such as trawling, bottom set gillnetting, bottom long lining, and purse seining are responsible for the majority of cable faults caused by fishing. Bottom trawling is believed responsible for the largest number of fishing related cable faults and represents the most substantial fishing hazard to cables. Bottom set gill nets and longlines represent a minor hazard since the gear, composed of relatively light breaking strength materials, generally does not penetrate the seabed much. Purse seines, if used with lightweight grapple anchors, could foul on the bottom. Survey and installation operations may also be affected by the fishing methods.

In Jamaica commercial fishing by vessels that are of a size to pose a serious threat to a cable system work almost exclusively on the Pedro and Morant Banks and therefore large fishing vessels do not pose a threat to the ALBA-1 cable system landing at Golden Sands Beach in the Parish of St. Ann on the north-coast. Additionally the bottom trawling method is reported as only being actively used off the south coast of Jamaica. Small-scale (using vessels less than 8.4m long) commercial fishing is active along the north coast of Jamaica and this includes the hook and line method. Small scale and artisanal fishing does not represent a hazard to the installed cable; however it may affect the cable route survey and subsequent cable installation.

For the duration of the cable route survey all marine interest were informed, particular fishermen from the White River fishing community. No incidences were reported and mutual, daily informed dialogue took place. This procedure will be repeated once approval has been received for the installation of the cable. Continued liaison with the Fisheries Department (Ministry of Agriculture) and local fishermen will ensure no incidences occur. In shallow water off the Jamaican coast the low threat from fishing activities means additional mitigation measures are not deemed necessary to protect the ALBA-1 cable system from fishing related threats.

5.2.6 Marine and Land Traffic Analysis

The closest port to the Jamaican Segment 2 landing is the Port of Ocho Rios to the west. There is only one charted designated anchorage area in the vicinity of the ALBA-1 cable system on the Jamaican coastline. This is within the area covered by the Ocho Rios Port Authority and is of sufficient distance from the ALBA-1 cable route. It does not represent a threat to the ALBA-1 cable.

There is no consideration for land traffic because the extent of this assessment involves laying the cable in the marine environment and subsequent termination into a beach manhole just outside the hotel property on the old north-coast roadway.

5.3 Biological Environment

5.3.1 Introduction

Alcatel-Lucent Submarine Networks (ASN) intends to deploy a fibre-optic cable on the seafloor between Venezuela and Cuba, a leg of which will transit the Jamaican island shelf and make landfall at Golden Sands Beach in Ocho Rios.

An alteration has been proposed for a previously submitted route (Plate 5-2) for the Alcatel-Lucent Submarine Networks (ASN) fibre-optic cable into Shaw Park Beach in Ocho Rios. The rationale for the newly proposed route was that it was found more environmentally conservative, efficient and economical for ASN to implement the cable lay. The proposed alterations to the route to be taken by the cable over the north coast island shelf are outlined on Plate 5-1 below.

Plate 5-1: Newly Proposed Route

Plate 5-2: Previously Proposed Fibre Optic Cable Routing for landing at Shaw Park Beach – Ocho Rios (A-proposed alignment)

Further to the investigations carried out in June 2010, field investigations for the marine assessment of the seafloor environment were carried out on the newly proposed cable route, along with a representative section of adjoining marine environment. This was conducted in October 2010.

The purpose of the assessment was to determine whether or not there were any sensitive or otherwise important marine resources that could be impacted by the deployment of the marine cable. In addition, the assessment served as a basis for the development of any mitigative actions that would be required to ensure an environmentally sound deployment. The study area in which the assessment was carried is shown in Plate 5-3.

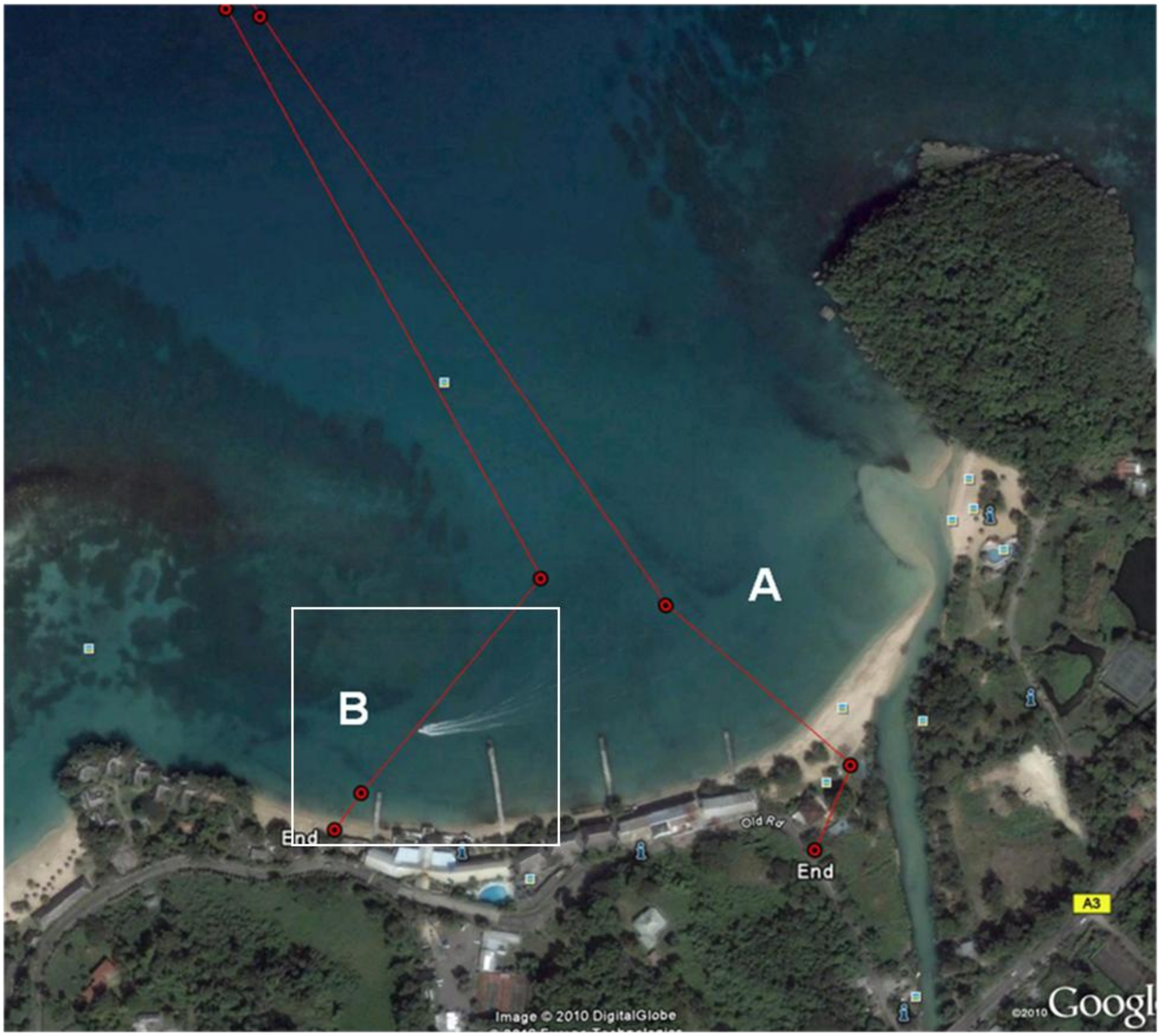


Plate 5-3: Google Earth Image With Overlaid Route of Previously Proposed Fibre-optic Cable Route and Landing Area at Shaw Park Beach (A), Currently Proposed Route (B) and Study Area (box).

5.3.2 Methods

5.3.2.1 Marine Environment Characterization

Air photo interpretation techniques were utilized to characterize marine substrate/life-form differences and their spatial extents. The baseline information used for interpretation was as represented on GoogleEarth images of the study area (defined in Plate 5-3). The GoogleEarth images were geo-referenced to the JAD 2001 projection/coordinate system and manipulated using Mapmaker Pro GIS software prior to being interpreted.

Following the initial characterization of GoogleEarth images, ground truthing was conducted with the aid of SCUBA, with video being the primary tool for field data capture. Data collection efforts were focused initially around obtaining videos along the proposed cable alignment.

Waypoints for the alignment were plotted into a Garmin Global Positioning System (GPS), which was used as a navigation aid by a supporting dive boat. The dive team used the dive boat as a reference for underwater navigation along the proposed alignment. Video information was captured of the entire proposed cable alignment, extending from the point where the cable intersected the island shelf (at a depth of approximately 40 meters) to shore.

Following the verification of the character of the seafloor along the cable route, 6- 33 meter long video transects were distributed over hard substrate areas interpreted from the GoogleEarth images. The transects were initially used for the capture of information on fish populations existing within the study area using video aided fish assessment methods devised by the Atlantic and Gulf Rapid Assessment project[5] (see Plate 5-4 below).

Plate 5-4: Photographic Description of Video-Aided AGRRA Fish Assessment method

Immediately following this, the same transects were used to guide the capture of vertically oriented video information for the benthic lifeforms existing within the area, using methods

[5] www.agrra.com

designed for the Caribbean Planning and Adaptation to Climate Change project[6] (see Plate 5-5 below)[7].

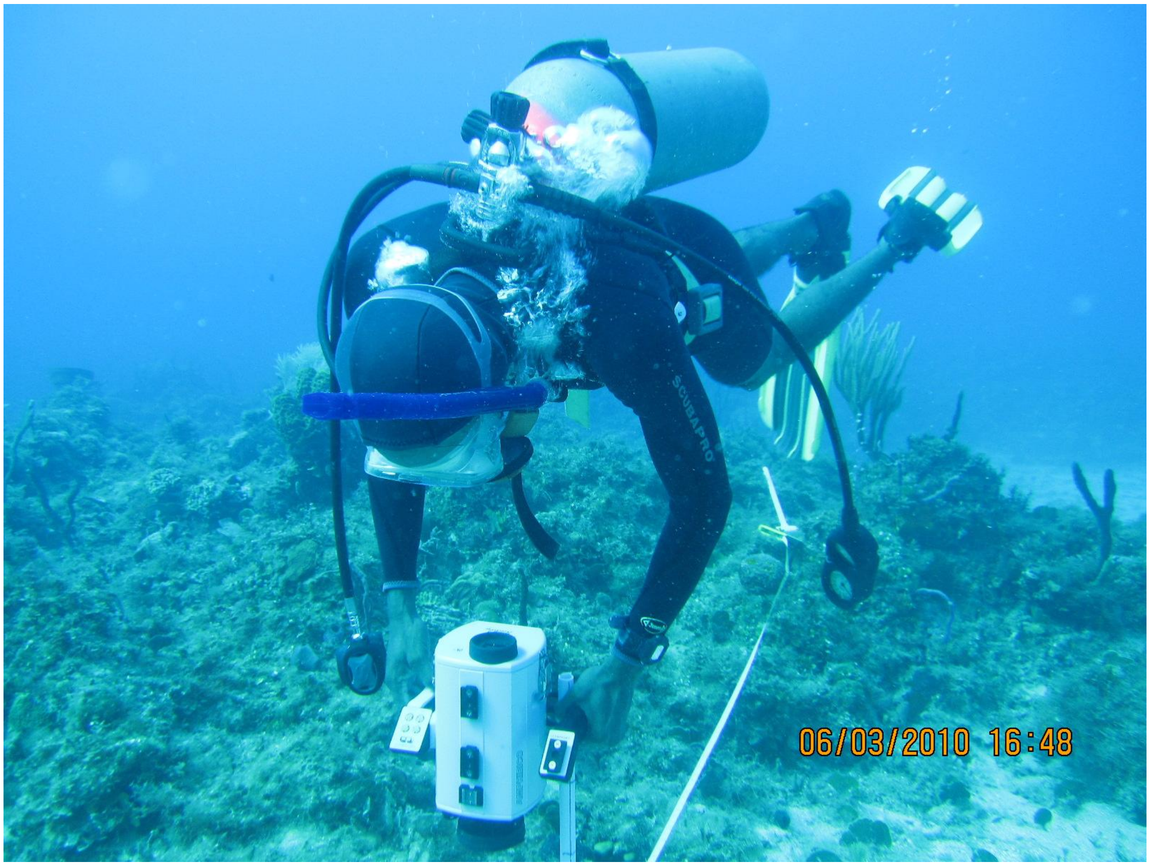


Plate 5-5: Photographic Description of CPACC Benthic Data Capture Method

Further, vertically oriented still photography techniques were used for the assessment of life-forms existing within areas interpreted as having soft substrates along the alignment of the proposed cable, with representative 1x1 m PVC quadrat frames being used for the estimation of densities of life-forms found within this area. Mapmaker Pro was used to generate a 10 cm x 10 cm grid over each of the quadrats photographed. A random selection of 20 of the 100 10 cm x10 cm grids within each quadrat was then examined and individual shoots counted. Simple proportion calculations were then used to extrapolate numbers up to the total area of the quadrat.

All vertically oriented images obtained for benthic resources assessments were analysed with the assistance of CPCE[8] and Mapmaker Pro software.

[6] www.cpacc.com

[7] Video-based assessments of hard substrate areas within the study box were limited due to the fact that the dive team had to coordinate in-water work with a survey vessel that was utilizing high energy SONAR for bathymetric surveys. The SONAR generated by the equipment would have been hazardous to the dive team. A total of 6-33 meter long transects were surveyed.

[8] www.nova.edu/ocean/**cpce**/index.html

5.3.2.2 Water Quality

Three sets of water samples were obtained within the water column along the alignment of the proposed fibre-optic cable. These samples were analysed for turbidity, total suspended solids, temperature and pH.

5.3.2.3 Oceanography

Research work done in the Kingston Harbour[9] has suggested that there are three primary engines for water movement within the embayed marine environment. These are:

1. Wind-induced movement
2. Tidally-induced movements
3. Water Density – related movements

For Kingston Harbour, tidal movements played a minimal role in the movement of water within that system. The dominant water moving forces were wind, followed by movements influenced by the differences in density between freshwater discharged from drainage systems and seawater. The dominant influences on the direction in which water would move would be a function of wind direction and the refractive forces dictated by bathymetry.

It was surmised that the driving and directional forces outlined above would be relevant to the study area, and as such, information that would suggest the following were obtained:

1. The direction from which the prevailing wind was blowing at the time of data collection, as obtained from the Met Services of Jamaica website.
2. The direction to which water would be moved under the influence of the wind, as illustrated on Google Earth (June 2002) images.
3. The direction of freshwater movement from the White River, which discharges into the bay – as illustrated on Google Earth (June 2002) images
4. Diver-deduced water movements recorded at depth within the bay area.

These patterns were then used to generate a summarized diagram of water movement within the bay area.

5.3.2.4 Generalized Characterizations and Identification of Alternative Landing Sites

In addition to the substrate characterizations done for the project area (defined on Figure 2), additional characterizations were done with the aid of Google Earth images. The geographical extent of the characterization progressed from the current project area eastwards to the Rio

[9] **Williams**, **Doreen**. 1997: The impact of coastline change and urban development on the flushing time of a coastal embayment, **Kingston Harbour**, Jamaica -MPhil Thesis UWI Mona.

Nuevo bay area and was done in an attempt to identify other potential landing routes for the proposed cable.

