1.0 PROJECT DESCRIPTION

EEPGL intends to implement a secure high-speed fiber optic / wireless transport service for its Guyana onshore and offshore facilities. This will be achieved by installation of a submarine fiber optic cable connecting the offshore EEPGL facilities to onshore network services. This connection will establish a foundation for high-speed / low-latency connectivity of onshore and offshore facilities as they become operational. The link will connect existing EEPGL onshore and offshore facilities to Guyana foundation infrastructure, allowing implementation of digital technology to improve productivity (field access data and planning), support remote operations, and support reliability (process monitoring and inspection).

EEPGL proposes to construct the Project starting in Q4 2020 (beginning with onshore civil work for the CLS) and ending in Q3 2021, followed by a connection to the Liza Phase 2 offshore development in 2022 and a planned connection to the Payara offshore development in 2023 pending required approvals. A "diverse-routed" subsea cable will be installed in a loop configuration during a single installation event between the offshore Stabroek Block and onshore facilities (Figure 1-1).

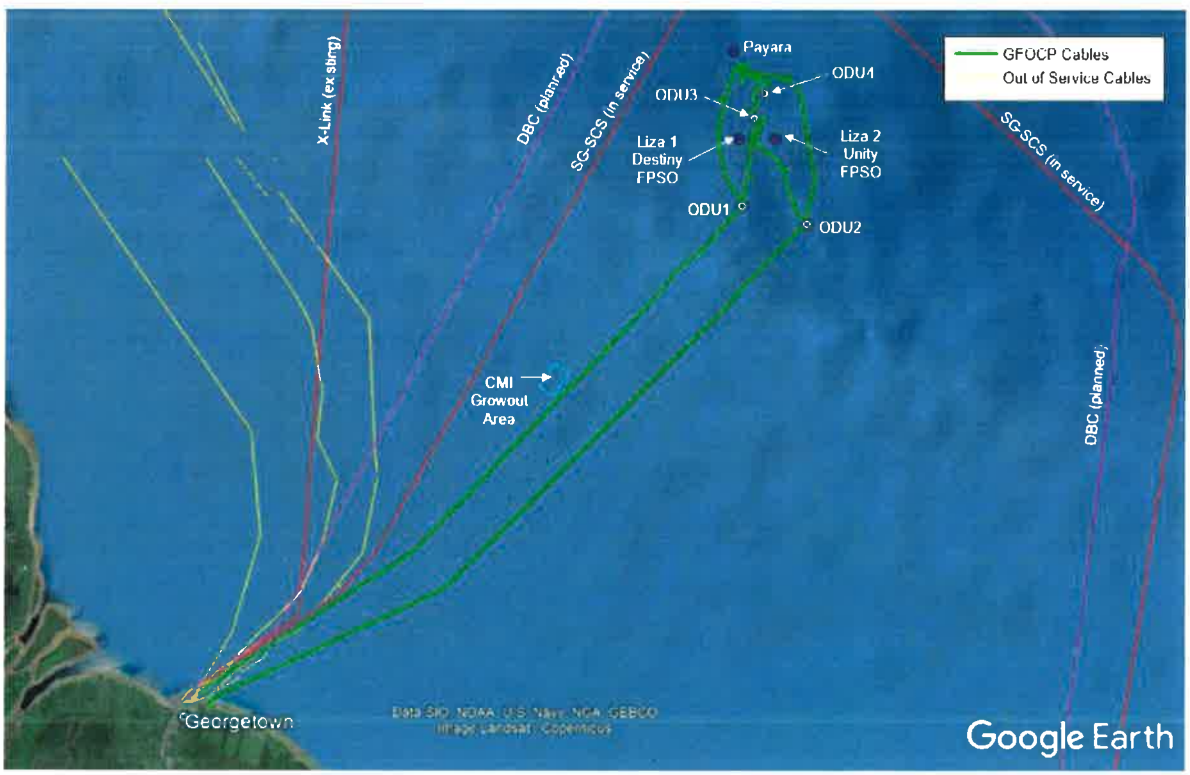


Figure 1-1 Offshore Fiber Optic Cable Route

1.1 SCOPE AND LOCATION OF THE PROJECT

The Project includes the construction / installation and operation / maintenance of the fiber optic cable infrastructure. The major components of the Project infrastructure are outlined in Table 1-1.