5.3.3 Findings

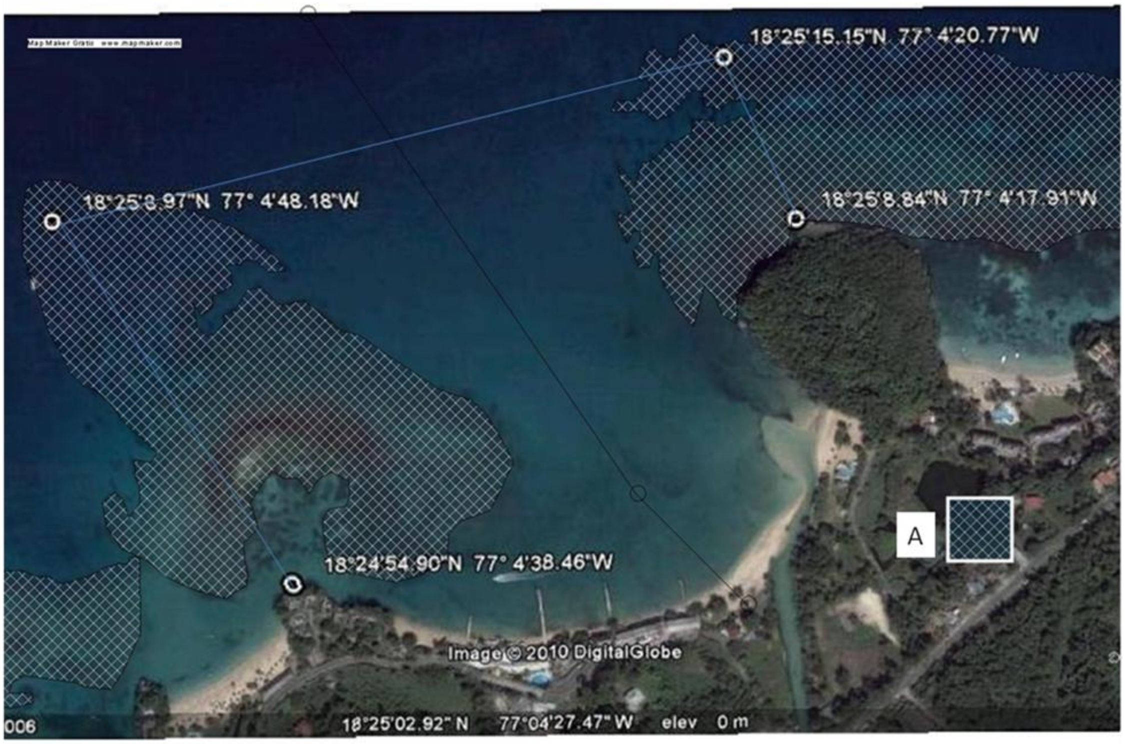
5.3.3.1 Marine Characterizations

5.3.3.1.1 Seafloor Substrate Spatial Analysis

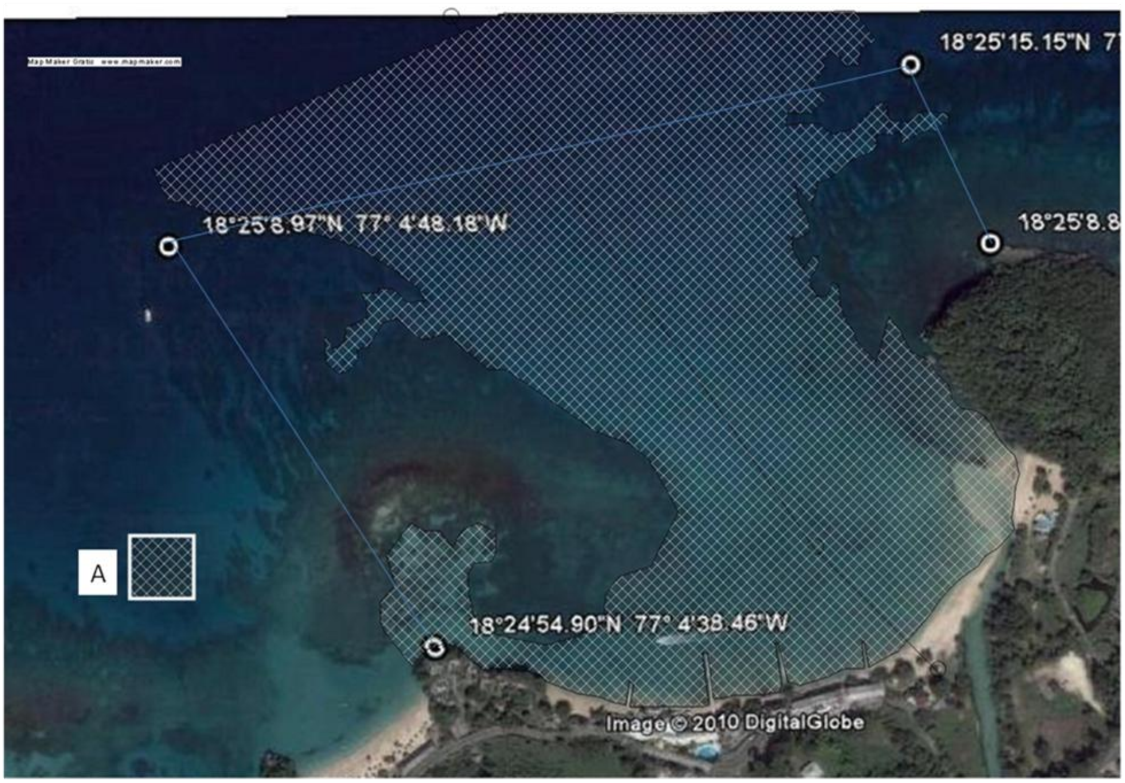
Plate 5-6 illustrates the distribution of marine substrate types within the project study area. Diving-assisted ground truthing confirmed the presence of two hard substrate systems of a carbonate composition towards the eastern and western boundaries of the study area (see Plate 5-6 Part A). Both hard carbonate systems vary in depth from emergent towards their southern extent to greater than 20 meters depth as they approach the island shelf towards the north.

Sandwiched between the two hard carbonate systems is an area of fine grained marine carbonate sand (see Plate 5-6 Part B), which is contiguous with a beach area immediately adjoining the Shaw Park Beach area and extends underwater to the island shelf approximately 900 meters to the north. At the island edge, this sandy area descends along a 45 degree slope from a depth of 24 meters to depths beyond 40 meters. Within this sandy slope, between depths of 33-40 meters, scattered hard carbonate outcrops of a diameter of up to 5 meters were observed.

Based on these interpretations, the proposed cable route will be positioned predominantly over soft marine substrates.



A - Hard Marine Carbonate Substrates Present Within the Project Study Area (A).



B - Soft Marine Carbonate Substrates Present Within the Project Study Area (A)

Plate 5-6: Seafloor Characterisation

5.3.3.1.2 Seafloor Lifeform Spatial and Status Analysis

Plate 5-7 illustrates the distribution of attached benthic marine life-forms within the project study area.

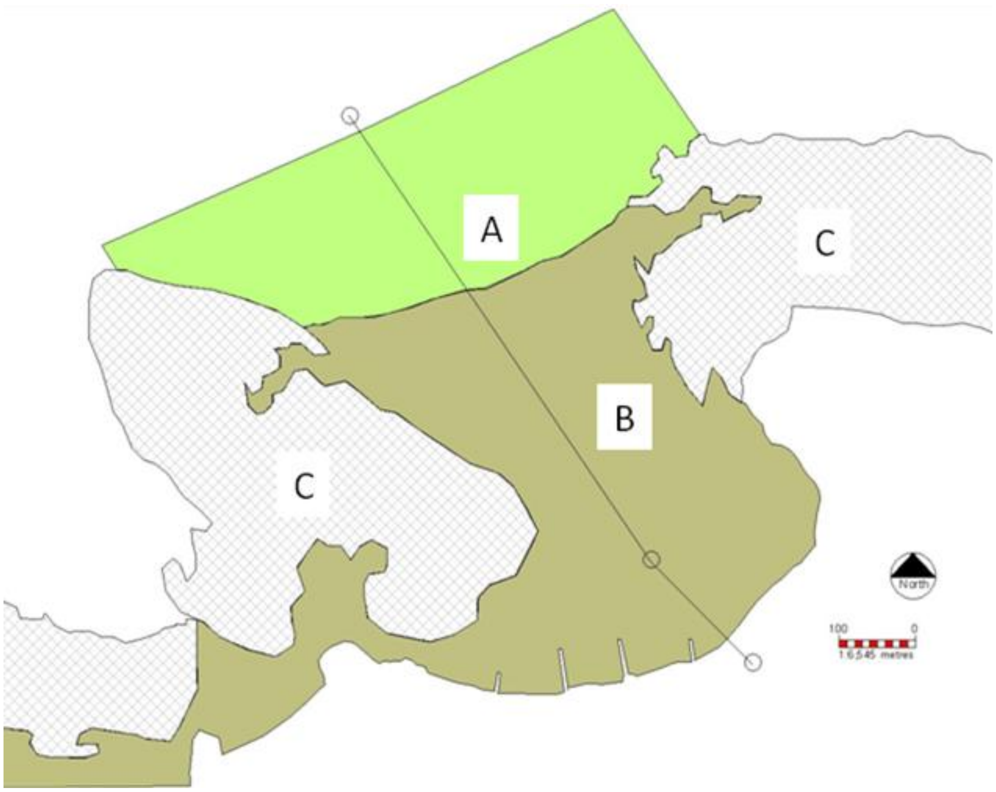


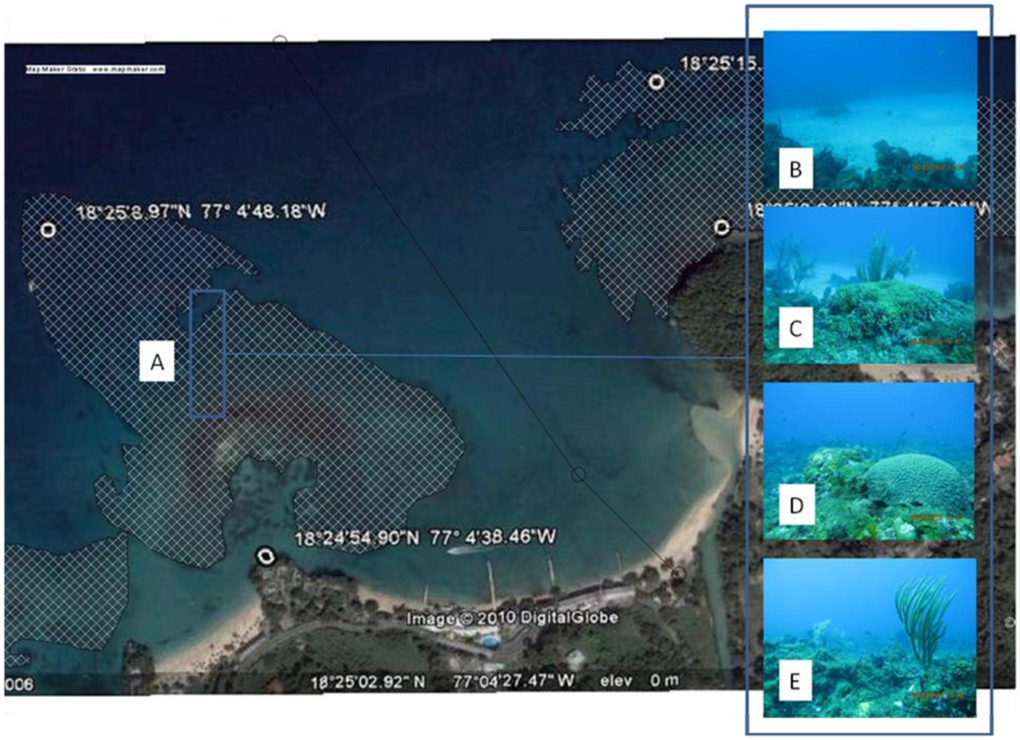
Plate 5-7: Attached Benthic Lifeforms [Areas shaded as: (A) Seagrass, (B) None, (C) Coral Reef Benthics]

Plate 5-8 illustrates the types of attached benthic lifeforms found within the coral reef areas present in the study area. CPCE analysis of video information obtained within both reef areas bordering the proposed cable alignment revealed the presence of four categories of attached benthic lifeforms, namely:

1. Macro Algae
2. Hard Corals
3. Soft Corals
4. Sponges

CPCE percentage cover analysis indicated the following percentage coverages:

1. Macro Algae -77%
2. Hard Corals -8%
3. Soft Corals -6%
4. Sponges -9%



A. Examples of Attached Benthic Life-forms Within the Western Hard Substrate Area (A) Area Surveyed (B-E) Life-form examples observed along video transects run within the surveyed area

B. Examples of Attached Benthic Life-forms Within the Eastern Hard Substrate Area (A) Area Surveyed (B-E) Life-form examples observed along video transects run within the surveyed area

Plate 5-8: Benthic Life-Forms within the Hard Substrate Areas

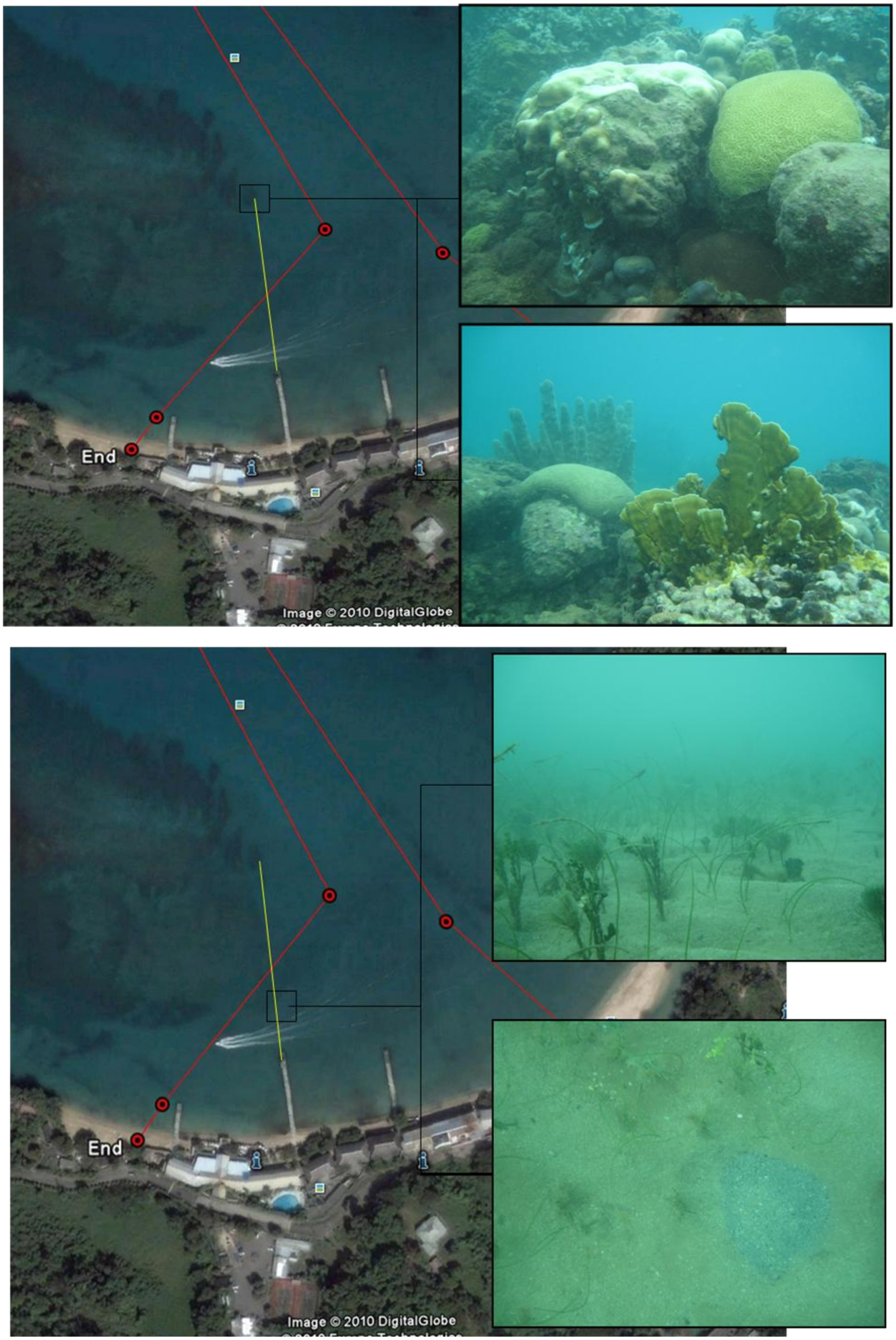


Plate 5-9: Benthic Life forms found within the study area (box)

Plate 5-10 illustrates the type of attached benthic life-form found within the soft substrate areas present in the study area. Manatee Grass (*Syringodium filiforme*) was the sole attached benthic life-form found within this area with its distribution being confined to depths between 11 metres to 24 metres. Depths shallower than 11 metres had no attached benthic life-forms existing on the seafloor.

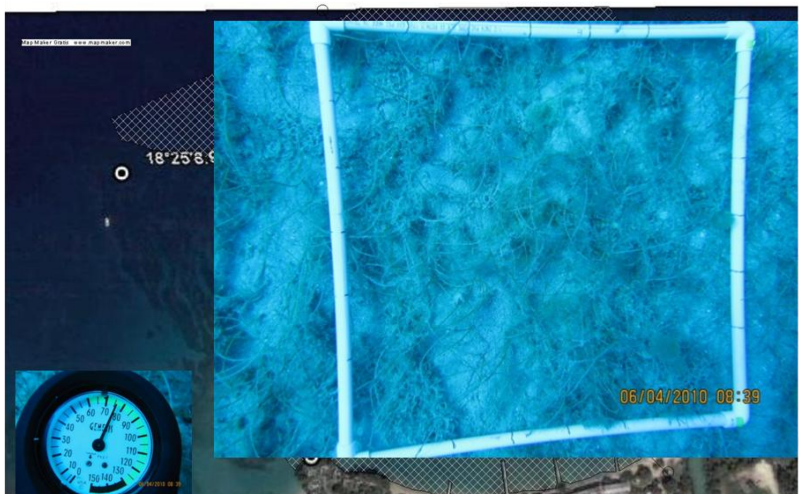
The densest distributions of Manatee Grass were found at depths of approximately 12 m, with these densities decreasing with depth. Densities calculated from 1m x 1m photo-quadrat assessments made within the seagrass beds revealed the following estimated densities:

1. At A - 24m depths, shoot density = 585 per square meter
2. At B - 15m depths, shoot density = 1416 per square meter
3. At C - 12m depths, shoot density = 3120 per square meter

The densities observed were expected with shoot densities increasing with illumination due to decreasing depth.

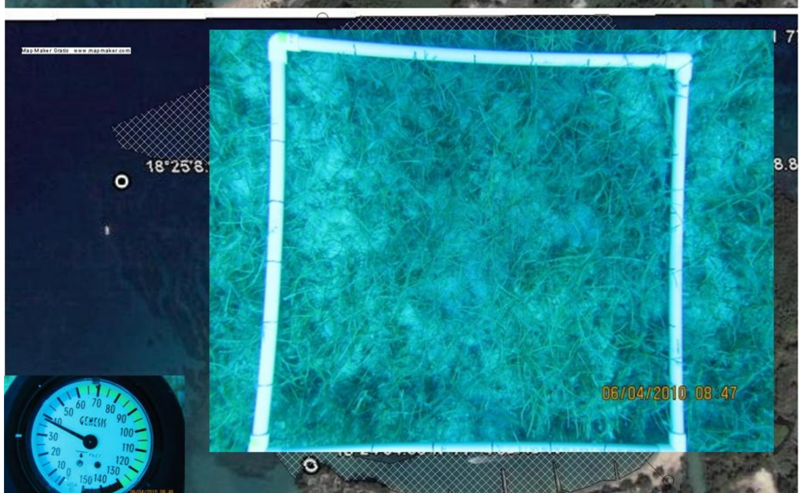
The densities observed were expected with shoot densities increasing with illumination due to decreasing depth.