Table 1-1 Major Components of Project Infrastructure

Major Component	Description
FPSO (Floating, Production, Storage and Offloading) Topside Fiber Optic Terminations	Each FPSO will have Fiber Optic Junction Box terminations, which will lead to optical transport equipment in the Telecommunication Equipment Room.
FPSO Umbilical System	Each FPSO connected to the Project will have an umbilical system that allows for subsea fiber optic connection.
Optical Branching and Distribution System	Optical distribution units (ODUs) will be installed offshore in the Stabroek Block. Each FPSO will be allocated a number of cores (6 to 8 cores per FPSO) that connect to the ODUs.
Diverse-Routed Cable to Onshore Cable Station	From Stabroek Block strategic locations, two diverse-routed fiber optic cables with multiple cores of fiber will connect to CLSs onshore.
Beach Manholes (BMH)	The subsea cable runs will terminate at two onshore, geographically separated BMH.
Cable Landing Stations (CLSs)	Two onshore geographically separated CLSs where cables from the BMH will be connected to optical transport equipment in the CLSs (one integrated within the Ogle Office Campus).
Dark Fiber Optic Connections to Offices	Where possible, the fiber optic connections will use existing infrastructure (trenches or aerial lines) from the CLSs to the EEPGL office location.

The marine route includes approximately 550 kilometer (km) of seabed cable, with lines from ODUs to onshore landing points and from optical distribution units (ODUs) to the Floating, Production, Storage and Offloading (FPSOs). The overall route is broken into three Subsystems (Figure 1-1, Table 1-2):

- Subsystem 1 is the trunk cable from Georgetown to ODU1 and from ODU2 back to shore
- Subsystem 2 is cable branches from ODU1 and ODU2 to the Liza Phase 2 FPSO
- Subsystem 3 is cable branches from ODU1, ODU2, ODU3 and ODU4 to the Payara FPSO

Table 1-2 summarizes the total cable lengths for the segments, and Section 2.2.4 describes the three segments in detail.

Table 1-2 Cable Route and Length

Segment		Cable Length (km)		
		Double Armour (DA) Cable	Single Armour (SA) Cable	Total Cable Length
Subsystem 1—Trunk Cable from Shore to ODU1 and from ODU2 Back to Shore				
1.1	Trunk Cable from Shore (Pegasus Site) to ODU1	105	74	179
1.3	Trunk Cable from Shore (Ogle Service Station Site) to ODU2	112	71	183
Subsystem 2—Cable Branches to the Liza Phase 2 FPSO				
2.1	Liza Phase 2 FPSO Branch to ODU1	-	25	25
2.2	Liza Phase 2 FPSO Branch to ODU2	-	34	34
Subsystem 3—Cable Branches to the Payara FPSO				
3.1	Payara FPSO Branch to ODU1	-	42	42
3.2	Payara FPSO Branch to ODU2	-	53	53
3.2	Payara FPSO Branch to ODU3 at DC3-I	-	23	23
3.4	Payara FPSO Branch to ODU4 at DC4-I	-	15	15

Note:
"-" = not applicable

Route selection considered other users of the marine environment, including fisheries, aquaculture, and other oil and gas operations. Fishing and other marine activity were taken into consideration in preliminary route engineering. In particular, the preliminary location of an offshore fish "growout area" proposed by Caribbean Mariculture Inc. (CMI) was taken into consideration, as were the locations of two existing in-service cable systems (Suriname Guyana Subsea Cable System [SG-SCS] and XLink [E-Networks]) and a planned cable system by the Deep Blue Consortium. The size of the CMI growout area was initially based on coordinates obtained from the Guyana EPA website. After consultations with CMI project personnel, the CMI area was revised to a smaller size and the cable route no longer needed to deviate to avoid it. The cable route will be greater than 1 km away from the proposed CMI area, and both projects will be able to coexist. A no-objection letter was received from CMI in relation to the Project on June 2, 2020.

The preliminary on-land routes for the cable are provided on Figure 1-2. The routes were selected to reduce the footprint of the Project where possible through use of existing conduits and transmission infrastructure (i.e., aerial power poles) and to have sufficient separation to provide the required redundancy. This route may require minor adjustments as EEPGL advances through the detailed design process and further engagement and alignment with government agencies and land owners.

Figure 1-2 Onshore Fiber Optic Cable Route

1.2 MARINE PROJECT COMPONENTS

The following sections describe the marine components of the Project, including the fiber optic cable and ODUs. A description of installation methods and detail on the final seabed routing selected for the Project is also provided.

1.2.1 Marine Fiber Optic Cable

Modern subsea fiber optic cables typically consist of several pairs of hair-like glass fibers, a copper power conductor, and steel-wire strength member, which is contained within high-density polyethelene. Layers of steel-wire armour are wrapped around the outside of the polyethelene jacket in areas where the cable requires extra protection from potential hazards, such as rocky or irregular seabeds, strong sea states (waves and currents), boat anchors, and fishing activity (Carter et al. 2009). The diameter of these cables typically ranges from 17 to 21 millimeter (mm) for deep-water cables, to 40 to 50 mm for more heavily armoured cables used in nearshore or harsh environments (Carter et al. 2009). Examples of standard fiber optic cables are shown in Figure 1-3.

Source: Carter et al. 2009

Figure 1-3 Examples of Marine Fiber Optic Cables

The Project cable will be designed to withstand laying, burial and potential recovery (e.g., if required for repairs). Burial of the cable, where feasible, will provide additional protection. Sections of the cable will be armoured for protection against the risks of abrasion and mechanical breaks due to environmental and/or anthropogenic stressors. The level of armouring (double, single) is dependent on seabed conditions, level of risk from external damage (either from natural hazards or a third party), and water depth.

Double armoured (DA) cable will generally be used between shore and approximately 50 meter (m) water depth, including areas known to be used for fishing and boat anchoring, to protect against damage. Single armour (SA) cable will be used at depths up to approximately 1,000 m. For the Project, SA cable will also be used for subsystems 2 and 3 in depths greater than 1,000 m for added protection due to the potential for future crossings of other infrastructure. The method of cable installation on the seabed will also vary with depth and sea conditions. Installation methods are discussed in Section 2.2.3.

1.2.2 Optical Distribution Units

An ODU allows for the passive connection of the topsides FPSO fiber optic cable system to main trunk cables headed onshore. A representative drawing of an ODU is provided in Figure 1-4. ODUs are installed on the seabed and are designed to connect to the FPSO. ODUs allow the trunk cable deployment at any time and will give flexibility for the individual connection of the different branches to the system. The ODUs will be designed to meet Project-specific requirements and can be adapted to incorporate the desired number of connectors. There will be a total of four ODUs, each with an approximate seabed footprint of 3 m by 5 m. The proposed locations for two of the ODUs are provided in

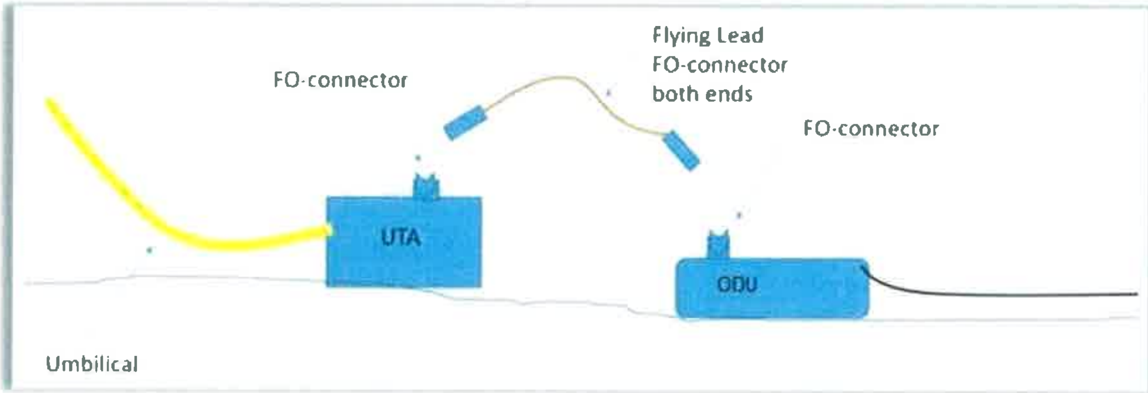
Figure 1-1; the additional two ODUs will be placed at the Liza Phase 2 injection drill centers for the Down Hole Fiber optic application. The fiber optic cable will terminate at the ODU, and the location of the ODUs will be determined based on fiber optic installer detailed design and in a location with an appropriate slope.