Plate 5-10: Density of Manatee Grass (*Syringodium filiforme*) at various depths within Study Area



Seagrass (Syringodium filiforme) sampled at approximately 24m

Seagrass (*Syringodium filiforme*) sampled at approximately 15m



Seagrass (*Syringodium filiforme*) sampled at approximately 12m

Plate 5-11: Close up of Seagrass densities in the study area

5.3.3.1.3 Mobile Life-form Spatial and Status Analysis:

The most prominent mobile life-forms observed on the reef areas peripheral to the project area were marine reef fish. Plate 5-12 illustrates the types observed during the study period. No obvious benthic mobile life-forms (including sea urchins, brittle stars and sea cucumbers) were observed during the survey, with the exception of the Spiny Lobster (*Panulirus argus*).

Plate 5-12: Mobile Marine Life Observed Within Reef Areas Adjoining the Proposed Cable Route [Images are internet photos]

It must be noted that the invasive Pacific Lionfish was observed on the reef within the study area during the survey (Plate 5-13).

Plate 5-13: Lionfish Observed Within Reef Areas Adjoining the Proposed Cable Route

There was a scarcity of both mobile benthic and free-swimming life-forms observed on or over the sandy substrates along the proposed cable route. Over the approximately 800 meters of proposed alignment surveyed, one Ocean Trigger fish (Plate 5-14) of approximately 30cm in length, one Stingray of approximately 30cm in diameter, and two schools of Ocean Surgeon Fish juveniles numbering less than 20 individuals each were observed. The Surgeon Fish juveniles were aggregated around two sunken logs on the seafloor. Several Sea Cucumbers and Starfish (one genus of each - genus and species unidentified) were observed on the seafloor.

Plate 5-14: Examples of Mobile Marine Organisms Found Along Proposed Cable Alignment

5.3.3.2 Water Quality

Table 5-2 outlines the water quality trends for three water quality parameters identified for investigation. Turbidity within the bay was relatively low except for near the shore and this is seen in the clear images taken of benthic and mobile organisms. The values seen at the nearshore are possible due to in water activities by boats and humans that were using the area. It should be noted that the area is generally very clear.

The high dissolved oxygen represented near the shore is possible due in part to the surf zone near the shore as well as the mixing of freshwater and seawater due to the White River emptying in close proximity. pH values were consistent throughout. These values do not represent any cause for alarm; neither will the project result in a worsening of these conditions in the long-term. Turbidity is the only factor likely to be affected by project activities and this will be addressed through the mitigation options outlined in this report.

Plate 5-15 represents the locations from which water samples were collected subsurface by divers conducting the marine survey.

Table 5-2: Water Quality Parameters Tested

POSITION	Water Quality Parameters			
	Turbidity [NTU]	Dissolved Oxygen [mg/L]	pH	Depth [m]
18° 24' 56.02"N 77° 04' 21.63"W	6.3	8.4	8	<2
18° 25' 04.88N 77° 04' 28.97W	1.3	2.5	8.4	11
18° 25' 15.91"N 77° 04' 34.70"W	1.1	1.7	8.3	15

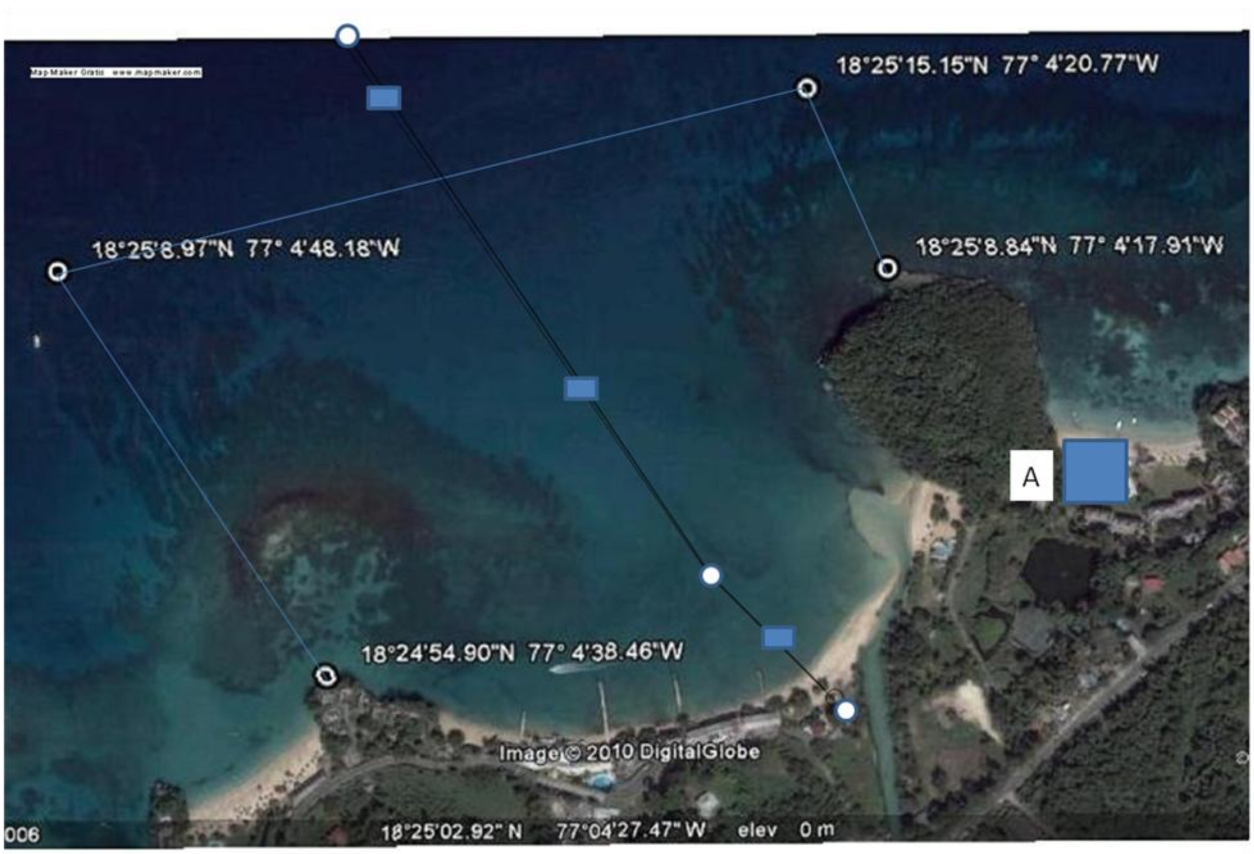


Plate 5-15: Subsurface Sample Locations for Water Samples Taken

5.3.3.3 Oceanography

Plate 5-16 illustrates the path of water movement, symbolized by wave movement, as influenced by prevailing winds, which on the Google Image were originating from an easterly direction – similar to the forecast predicted for Ocho Rios during the time of the assessment works. Offshore, the general movement of seawater, as influenced by wind, is towards the west. As proximity to shallower areas nearshore is reached, a process called refraction occurs; this ultimately turns the moving water body towards the shoreline.

Wind primarily exerts its influence on the upper portions of the water column, thus the water movements illustrated in Plate 5-16 can be described as surface water movements.

Diver-facilitated observation of subsurface water movements suggested an outward movement of water from the bay, as illustrated in Plate 5-17. This would make sense, considering that if water moves into a confined space, it has to evacuate that space at some point in time. It appears that wind-influenced water movement occurs into the bay at the surface, with the inbound water evacuating the bay by subsurface means.

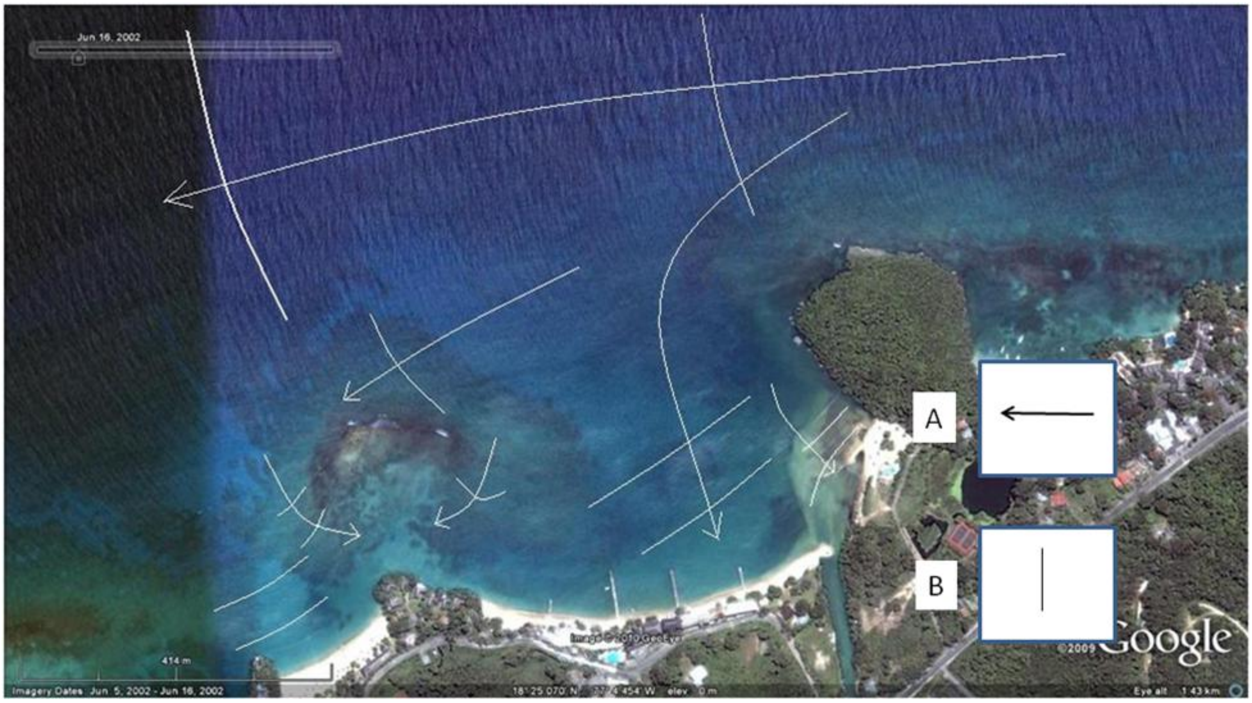


Plate 5-16: Surface Water Movement as Influenced by Prevailing Easterly Winds (A) Orientation of Wave Crests (B) Direction of Wave Movement.

Plate 5-17: Diver-deduced Sub Surface Water Movement within the Study Area (A) Approximate Subsurface water movement direction.

Aerial Imagery assessments of June 2002 Google Earth images suggested that a plume of surface bound fresh water discharged from the White River exited the Bay from its eastern extent, as illustrated in Plate 5-18. The path of the plume was defined by the extent of turbid water interpreted as exiting the mouth of the River. It is anticipated that a localized current movement would be established at this location, where the fresh water would flow out of the bay under the influence of its discharge force from the river mouth. Being less dense than seawater, the fresh water would float on top of the seawater body. A reversal of water movement would occur in the denser seawater, which would flow towards the river mouth to occupy the space vacated by the fresh water.

Plate 5-18: Location of Potential Density Driven Currents Driven by Fresh Water Discharge from the Fresh River (A).

5.3.3.4 Assessment – alternative route approaches

Plate 5-19 and Plate 5-20 outline possible locations for alternative approaches for the proposed cable. These areas were identified within an area of shoreline bounded by the town of Ocho Rios to the west and the Rio Nuevo bay to the east. The sites illustrated have been suggested based solely on the presence of gaps in prevailing reef systems protecting the shoreline, through which a cable could be routed and also on the presence of favourable sandy substrates on which a cable could be safely laid without incurring any significant environmental damage. **Note that no consideration has been given to land ownership matters that may or may not make an area feasible for landing.**

Plate 5-19: Potential Landing Sites in close proximity to Proposed Site at (A) Sandals Ocho Rios [18° 24.846'N 77° 5.126'W] and (B) [18° 25.177'N 77° 3.366'W]

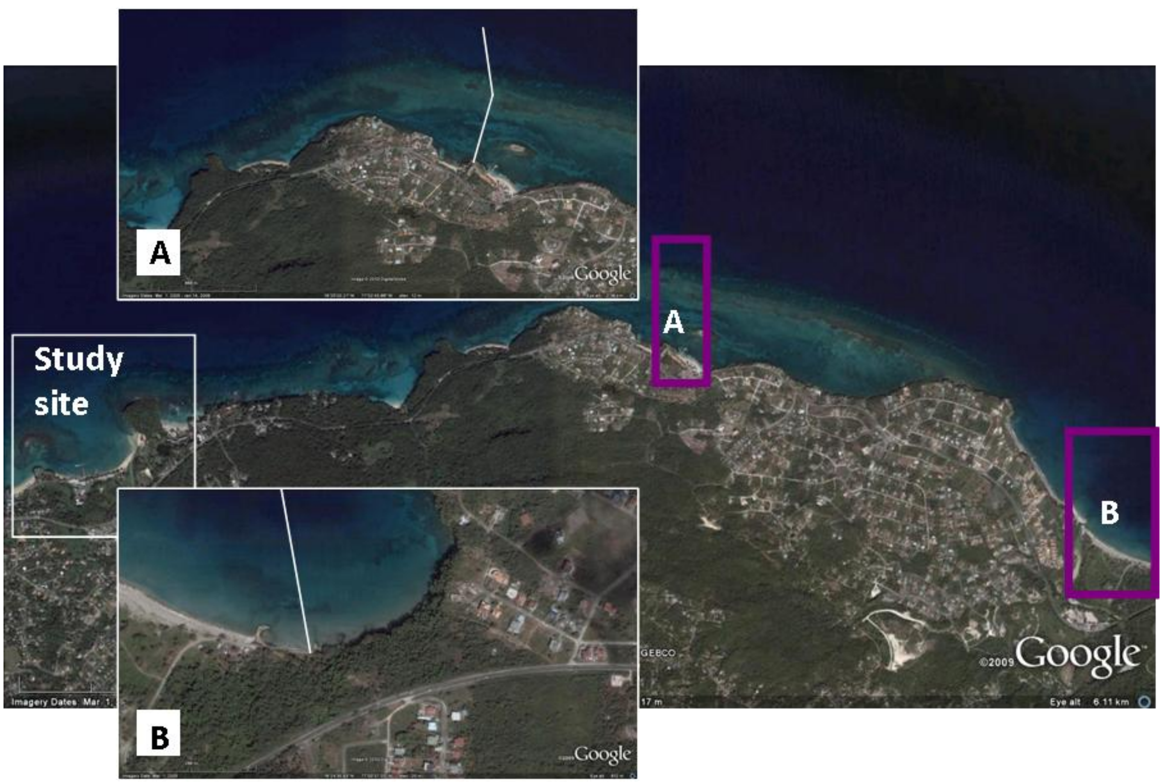


Plate 5-20: Potential Landing Sites (further East) at (A) Tower Isle along alignment of Existing Flow Cable [18° 25.363'N 77° 2.421'W] and (B) Rio Nuevo Bay [18° 24.632'N 77° 0.718'W]

5.3.4 Conclusions

The proposed route is ideal for the purposes at hand. It served the purposes of a Cable and Wireless cable, the alignment of which was approved by NEPA (then NRCA) in the late 1990s. The underlying seafloor substrates are benign in their character and, environmentally speaking, should represent no issues where impacts are concerned provided that the proposed alignment is maintained. Additionally, it is recommended that the cable simply be laid on the seafloor, with no trenching being done. Natural sediment movement processes will ultimately cover the cable, as was the case with the Cable and Wireless cable operation.

There are patches of coral reefs existing near the island drop off, at depths between 33-40 meters. The proposed cable alignment will not impact on the coral reefs identified.

SOCIO-ECONOMIC & SOCIO-CULTURAL ENVIRONMENT

6 Socio-Cultural & Socio-Economic Environment

6.1 Introduction

The region of St. Ann in which the project falls is a small residential community with a small tourist destination. There are a few beaches in the area but most are on privately owned lands. The commercial aspect of the area is also limited to small entrepreneurs and a few plazas. The major economic hub, Ocho Rios is a mere 5-10 min drive to the west.

6.2 Cultural Heritage Resources

The parish of St. Ann has various cultural heritage sites scattered throughout, some protected. However, there is no cultural heritage resource located within the immediate geographic sphere of influence of this project.

The project proponents recognize the significance and importance of any cultural and archaeological resources and are willing to cease operations should any of these resources be discovered during the duration of project activities. All necessary protocol will be followed such as informing the Jamaica National Heritage Trust (JNHT) and NEPA about these findings immediately.

6.3 Land-Use

6.3.1 Approach & Method

Land use was examined from both a historical and regional perspective. Site specific analysis of the proposed landing site and for areas within 1 km of the site was seen as an appropriate extent for the area of interest. Relevant land uses immediately adjacent to the outer limits of the selected buffer was also taken into account. The following were also useful in the investigation:

1. Aerial Photographs,
2. Satellite Imagery of the area dating 2006 (Google Earth), and
3. The use of field surveys to incorporate regional observations and documentation of existing land use, while providing verification of land use patterns depicted on the maps.

An accurate and thorough account of past and current land uses in the study area demanded a multi-faceted approach for collating land use information for the area.

6.3.2 Present Land Use

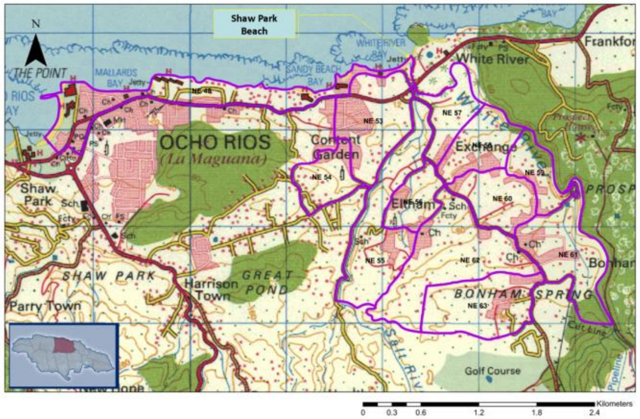
The site for the proposed cable lay comprises the nearshore and offshore waters and beach of a private property (Golden Sands Beach Cottages) located at the mouth of the White River in Shaw Park, St. Ann. The property comprises approximately two acres of beachfront lands at the eastern border of the parish of St. Ann. The title is registered under the registration of tiles law of 1888.

The beach can be utilised by residents of the area up to the high tide mark (Crown lands). The property is lands approximately just south of the Martha Brae exit of the North Coast Highway.

The property is bordered by private properties in all directions. Along the private roadway leading to the North-Coast Highway to the south are hotels, guest houses and private residences. At the entrance to the private road on the highway a small commercial plaza is situated. Situated to the east and west are large hotels such as Couples San Souci (to the east) and Sandals (to the west). The landing site has been used as a hotel and beach resort for more than 30 years and has been in private hands for much longer. Large tracts of lands in this region are privately owned.

The North Coast Highway is a fairly recently redeveloped roadway stretching from Port Antonio in the East to Negril in the west. The general area is primarily residential and commercial (tourist interest). The major hub in close proximity is Ocho Rios to the west.

Plate 6-1 below outlines the survey diagram attached to the certificate of title as well as photographs showing various aspects of the general area.



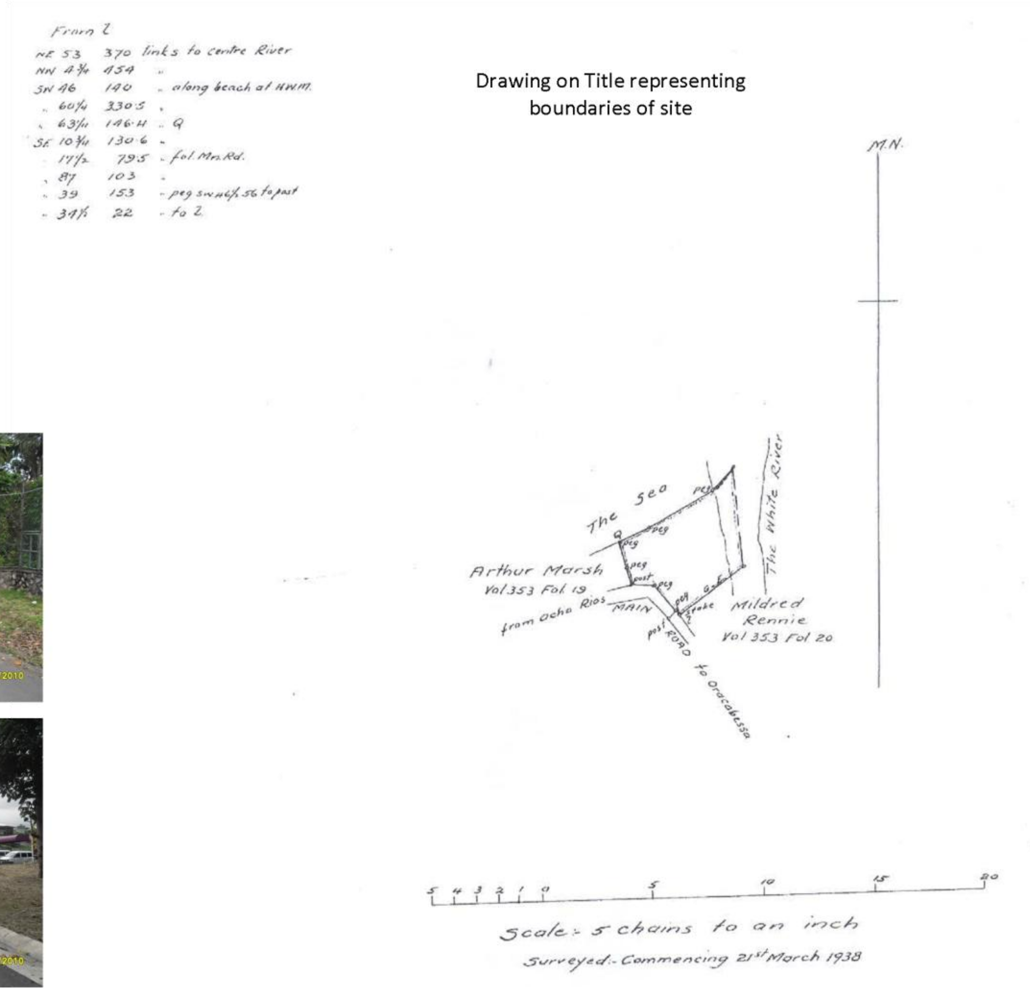


Plate 6-1: Characteristics of surrounding areas

6.3.3 Potential Land Use Conflicts

Potential land use conflicts are few. They can be grouped as follows:

1. Conflicts with transportation corridor (land and sea)
2. Conflicts with existing telecommunications services (land and sea)
3. Conflicts with owners of landing area
4. Conflict with marine interests (fishermen, private boaters, users of the beach among others)

6.3.3.1 Conflicts with transportation corridor (land and sea)

As discussed previously in this report, there is limited potential conflict with road and sea going vessels. During the process of physical site surveying as well as the proposed landing of the cable, all relevant parties will be informed of the dates of installation to ensure no incidences of note occurs.

The communication program will include the Maritime Authority of Jamaica, Port Authority of Jamaica and Fisheries Department as well as direct communication with fishermen from the White River Area, the owners of the Golden Sands Beach Cottages as well as all hotels, guest houses and private residences within a 1 km radius of the landing site.

6.3.3.2 Conflicts with existing telecommunications services (land and sea)

A fibre-optic cable was landed at this site in 1997 by Cable & Wireless. This proposed landing will utilise LIME Jamaica, a subsidiary of the Cable & Wireless, as the cable operators in Jamaica, and as such they have already been informed and are a part of the proposed landing. Every effort has been and will continue to be maintained to ensure the existing cable is not damaged in any way.

LIME will undertake the responsibility of the cable once it has been established in the beach manhole. It is the responsibility of LIME to undergo any trenching along the road corridor to Ocho Rios. They have a memorandum of understanding with the NWA and the local parish council with regards to a right-of-way agreement for any works along road corridors in the area. This agreement is replicated through-out the entire country. The necessary arrangements such as warning signs, traffic management approaches (news bulletins, traffic wardens, signal lights etc) will be put in place as necessary by LIME.

6.3.3.3 Conflicts with owners of landing area

No conflicts are expected with the owners of the landing site. A lease agreement and memorandum of understanding is in place with the property owners.

6.3.3.4 Conflict with marine interests (fishermen, private boaters, users of the beach among others)

No conflicts are expected with marine interest in the area. The property owner will be kept informed of progress before, during and after the cable has been landed. Similarly, all fishing interest will be kept informed of the intentions of the project team as it relates to intended dates for cable laying in Jamaica's maritime space. Private interests in the area and users such as fishermen, boaters and bathers will be informed through all possible direct means such as meetings, news bulletin, flyers etc.

6.4 Synopsis of Focus Group Consultations

In keeping with the approach to get feedback from the community, additional stakeholders were identified and interviewed. Due to the nature of the project the stakeholders surveyed were users of the marine environment in the general White River area. Their perceptions, views and concerns are considered vital and are therefore a critical component to be included in this socio-economic assessment. A copy of the survey instrument can be found in the appendix (Appendix III).

A total of nineteen (19) persons were interviewed all being fishermen by trade. Only two (2) had other livelihoods being rafter and painter. Seven (7) were self employed with the remainder employing between 2 and 4 other individuals. Seventeen (17) are fishermen for more than 10 years with four (4) doing so for more than 40 years. Only 2 individuals have been fishing for less than 5 years.

The majority of respondents considered the communities of the area to be either safe or very safe. Services offered by telecommunications (telephone, cable and internet) were considered to be adequate by the majority (17); however, some individuals had reservations for internet access (4), cable television (4) and telephone (2).

Most of the respondents (13) were aware of the proposed cable lay. This may be attributed to discussions held with some users (mainly fishermen) during site inspection activities as well as a meeting convened at the landing site for fishing interest of the area in March 2010. Additionally, the Fisheries Department were consulted and informed on the proposed cable lay.

The possible impact on their livelihood was considered nil by most respondents. Thirteen (13) indicated they expected no change to their livelihood as a result of the project, 3 had no opinions and 6 indicated a potential positive impact. This was largely realised by a few individuals indicating they expected jobs as a result of this project. Most respondents were aware of the previous cable lay in 1997 by Cable & Wireless and indicated it has caused no problem for users of the beach of its nearshore and offshore waters. Based on this information most (12) were able to identify the proposed activity as being of little risk to their livelihood. Those that suggested their may be a potential risk identified change in spawning grounds and fish migrating as their primary concern.

Most respondents held the opinion that the proposed cable lay was a vital development needed in Jamaica. They cited technological improvements, jobs, skills training, potential for more business and better and improved communication as the main reasons. Other developments slated for the area include: housing, hotel construction and the laying of new and/or upgraded water mains.

The fishing grounds used are mainly within the nearshore and offshore waters of Shaw Park. However, some fishermen ventured to other parishes and deep sea to improve their fishing efforts. Areas fished beyond the Shaw Park/Ocho Rios area included Montego Bay, sections of Trelawny, St. Ann, St. Mary and Portland, all found along the northcoast.

The primary methods of fishing practiced in the area are: hook and line (15), traps/pots (13) and spearfishing (7). However, it should be noted that some deep sea trawling is practiced, this accounted for 8 responses including the above mentioned practices. Most fishing was done in the early morning (18). However, it should be noted that fishing was practiced at other times during the day such as: mid-day (3), evenings (2) and nights (3).

6.5 General Survey Population

6.5.1 Demographics & Social Profile

The opinions, attitudes and views of the communities within which this project is proposed to be conducted must be taken into consideration despite the seemingly innocuous nature of the proposed works. In an attempt to comprehensively analyze the potential impacts associated with the proposed fibre optic cable lay a social impact assessment is necessary to obtain data on the demographic and other social characteristics of the communities and residents within a reasonable sphere of influence, and most importantly, their knowledge, views and concerns regarding the proposed actions. This section of the report presents the demographic and other social characteristics of the region. This survey was conducted in June 2010.

A 1.6 kilometre (1 mile) radius was identified as the sphere of influence for the proposed fibre optic cable lay. However, given the nature of the proposed project and the dispersed locations of communities in the area, a few communities were excluded from the sample. Communities surveyed include:

Table 6-1: List of communities surveyed

Enumeration Districts	Communities
NorthEast 48	1. Content Gardens/Bypass 2. Pineapple Place 3. DaCosta Drive 4. James Avenue

Enumeration Districts	Communities
NorthEast 52	1. Content Gardens 2. NE54 3. Shaw Park 4. Content Gardens/Bypass 5. Great Pond 6. Eltham/Great Pond 7. Great Pond/Power Isle 8. Shaw Park/River Oak 9. Great Pond/Exchange Top 10. Exchange Top 11. Pineapple/Bypass 12. Pineapple Place 13. Top Hill Street
NorthEast 53	1. Content Garden 2. Ocho Rios Bypass 3. Marvin Park
NorthEast 55	1. Dunnsville 2. Eltham 3. Dunnsville/Cornhouse 4. Marvin Park
NorthEast 57	1. White River: Milford 2. Exchange 3. Buckfield
NorthEast 58	1. White River 2. Hand to Mouth 3. Middle Street 4. Prosper Hall
West 01	1. White River 2. Eastern Prospect Property 3. White River/Dunnsville 4. Gayle Road

The selection of the areas for interviewing was based on Enumeration Districts (ED) as defined by the Statistical Institute of Jamaica (STATIN). However, it must be noted that it is possible for some communities to cross ED boundaries. As a result, the communities as presented in this report were also defined in the field by the interviewer and the respondent.

The survey population was devised from a 5% sample of the total number of households within the area according to the 2001 Population Census. A total of 73 surveys were conducted in the EDs as outlined by STATIN, which were within and/or along the periphery of the 1.5 km radius of influence (Table 6-2 and Plate 6-2).

Table 6-2: Enumeration Districts Surveyed

Parish and Enumeration District	Population	Number of Households	Sample Population (5%)
NORTHEAST 48	179	118	6
NORTHEAST 52	360	107	5

Parish and Enumeration District	Population	Number of Households	Sample Population (5%)
NORTHEAST 53	356	227	11
NORTHEAST 54	475	233	12
NORTHEAST 55	455	263	13
NORTHEAST 57	146	84	4
NORTHEAST 58	599	353	18
WEST 01	88	75	4
TOTAL	2658	1460	73

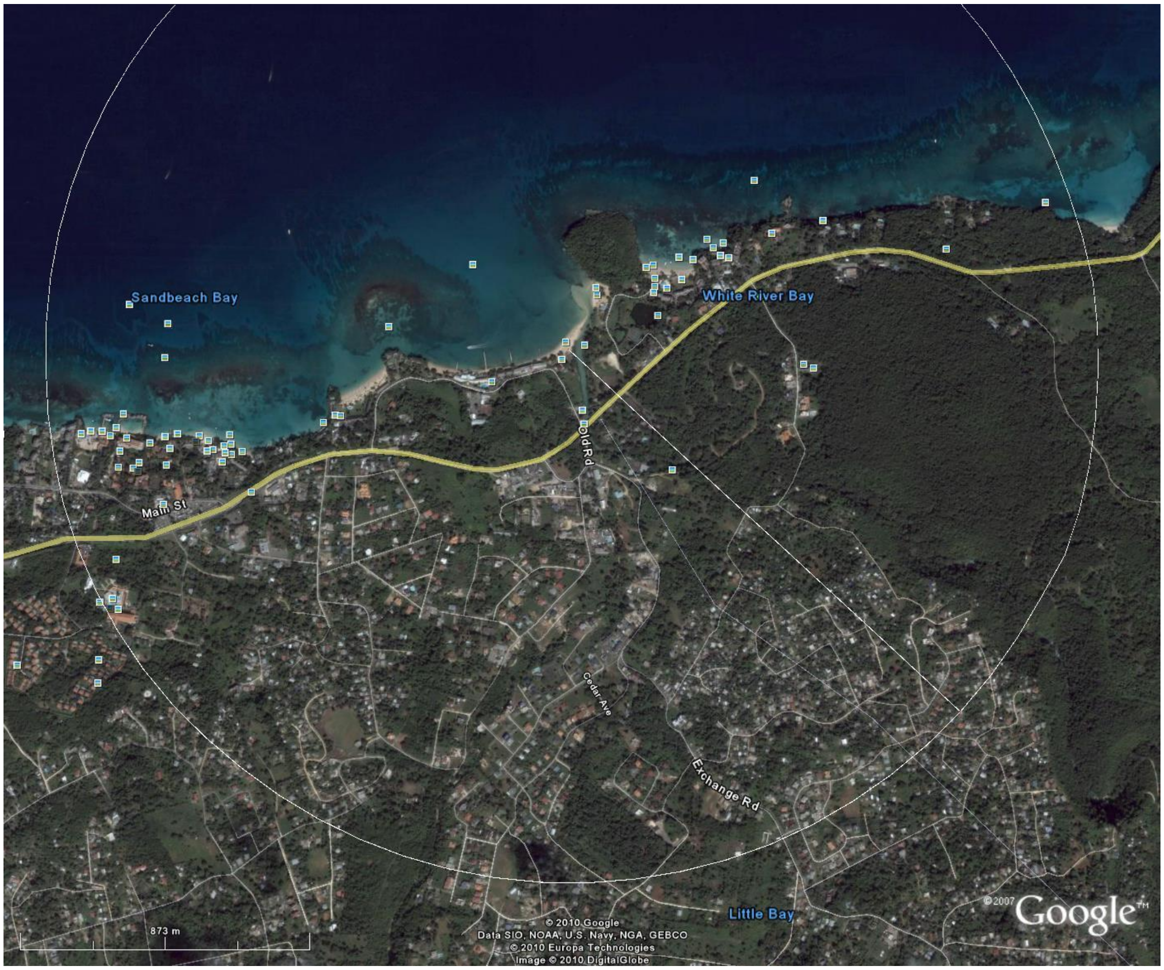


Plate 6-2: 1.5 km radius for Socio-Economic Assessment

Communities identified within the sphere of influence together have a total population of 2658 individuals and 1460 households. The age-sex pyramid indicates that the majority of the respondents (39.7%) are between the ages of 20 and 39 years, while individuals under the age of 20 years and those over the age of 60 years accounted for the smallest (12% and 11% respectively) (Figure 6-1**)**. Of the 73 households interviewed, the ratio of male to female respondents was approximately 2:1 in favour of males. Forty-five (45) males and twenty-eight (28) females were interviewed.