Figure 1-4 Representative Example of Optical Distribution Unit

Figure 1-5 provides a representative drawing of the connection between the ODU and the FPSO's umbilical termination assembly (UTA)[1]. The UTA and an umbilical will connect to the topsides of the FPSO, terminating in a topsides Fiber Optic Junction Box.

A mudmat foundation (approximately 0.5 m deep) will be embedded into the seafloor, on which the ODU will be installed. After the mudmat and ODU are installed, a post-lay inspection will be performed using a remotely operated vehicle (ROV) equipped with video cameras and water jet burial systems.

[1] Installation of the UTA's and umbilicals that run to them from the FPSO's are already part of the Subsea Umbilical Riser and Flowline (SURF) installation and operations scope described and covered by the approved Liza Phase 2 Development Project EIA and Environmental Permit and reflected in the approved scope and terms for the Payara Development Project EIA currently being reviewed.



FO = fiber optic

Figure 1-5 Installation of the Optical Distribution Unit to the FPSO's Umbilical Termination Assembly

1.2.3 Cable Installation

1.2.3.1 Pre-Installation / Route Selection / Route Clearance

Route selection was supported by a Cable Route Study conducted by IT International Telecom. Marine routing alternatives are discussed in Section 2.9.1.

A geophysical survey was conducted in early 2020 to gather the field data necessary to finalize the route. The width of the survey corridor was 500 m in the Shallow Water (15 m to 1,000 m water depth) and 2 to 3 times water depth in the deep water (>1,000 m), centered on the preliminary proposed cable route. Equipment used and data collected included:

- multi-beam echo sounders with global positioning system (GPS) to obtain bathymetric data along the proposed route
- side-scan sonar to visualize the seabed
- sub bottom profiler to visualize soil layers beneath seabed
- ultra-short baseline acoustic positioning system for towfish tracking
- magnetometer to determine the locations of in-service cables and other seabed infrastructure
- seabed sampling equipment (e.g., gravity corer, grab sampler, CPT)

Route clearance (i.e., a pre-lay grapnel run) will be carried out to remove debris (e.g., out-of-service cables, ropes, rocks, abandoned fishing gear) from the proposed cable route. Grapnels are specialized hooked tools that penetrate up to 1 m into soft sediment and are generally not used in rocky areas (Carter et al. 2009). Debris recovered during these operations will be disposed of appropriately onshore in accordance with local regulations.

1.2.3.2 Marine Cable Installation

The Project uses a variety of seabed installation methods depending on water depth, cable types, and onsite conditions. In general, the cable will be buried from the shore end out to the rocky scarp characterizing the approach to the continental shelf break; from this point seaward, seabed laying is sufficient and the cable will self-bury (i.e., the cable will be laid on the ocean floor and will bury itself through natural processes) where there is surficial sediments. For burial portions, the cable will be trenched to a depth of 1.0 to 1.5 m. Table 1-3 provides preliminary burial recommendations for each cable segment.

Table 1-3 Cable Route and Burial Recommendations

Segment		Burial Recommendations
Subsystem 1: From Shore to ODU1 and ODU2		
1.1	From Shore (Pegasus) to ODU1	• Excavation from the BMH to as far out as the equipment will reach dependent on soil bearing capacity and safety of equipment • Self-burial over the next 36 to 38 km, to the 15-m depth contour • Plow burial from the 15-m depth contour seawards to the 125-m depth contour (approximately 120 km) • Surface laid for the last 17 km to ODU1
1.3	From Shore (Ogle Service Station Site) to ODU2	• Excavation from the BMH to as far out as the equipment will reach dependent on soil bearing capacity and safety of equipment • Self-burial over the next 33 to 35 km, to the 15-m depth contour • Plow burial from the 15-m depth contour seawards to the 100-m depth contour (approximately 121 km) • Surface laid for the last 24 km to ODU2
Subsystem 2: Cable Branches to the Liza Phase 2 FPSO		
2.1	Liza Phase 2 FPSO Branch from ODU1	• Surface laid
2.2	Liza Phase 2 FPSO Branch from ODU2	• Surface laid
Subsystem 3: Cable Branches to the Payara FPSO		
3.1	Payara FPSO Branch from ODU1	• Surface laid
3.2	Payara FPSO Branch from ODU2	• Surface laid
3.3	Payara FPSO Branch from ODU3	• Surface laid
3.4	Payara FPSO Branch from ODU4	• Surface laid

Burial is typically the most effective way to protect a submarine cable from external damage. However, while it offers protection from fishing activities and small boat anchors, it will not protect it against larger anchors. The types of fishing that present the highest threat to submarine cables are the ones using mobile bottom contacting devices, such as trawling, which is a principal type of fishing employed in Guyana. The large pots used to catch snapper can potentially be harmful to a submarine cable system as well, although the risk is lower. Demersal fishing in Guyana is limited to water depths less than approximately 120 m. In very shallow water, the purpose of burial is to keep the cable out of sight, helping to prevent vandalism, as well as protecting it from heavy debris that could roll around during storms.