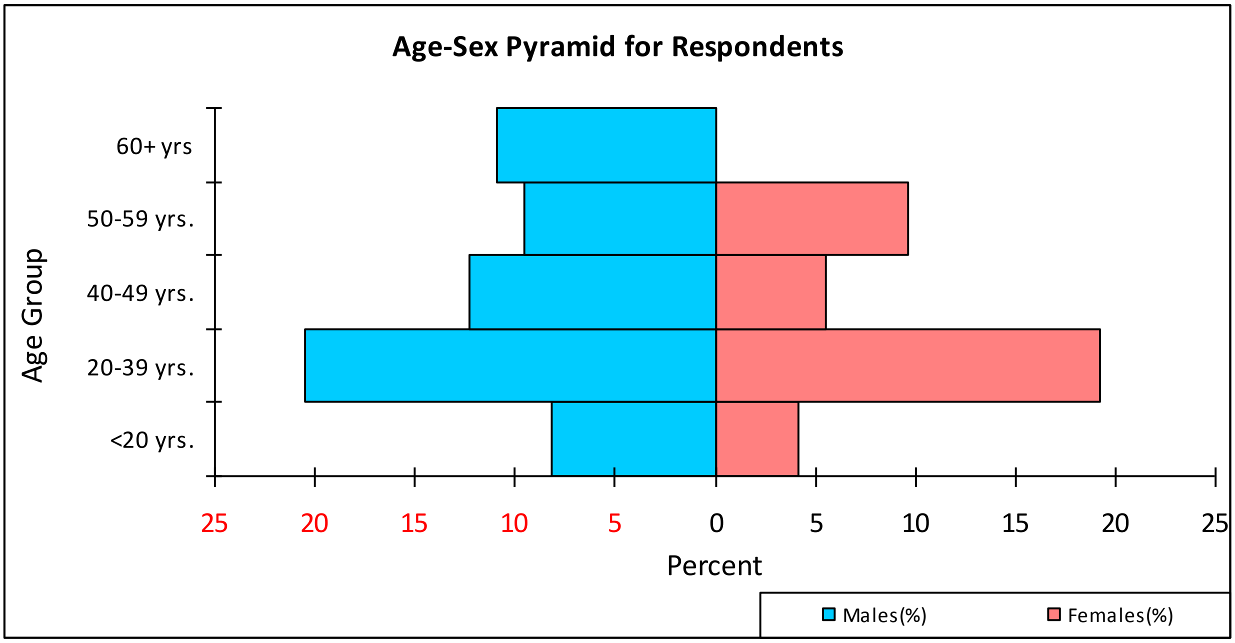


Figure 6-1: Age-Sex Pyramid of Respondent Population

At least 80% of householders have been living in the area for more than 10 years, and at least 56% for more than 20 years. The number of individuals that occupied these households was 321 with a ratio of 1:1 for males to females. With respect to the age range of householder; the three most dominant groups are 0-14 years (90), 20-35 years (74) and 36-45 years (54). There are 156 individuals with paid employment and this represent approximately 49% of householders. Seventy-nine percent (79%) of respondents are in paid employment.

Secondary education is the most common education attained with 51% of the respondents (39 individuals). Only ten respondents (13%) have achieved tertiary level education and five individuals have vocational training.

Table 6-3: Age and Sex of Residency of Respondents

Community ▶ / Parameter ▼	North-East 48	North-East 52	North-East 53	North-East 54	North-East 55	North-East 57	North-East 58	West 01	TOTAL
AGE RANGE									
Under 20	1	0	0	0	3	0	0	1	5
20-39	1	2	1	1	4	2	3	0	14
40-49	4	1	7	8	4	1	5	2	32
50-59	0	0	1	1	3	1	6	2	14
60-Over	0	0	1	3	1	0	3	0	8
NR	0	0	2	0	1	0	0	0	3
Total	**6**	**3**	**12**	**13**	**16**	**4**	**17**	**5**	**76**
YEARS OF RESIDENCY									
0-5 Yrs	1	0	0	2	4	1	0	1	9
6-10 Yrs	0	1	0	0	0	0	1	0	2
11-20 Yrs	1	2	3	4	5	0	2	3	20
20+ Yrs	3	0	9	7	5	3	14	0	41
No Response	1	0	0	0	2	0	0	1	4
Total	**6**	**3**	**12**	**13**	**16**	**4**	**17**	**5**	**76**

A wide range of occupation was provided by respondents. The most dominant being self employed (20), businessperson (11) and fishermen (10). The following list outlines the range of occupation enjoyed by respondents.

Range of occupation enjoyed by respondents

- Business Man/Woman
- Bartender
- Phone Operator
- Painter
- Fisherman
- Pensioner
- Policeman
- Security Guard
- Auto Electrician
- Self-Employed
- Nursing
- Sales Clerk
- Retired
- Contractor
- Farmer
- Florist
- Cashier
- Housekeeper
- Cabinet-Making
- Shopkeeper
- Taxi Operator
- Trucker
- Caretaker
- Carpenter
- Hair Dresser
- Mason
- Teacher
- Maintenance
- Manager
- Chef
- Information Technologist
- Mechanic
- Tractor Operator
- Student

Figure 6-2: Range of Occupation enjoyed by Respondents

6.5.2 Findings

6.5.2.1 Knowledge and Views on the Proposed Fibre-Optic Cable Lay

Awareness of the proposed project was fairly high with approximately 60% of respondents stating they were aware of the proposed cable lay. There were no dissenting opinions on the proposed project; however, at least 5 individuals had no view or no comment of its favourability. Of those stating they were in favour of the project 62% were in favour and 16% strongly in favour (Figure 6-3).

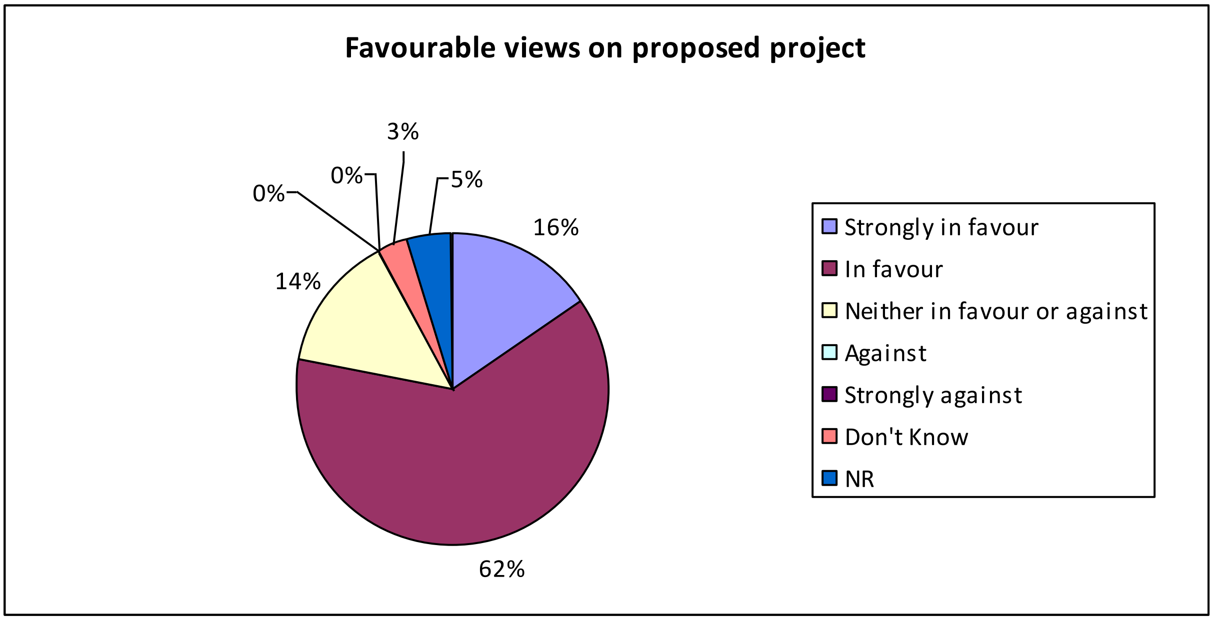


Figure 6-3: Bar Chart showing major source of water in the areas surveyed

The primary reason given for the favourable responses was the potential improvement in technology / communication services and lower cost through increased competition. This reason accounted for approximately 42% of all reasons provided (Figure 6-4).

Other notable reasons included: it's good for the community, better service rate and potential for employment.

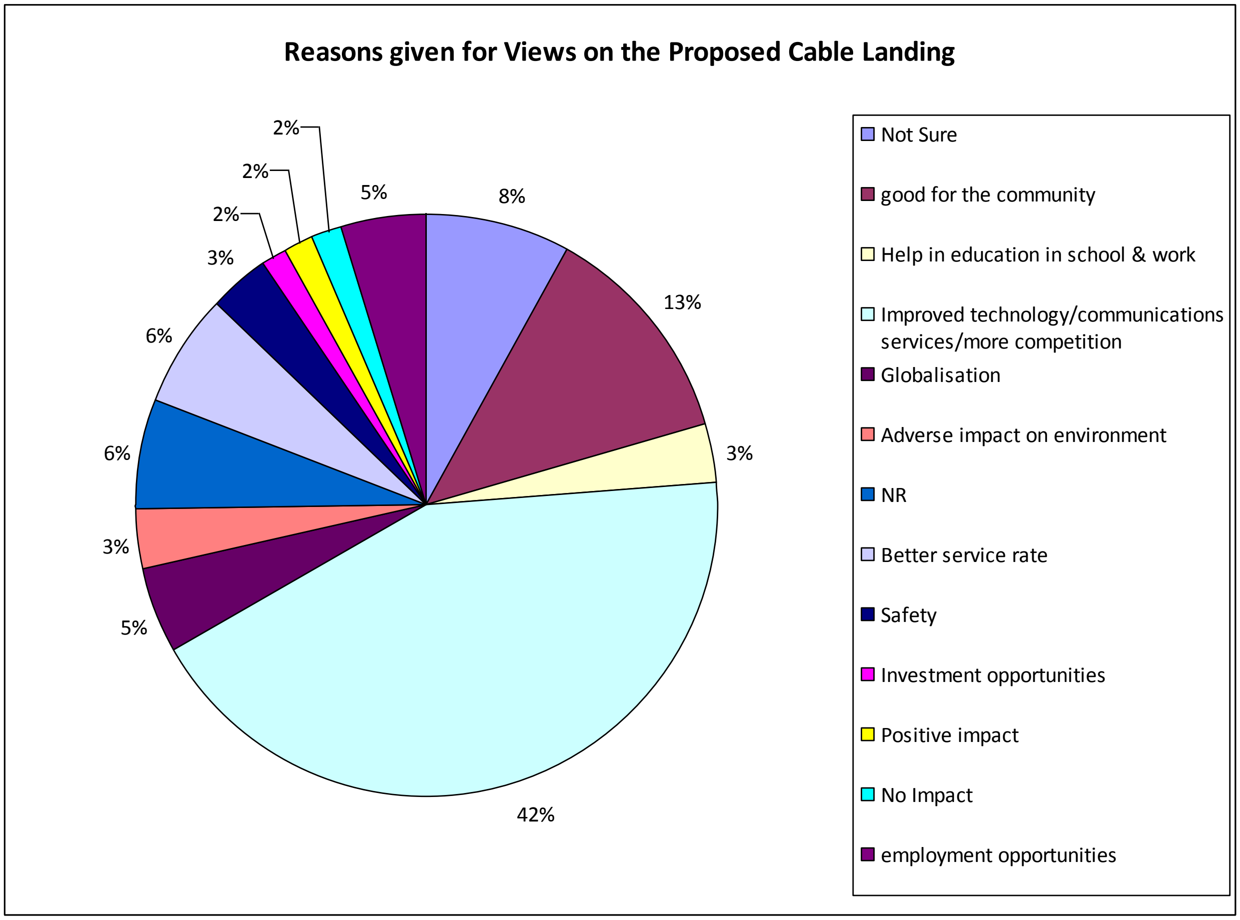


Figure 6-4: Reasons for favourable responses to the proposed project

Respondents were largely of the view that the installation of the proposed cable would have a positive economic value to the community. This positive view was shared by 78% of respondents. Potential employment as a result of the proposed project was expected from 74% of respondents. The potential for pollution was not regarded as high.

Services provided by fibre optic cables such as telephone, internet and cable television were considered to be adequate in the area (Figure 6-5). Of the three, only internet (32%) registered any significant negative response, positive response for this service was higher almost on a ration of 2:1.

Thirty-seven percent of respondents were aware of the previous cable that was laid at the Shaw Park Beach; at least 60% were unaware. Most respondents (75%) were of the view that the cable landing would have no impact on them personally. More than ninety percent of respondents were of the view that the proposed cable lay was a required development. Improved internet and communication services, community advancement and potential employment are considered as the main potential development impacts on the community should the project go ahead.

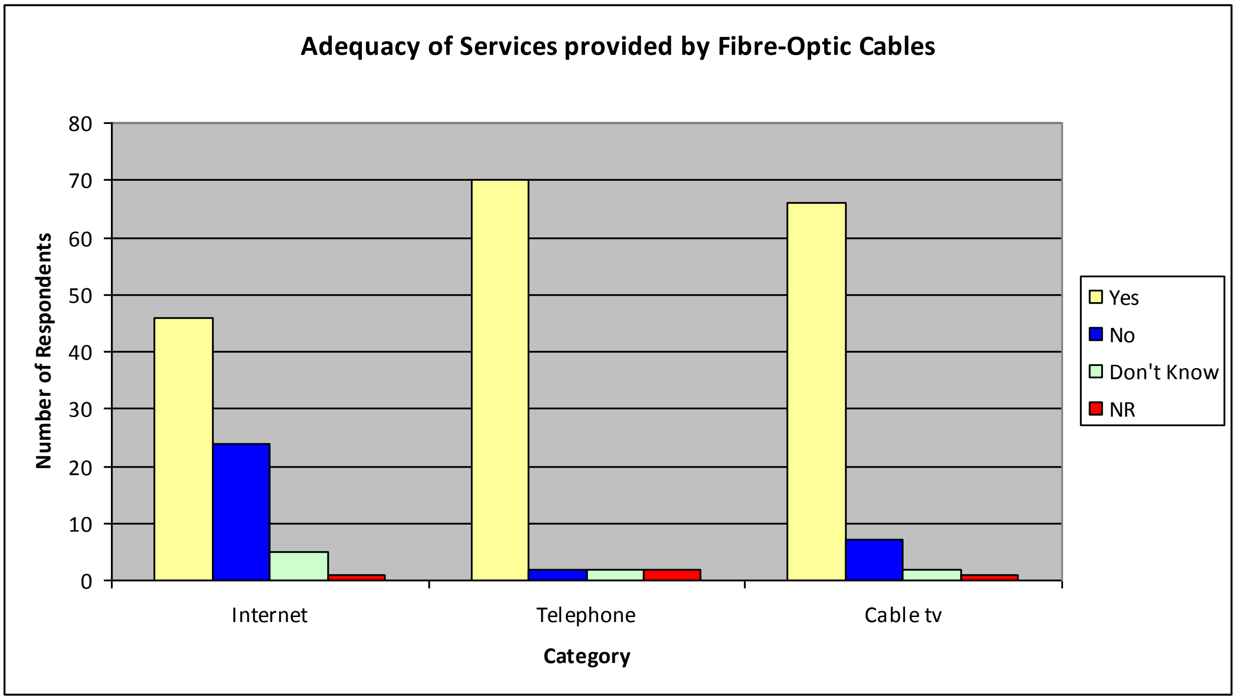


Figure 6-5: Adequacy of services provided by fibre optic cable

6.5.2.2 Social Attitudes

Less than seven percent of respondents have worked in the telecommunications industry. However, more than 86% are looking forward to the development with the outcome expected to be similar as the opinions already expressed.

Based on this outlook the majority of respondents do not foresee this proposed project impacting negatively on the resources in the area they currently enjoy. More than 71% of respondents do not anticipate that the fibre-optic cable lay and any associated construction activities will affect the availability of any of the natural resources in the area. Those that had a dissenting view identified fishing and use of beach as the resources that may be impacted.

The Golden Sands Beach and its environs are primarily used for swimming, recreation and fishing. Approximately 60% of those surveyed listed swimming as the primary use of the natural resources. At least 62% were of the view the proposed cable lay would not negatively impact on the environment.

6.6 Conclusions

The survey covered several communities and total of 76 households, which accounts for 5% of the total households in the area based on the STATIN 2001 National Census and the defined sphere of influence of the proposed development of 1.6 km. Interviews were conducted with a mature population with the age group 20 - 39 and 40 – 49 accounting for approximately 60% of the respondents, who have mostly been living in the area for over a decade. Their opinions and perception on current situations and prospective development are therefore considered critical and important in understanding the social ramifications that may be associated with the proposed fibre optic cable lay.

Generally speaking the respondents were largely in agreement with the proposed cable landing. Most were aware of the project. The main positive impacts anticipated were improved technology/communication services, improvements in community development through skills training in IT, and potential employment.

Although the natural resources of the area are used for various activities, it was largely felt that these activities would not be impacted by the proposed project. The focus group of marine users were also positive about this proposed project. They are extremely pleased with the communication to date. Most are of the view that their activities will not be impacted by the proposed cable lay. At most fish and other marine life are expected to migrate during the cable laying activities.

There are no natural or archaeological resource that may be impacted by the proposed cable lay.

DETERMINATION OF POTENTIAL IMPACTS & MITIGATIONS

7 Determination of Potential Impacts

7.1 Introduction

The proposed fibre-optic cable landing site has the potential to create a variety of impacts if it is implemented. These potential impacts can be either positive or negative depending on the receptors involved and other parameters such as magnitude, duration, project management and monitoring. Since this section of the report is geared primarily towards identification of potential environmental impacts their definitions and significance are presented in greater detail in the appendix, especially to assist the public review process (**Appendix VI**).