The cables will be buried nearshore using an excavator from the beach and as far out as possible, dependent on bearing capacity of the soil and safe reaching capacity of the equipment. Preliminary engineering suggests that the cable will be excavated for the first 2 km from shore. The remaining distance from the end of the excavation to the 15-m water depth contour (approximately 36 km offshore on Segment 1.1 and 33 km offshore on Segment 1.3 (the specific area to be excavated will be determined in the final installation plan) will be left to self-burial. The cable will be plow-buried from approximately the 15-m depth contour seawards to approximately the approach of the continental shelf break around the 125-m and 100-m depth contour for segments 1.1 and 1.3 respectively. In depths of more than 1,000 m, cables are typically laid directly on the seabed and allowed to be buried by natural movement of sediments. At these depths, there is little chance for damage from anchors or mobile fishing gear, and therefore burial protection is not needed.

Offshore

Following route clearance, a specialized cable ship will be employed to install the submarine cable. The main lay and burial operations require a cable-laying ship that will be supplied by the subsea fiber optic installation contractor. EEPGL engages experienced installation contractors that can provide a proper cable ship and marine specialists for deep-sea installations. Figure 1-6 depicts a typical cable lay vessel.

Figure 1-6 Cable Lay Vessel

The cable will be loaded from the factory directly to the vessel's cable tanks prior to sailing to Guyanese waters. For trenching operations, trenching equipment is pulled behind the ship, simultaneously laying the cable through the plow as the ship sails along the cable route.

The cable is loaded into, and subsequently brought up out of tanks, using specialized Linear Cable Engines onboard the cable lay vessel. The amount of cable being laid out, along with the tension applied to the cable during installation, is carefully monitored by onboard sensors.

The Route Position List (RPL), engineered from information gained from the Desk Top Study and the route survey, will indicate the designed route for the ship to follow, as well as the cable slack (Figure 1-7). Slack is described as the excess cable laid on the seabed to conform to the seabed undulations and is measured as a percentage when compared to the geographical route distance. The cable ship's task is to control the slack to conform to the planning and ensure that the cable "fills" the seabed profile, without suspensions. To assist in this task, a computerised slack monitoring and control systems are used. Surface laid cable can be efficiently laid at speeds of between 3 and 8 km/hr depending on cable type, water depth and RPL requirements.