In assessing the significance of potential impacts, various measures are used. These include the use of checklists/matrices, expert knowledge and a keen assessment of the project plans and details. Each parameter is evaluated according to the following:

- *Potential impact* - any change to the environment, whether adverse or beneficial, wholly or partially resulting from the proposed activities, products or services
- *Activity* – phase of development that action takes place in
- *Environmental receptor* – sensitive component of the ecosystem that reacts to or is influenced by environmental stressors
- *Magnitude* – A measure of how adverse or beneficial an effect may be
- *Duration* – the length of time needed to complete an activity
- *Significance* – A measure of importance of an effect
- *Mitigation* – Measures taken to reduce adverse impacts on the environment

Outlined below are the various phases of the proposed development on which assessments of potential impacts will be based, namely:

- Physical environment
- Biological environment
- Socio-economic environment

Mitigation measures are provided, where necessary, within the impact identification tables.

7.2 Impact Identification & Mitigation

This project is not expected to provide any significant employment opportunities during the cable lay. However, the value added service of an additional fibre optic cable in Jamaica will undoubtedly provide employment opportunities in various sectors such as telecommunications, conference facilities among others. During the cable lay it is possible that marine interest in the area (boatmen and divers) may be required to successfully deploy the cable, due to their proximity to the project site and their knowledge of the area and operations there.

The Island should see increased revenues from Income, Royalties and General Consumption Taxes related to the installation of the cable. Similarly, the local economy of the area will benefit from increases in good and services as a result of the increased telecommunications framework to be provided. This is a significant positive, both direct and indirect, long-term impact on the economy of Jamaica.

The potential environmental impacts identified as a result of the proposed cable lay includes:

Negative

- Minimal suspended solids during cable laying
- Minimal noise and vibration during cable lay and trench construction
- Minimal aesthetics and transient change of land and marine use

Positive

- Improved broadband access by connection to other islands and continents
- Potential vast increase in investment revenue and job creation due to improvements in the telecommunications industry from this project.
- No loss of bio**diversity**
- **No loss of archaeological** and historical heritage resources
- No loss of aesthetic appeal
- No loss of commercial and recreational fishing needs.

The following tables provide a clear indication of real and potential environmental impacts associated with this development, and provide information on potential receptors, duration, magnitude, and mitigation measures. Since these are potential impacts, there is no certainty that they will materialize. However, the developers will be prepared to address any adverse potential impacts should they arise during this cable laying project.

Mitigation costs associated with this project have been incorporated into the overall development cost and are not detailed in the mitigation assessment.

7.2.1 Impacts to Physical Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Aesthetics							
Pre-Construction, Construction, Operation	Humans	***Item A1*** – The construction of a trench at the beach face and clearance and removal of any vegetation from the landing site may result in a visually negative impact and loss of or damage to natural resources. The beach manhole to be constructed to house the equipment will be of similar construction to that which obtains for cable manholes along roadways and will fit into the existing surroundings. All activities on the site will be carefully examined to ensure as little impact as possible	Low & Short-Term	Limited & Minor Negative	Low & Direct	Cable lay, construction of trench and manholes will be conducted in the shortest possible time. Where necessary, hoarding of not less than 2.4 m above ground level should be provided along the entire length of that portion of the site where tranches or manholes are being excavated. This should be done in the interest of safety of fishermen and guest that use that portion of the beach. It should be accompanied by the erection of signs at appropriate locations warning of the dangers associated with the onsite activities as well as the duration of activities. Once completed the beach face should be restored to its previous profile using material removed during trenching. Other measures include: minimizing height of temporary structures, replanting of disturbed vegetation, and the re-use of topsoil. A management and operation plan should be implemented so that the project activities can be properly maintained. Effective monitoring and solid waste storage and disposal must be put in place so that the cleanliness of the facility and its environs is maintained.	Minor
Geological and Geotechnical							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item GG1*** – Although proposed activity entails cutting a trench across the beach face to the nearest roadway, no negative impact is anticipated for geological resources. The beach manhole and trench to be constructed will be of similar design and rigor to what currently obtains internationally.	Minor & Long-term	Local & Minor Negative	Low & Indirect	Construction design, planning and monitoring should ensure that existing topographical profile is restored on completion of cable lay.	Minor
Water Quality, Surface Water Hydrology and Groundwater							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item WQ1*** – The addition of additional cables into the marine environment may be considered as a negative input on marine water quality. However, the cables pose no threat and will not alter the quality of the water. Temporary impacts on water quality may be realized during the cable landing operations. This however, should be short in duration and limited in the amount of sedimentation that it causes. No chemical impacts are anticipated on water	Low & Long - Term	Local & Minor Negative	Low & Indirect	The use of silt screens/curtains will be required particularly during the trenching at the land-water interface. This is necessary to minimise the possibility of suspended particulate matter being carried away by nearshore currents towards the reef patches. Additionally, the laying of the cable must be monitored by staff of NEPA to ensure the cable is properly laid according to the route outlined in this report. It is recommended that the cable lay be conducted in the shortest period of time and outside rainfall events to minimise any action the adjoining river may have and sediment transport.	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
		quality.				All trenches constructed should be filled in at the earliest possible opportunity and the beach returned to its pre-activity state. The timely removal of removed and/or stockpiled soils and the use of containment berms, bunds or containers to secure soils and avoid siltation, etc. during incidence of rainfall are recommended.	
Air Quality							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item AQ1*** – It is possible that a small amount of fugitive dust may be produced during manhole construction at the proposed landing site. Trenching along the roadway also has the potential for observable fugitive dust. Otherwise, this project should not result in any negative air quality events as it relates to fugitive dust.	Low & Short -Term	Local & Minor Negative	Low & Indirect	Although the removed material may be of small volume it is recommended that the excavated soil and exposed soil surfaces be sprinkled as necessary and not allowed to dry out enough to become entrained in wind. Stockpile material for disposal elsewhere that may generate fugitive dust should be totally covered during transportation. Proper personal protection equipment (PPE) devices such as face mask should be provided to workers as necessary.	Minor
		Item AQ2 – Various mechanical equipment and vehicles are expected to be used at the project site. The heavy duty vehicles are expected to be primarily diesel fuel vehicles. When properly maintained heavy duty vehicles can operate without causing a significant decrease in air quality. However, if maintenance is poor, excessive fugitive emissions may result.	Low & Short-Term	Local & Minor Negative	Low & Indirect	Heavy duty equipment and vehicles using diesel fuel should be properly maintained and inspected prior to use at the site. All vehicular and equipment maintenance should be done at an approved off-site maintenance location such as a garage or dry dock. Vehicles causing excessive fugitive emissions should be removed from the site immediately.	Minor
Noise							
Pre-Construction, Construction, Operation	Humans and Fauna	***Item N1*** – Various mechanical equipment, vehicles and site activities may generate noise that may exceed acceptable levels. It is not expected that the project will cause a noise nuisance at any point, that is, neither during installation nor operation. Where necessary, work requiring heavy equipment will be scheduled for day-time and will be brief to minimize the potential for disruption of residents and guests. Operation will not produce any noise.	Low & Short-Term	Local & Minor Negative	Low & Direct	Silencers or mufflers on equipment sand vehicles should be properly fitted and maintained. If proposed site activities are known to be noisy, they should be scheduled at times least likely to impact those in hearing distance such as users of the beach and hotel. Proper personal protection equipment (PPE) devices such as ear plugs should be provided to workers as necessary.	Minor

7.2.2 Impacts to Biological Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Faunal Resources							
Pre-Construction, Construction, Operation	Fauna	***Item FaR1*** – No large-scale land clearance is proposed for the landing site. The manhole to be constructed is not large and is mostly underground. Trenching from the beach to the road is not expected to significantly disturb the area.	Low & Short-Term	Local & Minor Negative	High & Direct	There are no significant fauna that stand to be impacted by the proposed actions. No mitigation necessary	Minor
		Item FaR2 – The laying of the cable in the marine environment may impact on sessile marine fauna. It is in the best interest of those laying the cables to avoid corals or other structures in order to protect the cable. The cable is to be laid completely flat on the sea floor.	Low & Long-Term	Local & Minor Negative	High & Direct	The cable lay in the marine environment up to the high water mark must be done as outlined in the route identified in this report. NEPA officers should be present during the cable lay to ensure the cable does not impact on sensitive marine resources such as coral reefs. Where necessary, the cable should be anchored. Sessile organisms such as sponges and molluscs are known to establish themselves on marine cables	Minor
Floral Resources							
Pre-Construction, Construction, Operation	Flora	***Item FlR1*** – The laying of the cable in the marine environment may impact on marine flora. The cable will be laid through an area of sea grass and is unavoidable. The seagrass is found in patches. No significant thick meadows exist.	Low & Long Term	Local & Major Negative	High & Direct	The laying of the cable on seagrass may inadvertently lead to a loss of seagrass in the immediate area. However, over time the cable is expected to bury itself in the substrate and allow for seagrass re-growth. Seagrass is known to eventually grow to cover cables and the same is expected in this case. NEPA officers should be present during the cable lay to ensure the cable does not impact significantly on sensitive marine resources such as seagrass.	Minor

7.2.3 Impacts on Socio-Economic & Socio-Cultural Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Employment & Worker Health & Safety							
Pre-Construction, Construction, Operation	Humans	***Item E&HS1*** – This project will provide employment opportunities during all phases of project implementation, which will include residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there. When fully implemented, i.e. the cable has been installed and the infrastructure has been prepared, the project may result in jobs being realized though increased telecommunication and other related industries on the island. All the phases of the project implementation will generate local employment (some more than others) but the cumulative impact will be positive for the Jamaican economy.	Major & Long-Term	Regional & Major Positive	High & Direct	No mitigation required.	Positive
		Item E&HS2 –Occupational Safety Risks are associated with any working condition. This is primarily important where workers interact with moving and heavy equipment.	Low & Short-Term	Limited & Minor Negative	Low & Direct	Proper PPE should be issued to workers depending on the area they work in. This should include boots, ear plugs, goggles, gloves and hard hats at a minimum, where necessary.	Positive
		Item E&HS3 – Due to the services which can be received via installation of Fibre Optic cables, such as, faster remittance, faster transmission of data (sending and receiving), over broad band internet, better telecommunications, safer and less vulnerable international connections etc., there will be several positive impacts on the entire island. These include: • Remittances would be received more quickly; therefore there could be an increase in the remittances sent to the island. This would in turn mean an increase in revenue for the country. • Due to easier access to information (internet), the scope of knowledge of individuals would increase. Also, the less time spent obtaining this information, the more time would be left available for other activities. • Jamaica would become an example in the Caribbean of high quality international	Major & Long-Term	Regional & Major Positive	High & Direct	No mitigation required.	Positive

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
		telecommunications. Also, in inclement weather, the risk of service disruption would be very low. This ensures that productivity is not disrupted. • Cheaper communication service. With this decrease in cost, the service would be affordable to more people, improving the overall standard of living.					
Recreation & Heritage Sites							
Construction & Operation	Human	***Item R&H1*** – The proposed landing area can be considered a recreational area. It is utilised primarily by guests of the Golden Sands Beach Cottages and also by the White River fishermen. No known heritage resources are known to occur at the proposed landing site that may be adversely impacted.	Minor & Short-Term	Regional & Minor Negative	Low & Indirect	Adequate and proper signs and barriers should be put in place warning and protecting everyone from the proposed activities associated with the fibre optic cable lay. NEPA officers should be present during the cable lay to monitor the activities and ensure all mitigation measures are adhered to and the beach and marine environment are left in as good as or even better state than originally found. Based on the nature of the previous and current site usage and the proposed project, it is not anticipated that archaeological heritage resources will be found.	Minor
Traffic							
Pre-Construction, Construction, Operation	Humans	***Item T1*** – The existing main roads will be used to deliver and remove any materials, and equipment to and from the proposed landing site. The added vehicles and the frequency of their movement are minimal and not expected to add to the existing volume on the main and private roads during peak usage periods.	Moderate & Short-term	Regional & Minor Negative	Low & Direct	No Mitigation necessary	Minor
Solid Waste							
Pre-Construction, Construction, Operation	Humans	***Item SW1*** – Solid waste generated during cable laying activities, trenching, manhole construction and other waste from packaging may be generated during this exercise. If these waste streams are not properly managed then the potential exists for a negative impact. A properly implemented and executed solid waste management plan can remove this negative potential.	Low & Short-Term	Limited & Minor Negative	Low & Indirect	All solid waste generated should be collected, handled and disposed of appropriately. Solid waste removal should be facilitated by using approved licensed haulage contractors. A comprehensive project based waste management plan will be prepared for the duration of the exercise.	Minor

7.3 Cumulative Impacts Identification & Mitigation

7.3.1 Impacts to Physical Resources

The area already accommodates one (1) fibre optic cable that was laid in 1997. This cable has had no adverse impact on the physical resources of the area. The cable has since buried itself and is not visible anywhere within the nearshore waters.

It is not envisaged that the laying of the new cable will result in any adverse potential impacts to these resources. No adverse cumulative impact is expected.

7.3.2 Impacts to Biological Resources

The biological resources of the area, primarily the seagrass meadows and coral reefs are in a poor state. However, the marine assessment has revealed improving conditions within the area. The existing fibre optic cable has not affected the existing biological resources in an adverse manner.

It is not envisaged that the laying of the new cable will result in any adverse potential impacts to these resources. No adverse cumulative impact is expected.

7.3.3 Impacts on Socio-Economic & Socio-Cultural Resources

The existing cable has had a positive impact on the socio-economic resources of the area. The laying of the cable in 1997 afforded the country an increase in its telecommunications inventory at that time. This has allowed various services and products to be realised. Since 1997 several fibre-optic cables have landed in Jamaica and the countries telecommunications industry has experienced significant growth since then. The addition of another cable will only add to this growth sector allowing for areas such as IT, tele- and video-conferencing among other areas to continue to experience growth.

There has been no adverse impact to socio-cultural resources. None is expected.

7.4 Impact Matrices

Table 7-1: Impact Identification of Proposed Cable Lay

	EIA Activities										
	Landing Site Preparation			Cable Installation							
	Site Surveying	Site Preparation	Floating of buoys	Trench & Manhole Construction	Cable Laying (marine)	Cable Laying (land)	Trenching	Materials Sourcing	Materials Transport	Solid Waste Disposal	Beach-face and land restoration
TOPOGRAPHY											
GEOLOGY											
VIBRATION											
RAINFALL											
GASEOUS EMISSIONS/ ODOUR											
AMBIENT NOISE											
DUST											
DRAINAGE											
TEMPERATURE											
NATURAL HAZARD											
Water Quality											
SEDIMENTATION											
CHEMICAL IMPACT											
Ecological Parameters:-											
TERRESTRIAL ECOSYSTEMS											
• VEGETATION											
• BIRDS											
• OTHER FAUNA											
MARINE ECOSYSTEMS											
• VEGETATION											
• FAUNA											
SENSITIVE HABITATS											
Socio-Economic Parameters:-											
AESTHETICS											
LAND USE COMPATIBILITY											
EMPLOYMENT											
FOREIGN EXCHANGE EARNINGS											
STRUCTURES/ROADS											
WASTE MANAGEMENT											
TRAFFIC ON THE ACCESS ROAD											
INCREASED CRIME											
HAZARD VULNERABILITY											
SOLID WASTE DISPOSAL											
FISHING INDUSTRY											
Occupational Health & Safety											

See Key next page

KEY (See Appendix VI for definitions)					
No Impact		Minor Negative		Major Negative	
Minor Positive		Major Positive			

Table 7-2: Impact Mitigation Matrix & Residual Effect (Post Cable Lay)

	Proposed Mitigation Measures						
	Operation & Maintenance Plan	Detailed Bathymetric Surveys	Effective Site Management	Waste Management Plan	Dust Management Techniques	Installation of Sediment Traps	RESIDUALS
SITE PREPARATION							
TRANSPORTATION OF CONSTRUCTION MATERIAL							
INCREASE IN NOISE							
INCREASE IN DUST							
DISTURBANCE OF FLORA AND FAUNA							
AESTHETICS							
INCREASED SHORT-TERM EMPLOYMENT							
INCREASED SEDIMENTATION OF COASTAL WATERS							
CHANGE IN THE NATURAL DRAINAGE PATTERNS							
SOLID WASTE GENERATION							
INCREASED EARNING POTENTIAL FOR COUNTRY							
TRAFFIC INCONVENIENCES							

KEY (See Appendix VI for definitions)					
Major		Minor		Positive	
Moderate		Negligible			

OUTLINE ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

8 Outline Environmental Management & Monitoring Plans

8.1 Introduction

The Monitoring Plan to be devised for the proposed cable lay involves the observation, review and assessment of onsite activities to ensure adherence to regulatory standards and the recommendations made to reduce or eliminate potential adverse impacts. The Plan must be comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies on completion of cable laying activities. It is recommended that the report be submitted within ten (10) days of the completion of the cable lay.

The monitoring report will include at a minimum:

- Raw data collected
- Tables/graphs (where appropriate)
- Discussion of results with respect to the project activities, highlighting parameters which exceed standards
- Recommendations
- Appendices with photos/data, etc.

It should be highlighted that the cable laying process is of very short duration, usually no more than one or two days. Land activities usually are completed within the same time frame. At a minimum, the following activities will be managed throughout the cable laying process:

8.1.1 Construction Phase Monitoring – Cable Lay, Trenching and Beach Manhole

- During trench construction activities, the topsoil removed should be placed in a location that ensures little or no fugitive dust formation from stockpile, no erosion potential, no turbidity impacts and be aesthetically acceptable. Should the contractor vacate the area leaving stockpiled material a suitable penalty (fine and removal cost) should be levied to remedy the situation within 10 working days.
- During cable lay in nearshore waters, the routing of the cable should be monitored and a video record taken to establish the condition in which the cable is laid. The cable should not come in contact with the coral reef. The cable should be anchored in areas where the potential for movement of the cable onto the coral reef is significant. Should the cable be found to impact of the coral reef, the contractor should be held liable to remedy the situation within the shortest possible time period.

- Noise levels along the perimeters of the project area should be monitored during the cable lay process and any defective equipment or vehicle removed from activities immediately.
- Erosion/Siltation Management – Exposed soil areas must be monitored to determine potential for erosion, silting and sedimentation particularly in the case of a rainfall during cable lay. If erosion, silting or sedimentation is a potential or occurs, immediate steps must be taken to negate their impacts, where applicable.

8.2 Outline Environmental Monitoring Plan

This section outlines the main environmental parameters to be monitored, timing of the monitoring work and the recommended frequency of monitoring for general aspects of the proposed project. A more detailed scope of work will be provided once an environmental permit with accompanying conditions have been issued, and will be subjected to NEPA's approval prior to the commencement of any pre-construction/construction work.

The main objectives of the proposed monitoring plan are:

1. to clarify and identify sources of pollution, impact and nuisance arising from the proposed works;
2. to confirm compliance with legal and contract specifications;
3. to provide an early warning system for impact prevention;
4. to provide a database of environmental parameters against which to determine any short term or long term environmental impacts;
5. to propose timely, cost-effective and viable solutions to actual or potential environmental issues;
6. to monitor performance of the mitigation measures;
7. to verify the EIA predicted impacts;
8. to collate information and evidence for use in public, NEPA, and any other required regulatory consultation; and

The basic details of monitoring are discussed in the following tables.

Table 8-1: Framework for Environmental Monitoring

Monitoring	Period	Parameters	Monitoring Frequency
Noise	Baseline (1 occasion)	Leq* (30 mins) GPS location	One set of measurements at selected locations prior to commencing cable laying activities (at property

Monitoring	Period	Parameters	Monitoring Frequency
			boundary)
	Cable lay	Leq (60 mins) GPS location	Three (3) set of measurements between 0700-1900 hours during the cable laying process.
Air Quality	Baseline (1 occasion)	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (24 hour sampling) at selected locations (downwind of site activities and in close proximity to human receptors).
	Cable Lay	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (24 hour sampling) at selected locations during cable lay (downwind of site activities and in close proximity to human receptors).
Waste	Baseline	Visual Survey of proposed cable landing site	Once prior to commencing cable laying activities
	Cable Lay	Routine supervision of construction works	For duration of cable lay
Chemical Waste & Control of Spills	Cable Lay	Materials to be used during construction	For duration of cable lay

Note (1): Should the construction schedule require works in restricted hours, monitoring in the form of 3 consecutive Leq $_{(5mins)}$ readings should be taken.

Leq: One of the more common descriptors used to characterize the fluctuating noise levels is called the Equivalent Sound Level or Leq. The Leq sound level is the steady A-weighted sound energy which would produce the same A-weighted sound energy over the same given period of time as the specified time-varying sound.

8.2.1 Reporting

Deliverables in the form of the summary environmental monitoring reports should be prepared in accordance with any requirements issued by NEPA as part of the Environmental Permit.

It is recommended that the summary report be submitted to NEPA no more than 10 working days after conclusion of cable lay activities.

REFERENCES

9 References

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APPENDIX

Appendix I: Approved Terms of Reference

TERMS OF REFERENCE

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

THE LANDING OF A FIBRE OPTIC CABLE AT GOLDEN SANDS BEACH IN ST. ANN, JAMAICA

BY

ALCATEL-LUCENT SUBMARINE NETWORKS

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Terms of Reference

Conrad Douglas & Associates Limited (**CD&A**) has been contracted to conduct the Environmental Impact Assessment for the implementation of the proposed Fibre Optic Cable Landing at Golden Sands Beach Cottages in Ocho Rios, St. Ann, Jamaica. In keeping with the requirements of the National Environment and Planning Agency (NEPA), CD&A provides this Revised Draft Terms of Reference document for review of the captioned project.

Background

Alcatel-Lucent Submarine Networks (ASN) in collaboration with their client TGC and their local partners LIME, are seeking to land a fibre-optic cable in St. Ann, Jamaica. The sub-sea fibre-optic cable lay will connect Jamaica and Cuba, with termination in Venezuela. This proposed network is known as the ALBA-1 Fibre Optic Cable System and comprises two segments. This will facilitate continued high quality connectivity and broadband access for Jamaica through another international port. Hence greatly improving the reliability of the telecommunications industry in Jamaica, and especially for LIME provided services.

The landing party in Jamaica will be LIME, a telecommunications license holder in Jamaica.

This project will present the country with another option for linking with the outside world and provide LIME a level of redundancy to their network to safeguard against total disruption of services in the event of significant natural disasters, representing great economic and social potential.

Study Area

The study area will include to some extent Jamaica's territorial waters and one (1) landing site, namely the Golden Sands Beach (St. Ann). The projected sphere of influence of the study sites is expected to be no more than 1km in radius of identified sites. The landing site is approximately 500 m west of the White River and about 4 km east of LIME's existing terminal station in Ocho Rios. The landing is already in use by one other in service fibre optic cable, the Cayman Jamaica Fibre System (CJFS), which was installed in 1996. ALBA-1 will share an existing LIME terminal station in Jamaica with CJFS.

Scope of Work

The Scope of Work requires that a Marine Assessment be carried out. The Scope of Work is listed under the tasks to be undertaken below.

Tasks to be Undertaken

The tasks to be undertaken are structured to meet the requirement of the National Environment and Planning Agency (NEPA), Ministry of Health (Environmental Health Unit), Office of Disaster Preparedness and Emergency Management (ODPEM) and all other relevant governmental and regulatory agencies.

Task 1: Project Description

CD&A will identify all the critical activities, equipment and procedures that will be implemented throughout the major stages of the project. The project designs, specifications, and schedules will be clearly presented in this section. The completed project description will include at a minimum, details such as:

- Description of the materials of construction and structure of the fibre optic cable. Method of linkages and securing along its alignment as well as linkages from sea to land
- Project implementation schedule, descriptions of preconstruction, construction and occupational activities
- Detailed description of project components, with special emphasis on those that may cause potential environmental impacts during each phase.
- Review of designs with details to show how Alcatel-Lucent will be able to maintain environmental compliance and not negatively impact the environment. This includes structural, operational and emergency safeguards
- Mode of operation, hours of operation and types of machinery and equipment to be used. Special emphasis will be placed on activities that involve the generation of waste materials
- The number of employees proposed for the operation
- Description of the role of regulatory agencies, NEPA, Parish Council, Marine Police and others in terms of inspections and follow-up visits

The relevance of the project to national development will also be evaluated.

Task 2: Policy, Legislative and Regulatory Framework

All International and Government of Jamaica policies, legislation and regulations relevant to the project will be identified and analysed. This will be a comprehensive analysis from which Alcatel-Lucent will be advised as necessary to ensure that all phases of the project maintain compliance.

Task 3: Analyses of Alternatives

Alternative landing sites and plans (inclusive of the preferred and no action alternatives) will be evaluated in terms of the economic, logistical, and environmental selection criteria, inclusive of their potential for positive and negative impacts, and the degree to which the negative impacts may be mitigated. In the case of each alternative reviewed a rationale will be provided for selection or non-selection.

Task 3.1: Description of Current and Proposed Broadband Systems in Jamaica

CD&A will utilize both graphical and descriptive approaches to describe and compare the existing fibre optic equipment and capabilities on the island against those of the proposed upgrade, to highlight effectively the benefits both environmentally and economically of the proposed project. This will include at a minimum:

- Characteristics of the methods, equipment and processes
- Designs, size, scale and capacity
- Equipment and machinery

Task 4: Description of Current Environmental Baseline Data

This task seeks to identify the principal parameters of the natural and human environment which may be sensitive to the project, and to compile, analyse, assess and document the present (baseline) status of this environment. This database will provide an invaluable baseline against which future impacts on the environment may be measured. The environmental setting and baseline parameters will address primarily the bio-physical environment and the socio-cultural environment.

The Bio-Physical Environment

- Topography, basic land, and marine conditions.
- geomorphology and earth surface processes
- natural hazard vulnerability and risks
- marine environment (territorial waters)
- wind speed and direction
- water quality surveys
- marine floral and faunal types and their distribution
- the ecology of the marine area (identification of any rare, endangered and threatened species, and habitats)

These studies will incorporate the proposed landing site and the surrounding environment/communities that may be impacted. A potential environmental sphere of influence will be developed based on the information collected and the potential for impact.

The Socio-Cultural Environment

Both primary and secondary data sources will be developed involving: documentation of the existing human environment will include a review and analysis of census data. Populations in the environs of the landing sites will be taken into account in compiling the socio-economic baseline information. A coded, pre-tested socio-economic survey instrument will be developed and administered in the communities located within the anticipated sphere of influence of the project.

The findings will be presented in a manner to categorize and identify socio-economic impacts (perceived and real) in terms of positive and negative.

Among the key elements which will be addressed are:

- the spatial distribution of coastal communities within the sphere of influence of the proposed project
- demographic profile
- use/dependence on natural resources
- knowledge of the proposed project and their disposition towards it
- occupations and skills
- employment levels
- economic activity
- relevant historical heritage in the vicinity of the site

Task 5: Impact Identification

All potential impacts on the receptors and attributes of the environment, both adverse and beneficial, will be identified and their duration, magnitude, reversibility, and extent described and quantified. In addition, in the case of positive impacts, recommendations will be made on their maximisation. This will cover all phases of the project. This will include qualitative as well as quantitative assessments. Areas to be addressed will include at a minimum:

- Human population of the area
- Flora and fauna
- Marine environment
- Weather and climate
- Cultural Heritage Resources

Cumulative impacts will also be addressed by taking into account existing operations in the area, particularly in respect of their contribution to the baseline and the incremental changes which will be caused by the proposed works, if any.

Task 6: Impact Mitigation

An impact mitigation plan will be developed. This will include the measures to be implemented in the environmental action plan for each potentially negative impact identified. These will also include mitigative measures to be applied during all phases of construction and operation to minimise or eliminate any identified negative impacts. Estimated costs to implement the mitigation items in the plan will be presented. Additionally a Disaster Preparedness Plan for the project will be developed based on findings of the Natural Hazard and Vulnerability section of the report.

Task 7: Environmental Management and Training

CD&A will work with ASN and their sub-contractors to develop management and training protocols to govern the actions of employees and contractors within Jamaica's territorial waters and on land during all phases of the project. The protocols developed will address all the steps which will be taken during the site preparation, construction and operating phases of the project to avoid, or mitigate potential impacts, as well to maximise beneficial impacts. Where necessary, required training activities will be defined and in conjunction with Alcatel-Lucent these will be developed and tested. This is an important step in the project as it speaks to issues of regulatory compliance, liability, and occupational health and safety.

Task 8: Environmental Monitoring Plan

CD&A will develop an environmental monitoring plan in which all the parameters to be monitored and the methods to be used will be identified and described. This plan will include at a minimum:

- An organizational/responsibility chart
- Institutional arrangements for carrying out the work
- Parameters to be monitored
- Methods to be employed
- Standards, guidelines or protocols to be used
- Evaluation of results
- Schedule and duration of monitoring
- Initiation of mitigative actions
- Format and frequency of reporting

Task 9: Risk Assessment/Natural Hazard Vulnerability

All potential physical risks associated with the proposed project, such as hurricanes, earthquakes, fires, explosions, spillages, flood events and landslides will be identified and addressed. Methods to address these will also be documented.

A Disaster Preparedness Plan/Emergency Response Plan for any construction site will be developed based on the findings of this task and through consultation with the Office of Disaster Preparedness and Emergency Management (ODPEM), as necessary.

Task 10: Public Participation

CD&A will follow international and NEPA's national guidelines for public participation that the public, particularly those who may be impacted (negatively or positively) by the project. This will begin as an early stage in planning and project implementation. Public participation will provide early indications of public perception and potential areas where problems may arise and what it may take to handle those situations. While the socio-economic survey will introduce the project to the community through a fact sheet, informal meetings and collaborations will be held with community leaders and members to explain the project.

CD&A recommends the following procedures and schedule for meeting with communities in the estimated radius of influence of the facility:

Procedures:

- Identify and classify the various communities in the radius of influence
- Identify and involve "community leaders" early in the process
- Listen carefully and record the ideas, needs, and wants of the communities (where possible implement their input into the process)

CD&A recommends that this type of interface with the community continue as long as the project is being implemented and beyond if practicable, to foster good community relations.

The Marine Assessment Report

CD&A will present all findings in the Marine Assessment, reflecting the headings in the body of the approved Scope of Detail, as well as other references. Eight (8) hard copies and one electronic copy of the report will be submitted to NEPA. It will include an appendix with items such as maps, site plans, the study team, photographs and other relevant information.

The Marine Assessment Report will take the following form:

- Executive Summary
- Project Description
- Policy, Legislative and Regulatory Framework
- Analyses of Alternatives
- Description of Current Physical, Environmental and Socio-Economic Baseline Data
- Risk Assessment/Natural Hazard Vulnerability
- Impact Identification
- Impact Mitigation
- Environmental Monitoring Plan
- Environmental Management and Training
- List of References
- Appendices

Appendix II: General Socio-Economic Survey Instrument

SURVEY INSTRUMENT
ENVIRONMENTAL IMPACT ASSESSMENT
For
ALCATEL Fibre Optic Cable Lay, Shaw Park, St. Ann

Name of Community:	____________________	Community Code:	☐☐☐☐☐
Name of Interviewer:	____________________	Date:	__________

<u>SECTION 1: PERSONAL CHARACTERISTICS</u>

1. Gender: Male ☐ Female ☐
2. Age Range

Under 20	☐	20 – 39	☐	40 – 49	☐
50 – 59	☐	60 – over	☐	Not Stated/No Response	☐

3. How many years have you been living in the community?

0 – 5 Years	☐	6 – 10 Years	☐	11 – 20 Years	☐
more than 20 Years	☐	Not Stated/No Response	☐		

4. How many people live in this household? M _______ F _____ Total _____

- How old are they?

Age Range	#	Age Range	#
0-14	______	36-45	______
15-19	______	46-55	______
20-35	______	56-64	______
		65 and over	______

- How many persons are in paid employment? ______
- How many persons are unemployed? ______

6. Are you in paid employment? Yes ☐ No ☐
7. What is your occupation? ____________________________________
8. What is the highest level of education attained?

Primary	☐	Secondary	☐	Tertiary	☐
Vocational/Technical	☐	Not Stated/No Response	☐		

SECTION 2: KNOWLEDGE AND VIEWS ON THE FIBRE-OPTIC CABLE LAY

9. Are you aware of the proposal to land a fibre-optic cable lay at Shaw Park Beach in St. Ann?

Yes ☐ No ☐

If yes, are you:

Strongly in favour ☐ In favour ☐ Neither in favour or against ☐

Against ☐ Strongly against ☐

10. What are your reasons?

____

____

____

11. What effect do you think the proposed fibre-optic cable lay will have on the following:

- Economic value of ***your*** community

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

- Job Opportunities

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

- Pollution

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

12. Is the community adequately serviced by the following? ***ASK & WAIT FOR RESPONSE***

Internet Yes ☐ No ☐

Transportation Yes ☐ No ☐

Cable TV Yes ☐ No ☐

13. Are you aware that a similar cable was landed at Shaw Park Beach in 1997? This cable has been operating for more than a decade without any environmental issues.

Yes ☐ No ☐

14. Do you think the proposed fibre-optic cable lay will affect you personally?

Yes ☐ No ☐

Don't Know/Not Sure ☐ Not Stated/No Response ☐

If Yes, how?

____

____

15. Do you think that the area needs this type of development?

Yes ☐ No ☐

16. How may this development impact your community?

____

____

____

SECTION 3: SOCIAL ATTITUDES

17. Have you or any member of your household ever worked in the telecommunications industry?

Yes ☐ No ☐

Don't Know/Not Sure ☐ Not Stated/No Response ☐

18. Do you look forward to this development?

Yes ☐ No ☐

If Yes, how?

____

____

If no, why not?

____

____

19. Do you think that the fibre-optic cable lay and any associated construction activities will affect the availability of any of the following resources (fishing, use of beach, swimming, diving, snorkelling or pleasure boating?)

Yes ☐ No ☐

If Yes, please state which of the resource(s) you suspect will be affected?

____

____

20. For each affected resource, describe briefly, the nature/extent of the effect

Resource	Nature/ extent of effect
______________________________	______________________________________
______________________________	______________________________________
______________________________	______________________________________
______________________________	______________________________________

21. Do you use the Shaw Park Beach and its environs for any activity?

Yes ☐ No ☐

If Yes, what do use the proposed site for?

____

____

22. Do you think the proposed development will have any impacts on the environment?

Yes ☐ No ☐

If yes, please explain.

____

____

23. What benefits do you think the proposed development will have on the community, if any?

____

____

24. Do you have any involvement in the proposed development?

Yes ☐ No ☐

If Yes, how are you involved?

____

____

The completed survey instrument is available for review at your discretion.