Area Slack

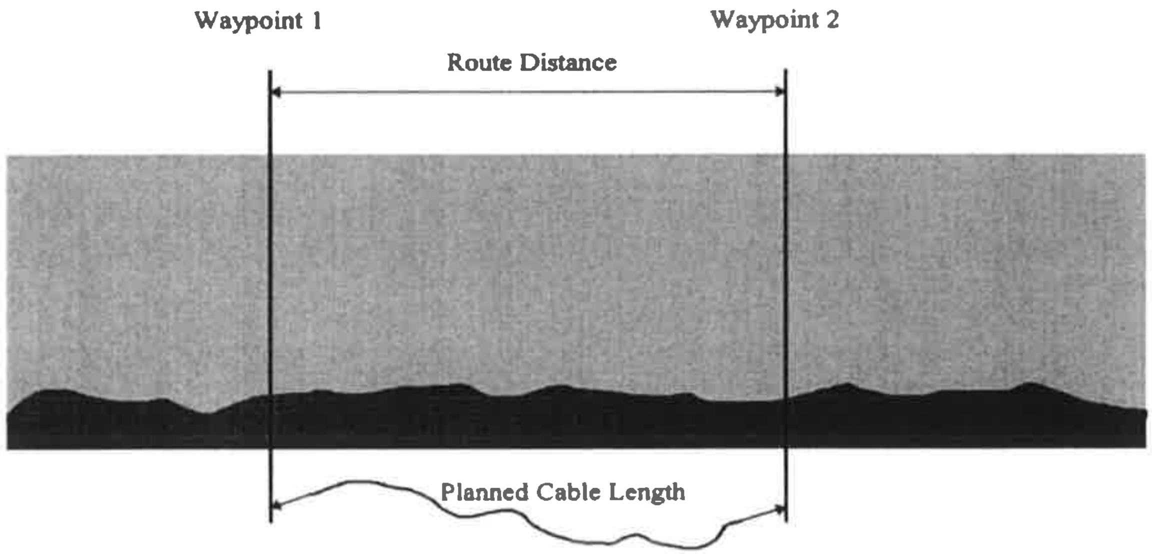


Figure 1-7 Cable Slack for Surface Lay

Nearshore

To protect cables from the fishing trawlers that operate in deeper waters off the continental shelf, the cables will be plow-buried through the fishing grounds. Where plow burial is conducted, the cable is simultaneously laid and buried, using a specialized subsea plow, as shown on Figure 1-8. Plow burial speed varies based on seabed condition, typically between 0.25 and 2 km/h.

Figure 1-8 Specialized Subsea Plow

Figure 1-9 illustrates how the cable is trenched into the seabed with the plow. The fiber optic cables will be trenched, using this method from approximately the 15-m water depth contour to the rocky scarp characterizing the continental shelf break (approximately 125-m water depth contour on Segment 1.1 and approximately 100-m water depth contour on Segment 1.3).

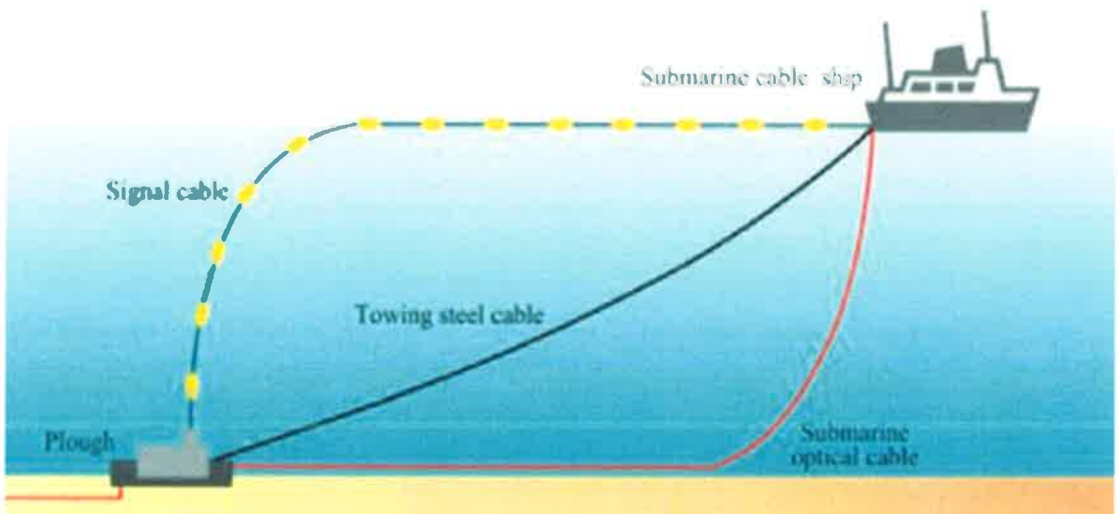


Figure 1-9 Typical Method to Plow Cable into Seabed

As the cable could become exposed in the shifting mud bank zone even with good trenched burial, DA cable will be used from shore to a water depth of 45 m. At that point, cable type can be reduced to SA.

Shallow Water and Beach

Shore-end cable installation occurs when water depth is less than 15 m and is completed using a similar approach as in deeper water, but uses a barge instead of a cable lay vessel (Figure 1-10). The barge is positioned either using tugboat(s), 4-point mooring anchors, or portable thrustmasters. Unlike the cable lay vessel, barges are typically sourced locally as they are generally available in most ports and are already appropriately flagged and permitted for local work. The barge is equipped with cable-lay equipment in-place rather than bringing in a specific (already mobilized) barge for the work.

Figure 1-8 Typical Barge

The barge will have similar equipment as the cable lay vessel so it can safely navigate and lay the cable along the intended corridor / track. Nearshore cable burial will be completed using an excavator from the beach and as far out as possible, dependent on bearing capacity of the soil and safe reaching capacity of the equipment.