Appendix III: Focus Group Survey Instrument

SURVEY INSTRUMENT – FOCUS GROUP
ENVIRONMENTAL IMPACT ASSESSMENT
For
Alcatel Fibre Optic Cable Lay, Shaw Park Beach, St. Ann

Date:____________________

1. What is the name and nature of your business? ____________________________________

____

____

2. Approximately how many persons are employed by your business? __________
3. How many years have you been working in this community? ________

OPINIONS ON THE BUSINESS COMMUNITY

4. How would you rate your business community?

   Very Safe ☐ Safe ☐ Unsafe ☐ Very Unsafe ☐

5. Is the business community adequately serviced by the following?

   Telephone services Yes ☐ No ☐

   Cable Services Yes ☐ No ☐

   Internet Services Yes ☐ No ☐

KNOWLEDGE AND VIEWS ON THE PROPOSED ALBA-1 CABLE LAY

6. Are you aware of the proposal to land a fibre-optic cable at Shaw Park Beach on the property of the Shaw Park Beach Hotel

   Yes ☐ No ☐

7. What effect do you think the proposed fibre-optic cable lay will have on your business?

   Positive ☐ Negative ☐ No Change ☐ Don't Know ☐

   What are your reasons?

   ____

____

____

8. Do you think that the area needs this type of development?

Yes ☐ No ☐

9. Are you aware of any other new development in or near your business community?

____
____
____

10. Do you look forward to this development?

Yes ☐ No ☐

If Yes, how?

____
____
____

If no, why not?

____
____

FOR FISHING & OTHER MARINE INTERESTS

11. Where do you fish or boat generally?

____

12. Do you think the laying of the fibre-optic cable will interfere with your activities?

Yes ☐ No ☐

How? ____

13. What types of fishing do you practice?

Hook & Line ☐ Trap/Fish Pots ☐ Dive ☐ Spearfishing ☐ Nets ☐

Other (specify) ____________________________________

14. What time of day do you fish ______________________________

15. Are you aware there is little or no risk of pollution from this project?

Yes ☐ No ☐

Thank You

End of Survey

Appendix IV: List of Preparers

Information and data for this EIA was compiled from work done by the following persons and/or organisations:

1. Dr. Conrad Douglas – Process and Environmental Management Specialist –Planning & Project Director
2. Mr. Orville Grey Jr. – Project Manager – Project Management & EIA Specialist
3. Mr. Wayne Morris – Chemical & Process Engineer – Air Quality & Noise Assessment
4. Mr. Doran Beckford – Process and Environmental Engineer – Air Quality & Noise Assessment
5. Mr. Burklyn Rhoden, Mr. Noel Watson & Team – Socio-Economic Survey
6. Mr. Peter Wilson-Kelly and Mr. Marvin White – Marine Ecology
7. Mr. Anthony Pyne – EGS Limited – Cable Route Surveyors

Appendix V: Inter-Agency Communications

FORM 2 (Regulation 3)

THE TELECOMMUNICATIONS ACT

The Telecommunications (Forms) Regulations, 2000

Carrier Licence
(Pursuant to section 13)

TELECOMUNICACIONES GRAN CARIBE S.A CARRIER LICENCE

Licence No.:

The Minister pursuant to section 13 of the Telecommunications Act hereby grants a carrier licence to **TELECOMUNICACIONES GRAN CARIBE S.A** of

Ministerio del Poder Popular para las Telecomunicaciones y la Informática,
Avenida Andrés Bello, Torre Fondo Común
3er piso, Distrito Capital,
Republica Bolivariana de Venezuela. ZP

subject to the terms and conditions specified in the Schedule.

SCHEDULE

Terms and Conditions of Licence

Grant of Rights

1. The licensee is licensed to own and operate, in accordance with the terms of this licence, the following facilities:

I. A submarine fibre-optic cable system named the **ALBA-1** System which links Jamaica to Cuba via a non-repeatered cable. The routing of the cable system and the system configuration are provided in Annex 1 hereto denoted as Figure 1 and Table 1-3.

II. Cable landing stations, satellite earth stations including VSATS, submarine fibre optic cables anywhere in Jamaican waters, terrestrial fibre cables in Jamaica, telecommunications points of

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presence, co-location facilities, cross-connect facilities, international gateway switches, transmission towers, telecommunications cable landing points and buildings and conduits to house these facilities.

III. Such facilities comprising a network for the provision of all specified services to other carriers or service providers Licensed under Section 13 of the Telecommunications Act, including, for the avoidance of doubt, subscription television operators and Licensees, to or from:

(a) anywhere in Jamaica; and/or
(b) anywhere outside Jamaica, provided that such foreign locations have not been proscribed by the government.

For the avoidance of doubt, **TELECOMUNICACIONES GRAN CARIBE S.A.** is not authorized to own or operate any other facilities unless such facility is specified in Annex 1 hereof, by amendment or otherwise.

On the application of the licensee for the addition or removal of any facility specified hereunder, the Office of Utilities Regulation shall amend this Schedule on such terms as the Office of Utilities Regulation (on consultation with the Ministry) deems fit.

Commencement, Duration and Renewal of Licence

2. This licence shall take effect on the **17th day of November, 2009** and shall be for a term of twenty years, unless the licence is renewed. The term shall commence on the 'Ready For Service Date' which shall be no later than the **31st day of March, 2011**.

3. This licence shall be renewable pursuant to section 15 of the Telecommunications Act.

Assignment or Transfer of Licence

4. This licence and any right granted hereunder shall not be assigned or otherwise transferred except in accordance with the Telecommunications Act.

General

5. Any notice or other document required or authorized to be served upon the licensee may be served at the licensee's address, or where the licensee is a company, the address of its registered office.

6. This licence, and the terms and conditions hereof, shall constitute the entire licence and supersede any prior licenses, permits or undertakings.

7. This licence is granted subject to the other terms and conditions set out in Annex 3 attached hereto.

Revocation or Suspension of Licence

8. Any contravention of the above terms and conditions may result in the suspension or revocation of this licence pursuant to the provisions of the Telecommunications Act.

Dated this 17th day of November 2009.

Bruce Golding

....

Honourable Bruce Golding
Prime Minister

Appendix VI: Impact Identification Definition and Significance of Impacts

In assessing the significance of potential impacts, various measures are used. These include the use of checklists/matrices, expert knowledge and a keen assessment of the project plans and details. Each parameter is evaluated according to the following:

- Potential impact - any change to the environment, whether adverse or beneficial, wholly or partially resulting from the proposed activities, products or services
- Activity – phase of development that action takes place in
- Environmental receptor - sensitive component of the ecosystem that reacts to or is influenced by environmental stressors
- Magnitude - A measure of how adverse or beneficial an effect may be
- Duration - the length of time needed to complete an activity
- Significance - A measure of importance of an effect
- Mitigation - Measures taken to reduce adverse impacts on the environment

Outlined below are the impacts on the various phases of the proposed development as they relate to key aspects of the project. Namely:

- Physical environment
- Biological environment
- Socio-economic environment
- Cumulative impact assessment

Mitigation measures are provided, where necessary, at the end of each subsection.

<u>Impact Identification & Mitigation Method</u>

A. Impact Identification

This section is undertaken to forecast the characteristics of the main potential impacts. Known as impact analysis, this stage can be broken down into three overlapping aspects:

- *identification* — to specify the impacts associated with each phase of the project and the activities undertaken;
- *prediction* — to forecast the nature, magnitude, extent and duration of the main impacts; and
- *evaluation* — to determine the significance of residual impacts i.e. after taking into account how mitigation will reduce a predicted impact

Impact identification and prediction are undertaken against an environmental baseline, such as:

- human health and safety;
- flora, fauna, ecosystems and biological diversity;

- soil, water, air, climate and landscape;
- use of land, natural resources and raw materials;
- protected areas and designated sites of scientific, historical and cultural significance;
- heritage, recreation and amenity assets; and
- livelihood, lifestyle and well being of those that may be affected by the proposed project

These requirements were identified in the Terms of Reference. The parameters to be taken into account in impact prediction and decision-making include:

- likelihood (probability, uncertainty or confidence in the prediction);
- nature (positive, negative, direct, indirect, cumulative);
- magnitude (severe, moderate, low);
- extent/location (area/volume covered, distribution);
- duration (short term, long term, intermittent, continuous);
- reversibility/irreversibility; and
- significance (local, regional, global)

A.1 Nature

The most obvious impacts are those that are directly related to the proposed project, and can be connected (in space and time) to the action that caused them. Typical examples of direct impacts as it relates to this project are: modifications of a surface runoff on and adjacent to the project site; loss of habitat caused by land clearance; any perceived changes/increases in air particulate emissions (temporary/permanent), etc.

Indirect or secondary impacts are changes that are usually less obvious, occurring later in time or further away from the impact source. Typical example of indirect impact as it relates to this project is: noise related stress caused by urban development.

Cumulative effects, typically, result from the incremental impact of an action when combined with impacts from projects and actions that have been undertaken recently or will be carried out in the near or foreseeable future. These impacts may be individually minor but collectively significant because of their spatial concentration or frequency in time. Cumulative effects can accumulate either incrementally (or additively) or interactively (synergistically), such that the overall effect is larger than the sum of the parts.

A.2 Magnitude (Intensity)

Estimating the magnitude of the impact is of primary importance. In this document it is expressed in terms of relative severity, such as major, moderate or low. Severity, will also take into account other aspects of impact magnitude, notably whether or not an impact is reversible.

- **Low**: negligible effect when component is slightly altered. For human population the effect is negligible when it slightly affects a component or its use or valuation by the community.
- **Moderate**: moderate effect when component is altered to a lesser extent but doesn't compromise its presence in the new environment. For human population the effect is less intense when it partially limits the use of the component or its valuation by the community.
- **Major**: major effect when component is completely destroyed or is altered significantly. For human population the effect is when it compromises or alters significantly the component or its use or valuation by the community.

A.3 Duration

Some impacts may be short-term, such as the noise arising from the operation of equipment during construction. Others may be long-term, such as noise arising from the operation of conveyor during operation. Certain impacts may be intermittent, whereas others may be continuous.

- **Short-term impacts**: when component will be affected for a limited period such as the pre-construction phase of the project, i.e., pre-construction and construction.
- **Intermittent impacts**: when component will have difficulty to adjust at first to the new environmental conditions but will eventually return to pre-project levels and the population will be able to use it eventually as before or even better.
- **Long-term impacts**: when component will be affected for the lifetime of the project enough to compromise the survival of a local species or use of a component by the population.

Impact magnitude and duration classifications will be cross-referenced; as necessary, for example, major but short term (less than one year).

A.4 Extent/Location

The spatial extent or zone of impact influence can be predicted for site-specific versus regional occurrences. Depending on the type of impact, where necessary, the variation in magnitude will be estimated.

- **Limited**: When impact occurs in relatively restricted areas such as the construction site facilities
- **Local**: Limited area when component is well represented in region (<1 km radius)
- **Regional**: When an impact exceeds local boundary and has the potential to affect a wide radius of communities such as a nearby town (1-10 km radius)
- **National**: When an impact has the potential to affect the entire island
- **International**: Impacts that may be considered as affecting the global population such as contributions to global warming

A.5 Significance

The evaluation of significance at this stage of EIA will depend on the characteristics of the predicted impact and its potential importance for decision-making. An impact may be categorized as negative if it adversely affects an environmental component and positive if it favourably affects an environmental component. For the purposes of this project:

- **Minor**: An impact of low significance is one that is short term and will have no long term cumulative effect on the environment and/or will affect a negligible portion of an environmental component.
- **Moderate**: An impact may be considered to be of moderate significance when the change is medium to long term and/or will result in changes that affect a considerable portion of the environmental component.
- **Major**: An impact of high significance will cause long term changes and/or will result in changes that affect a major percentage of the environmental component.

Significance may also be attributed in terms of an existing standard or criteria of permissible change.

B Impact Mitigation

The elimination of adverse environmental impacts or their reduction to an acceptable level is at the heart of the EIA process. By definition all EIA projects are likely to have significant environmental effects. In this case, the potential for mitigation will be considered at every stage of the proposed project. In determining the level of effectiveness of mitigation measures, the following will be taken into account:

A. **Prevent** - The most effective approach will be to prevent the creation of adverse environmental effects at source rather than trying to counteract their effects through specific mitigation measures. At source solutions may include:
    - specification of operational equipment- for example the use of an inherently quieter machine
B. **Reduce** - If the adverse effects cannot be prevented steps will be taken to reduce them. Methods to reduce adverse effects include: minimisation at source
    - use of low noise or vibration construction equipment
    - operating the site to minimise the production of leachate
    - abatement on site
        i. colour of buildings
        ii. screen planting and landscaping
        iii. noise attenuation measures
        iv. reduced hours of construction
    - abatement at receptor

i. noise insulation for houses

ii. relocating rare species

Quantification of impacts is a difficult technical aspect of an EIA. For some impacts the theoretical basis for computing the magnitude does not exist. Such impacts may have to be addressed in a qualitative way.

C. Summary of Impact Matrices

Summary matrices are included and give an overall picture of the potential pre-mitigation impacts and residual impacts.

C.1 Residual Impacts

Any potential residual impacts, ranked as moderate or major will be discussed in more detail in the subsequent text in the section addressed. The residual environmental impacts refer to the net environmental impacts after mitigation, taking into account the background environmental conditions and the impacts from existing, committed and planned projects.

The following table outlines the criteria used to assess environmental impacts in terms of minor, moderate, or major impact subsequent to mitigation measures being incorporated.

Table C: Level of Impact after Mitigation Measures

	Ecological Effects	Socio-economic Effects	Stakeholders	Consequence for Proponent
Major	Degradation to the quality or availability of habitats and/or fauna with recovery taking more than 2 years	Change to commercial activity leading to a loss of income or opportunity beyond normal business variability/risk Potential short term effect upon public health / well-being, real risk of injury	Concern leading to active campaigning locally or wider a field	Introduce measures to avoid these impacts wherever possible, closely monitor and control areas of residual impact
Moderate	Change in habitats or species beyond natural variability with recovery potential within 2 years	Change to commercial activity leading to a loss of income or opportunity within normal business variability/risk Possible but unlikely effect upon public health/well-being. Remote risk of injury	Widespread concern, some press coverage, no campaigning	Actively work to minimize scale of impacts
Minor	Change in habitats or species which can be seen and measured but is at same scale as natural variability	Possible nuisance to other activities and some minor influence on income or opportunity. Nuisance but no harm to public	Specific concern within a limited group	Be aware of potential impacts, manage operations to minimize interactions
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe	Noticed by but not a nuisance to other commercial activities. Noticed by but effects upon the health and well-being of the public	An awareness but no concerns	No positive intervention needed but ensure they do not escalate in importance
Positive	An enhancement of ecosystem or popular parameter	Benefits to local community	Benefits to stakeholder issues and interests	Actively work to maximize specific benefits

Appendix VII: Photo Inventory

Plate 9-1: General Environs of the Project Site

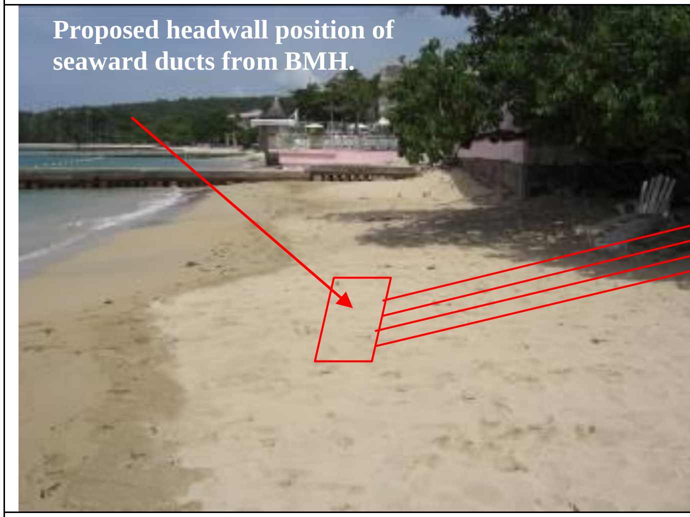
View of beach at landing point looking south east

View of beach at landing point looking west

View of beach at landing point looking south from end of jetty.

View of beach at landing point looking south from end of jetty.

View looking south along jetty

Views looking east from jetty	
	
View looking east along beach showing proposed location of seaward ducts.	View of road and proposed BMH position
	
View of land route looking west from BMH	View of beach property perimeter fence seaward of proposed BMH position
	

View of beach perimeter wall that can be removed for beach access for equipment (shown in red)	View of BMH position looking east
	
View of beach perimeter wall that can be removed for beach access for equipment (shown in red)	View looking west along land route from beach.
	
View looking north along land route from junction with Ocho Rios by-pass	View looking south along land route towards junction with Ocho Rios by-pass

	
View looking west along Ocho-Rios by-pass. Land route to pass on right side of road	View looking west along Ocho-Rios by-pass. Land route to pass on right side of road
	
Test hole dug at planned manhole position	View looking west along Ocho-Rios by-pass. Land route to pass on right side of road
	
View looking west along Ocho-Rios by-pass. Land	View looking east along Ocho-Rios by-pass. Land

route to pass on right side of road	route to pass on left side of road
	
Manhole construction works on Ocho Rios by-pass	Trenching works on Ocho Rios by-pass
	
Trenching works on Ocho Rios by-pass	
	
Laying ducts and installing draw rope	

	
Junction of Ocho Rios by-pass and Craft Market Road	View looking North down Craft Market Road. Land route to pass on left of road. Visible works are for water utility and not associated with ALBA-1 works.
	
Junction of Craft Market Road and Main Street looking west along Main Street. Land route to pass on left side of road	Junction of Craft Market Road and Main Street looking east

	
Power / telegraph cables along Main Street over proposed land route	View looking south from junction of Main Street and Douglas Close towards terminal station
	
View looking east from junction of Main Street and Douglas Close along Main Street. Land route to pass on right side of road	View looking north down Douglas Close from terminal station