1.2.3.3 Survey Navigation During Installation

Navigation will be fully operational on a 24-hour basis throughout the cable lay operations, providing an accuracy of better than ± 10 m. Positions shall be logged and reported according to WGS 84 (Latitude/ Longitude). Positions in UTM (Easting/Northing) will be capable of being logged, as required. Throughout operations a second, complete navigation system will provide backup of the primary navigation system. The secondary system will be operational and fully maintained to allow immediate cut over in the event of a main system disruption.

Navigation software will be used to monitor, display and record both the ship's and "cable touch-down" position throughout operations, on a 24-hour basis. The software will provide a 3-D cable model that is designed specifically for precise real-time cable laying control (Figure 1-11). Significant factors influencing the position and control of the cable are included in the program including 3-D modeling, complex cables and shapes that change with time, either 3-D or 2-D bottom terrain. Numerous cable types and cable bodies can be incorporated into a single cable lay or recovery, and the program is suitable for all ocean depths and cable laying speeds.

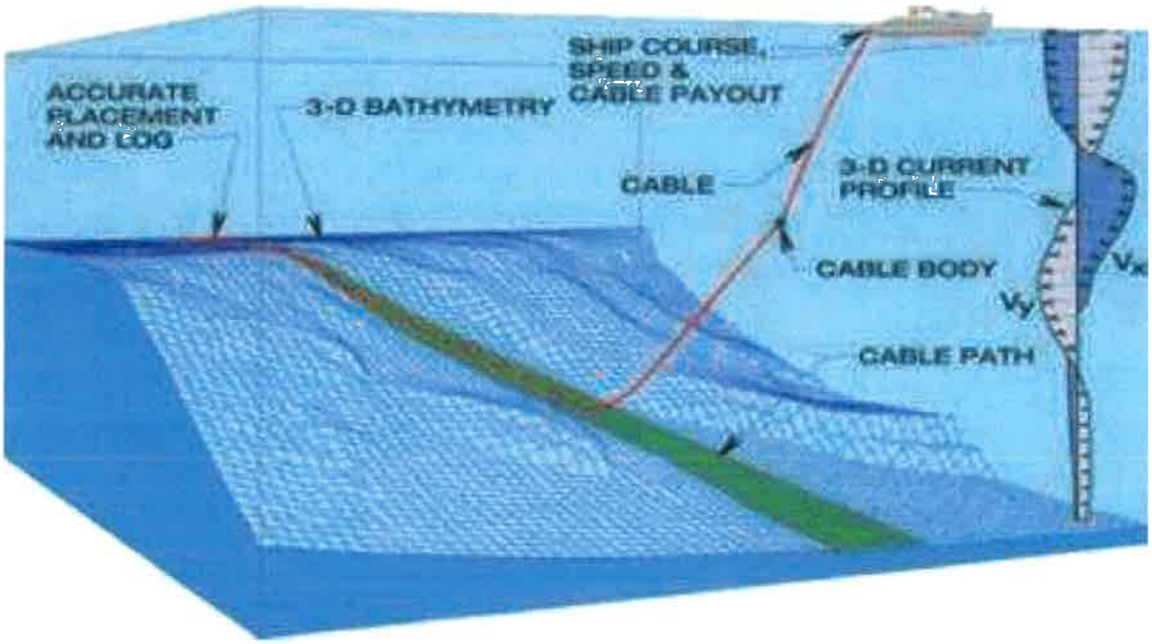


Figure 1-9 Software Model of Cable Installation

1.3 TERRESTRIAL PROJECT COMPONENTS

The terrestrial components of the Project include the BMHs, CLSs, and transmission to the EEPGL office. The following sections describe these components and provide detail on the final terrestrial transmission routing selected for the Project.

1.3.1 Beach Manholes

The offshore cables will terminate at a BMH. A BMH is the point where the marine cable is joined to the terrestrial cable. A BMH unit is installed near the landing point and the cables are joined inside (Figure 1-12). The cable is often also anchored at the BMH.

The Project will require the installation of two BMHs, one at each landing site: the Pegasus and Service Station sites (Figure 1-2). The BMHs will be located above the high-water mark to reduce the potential for flooding, and will be either a pre-fabricated unit or will be poured in-place.

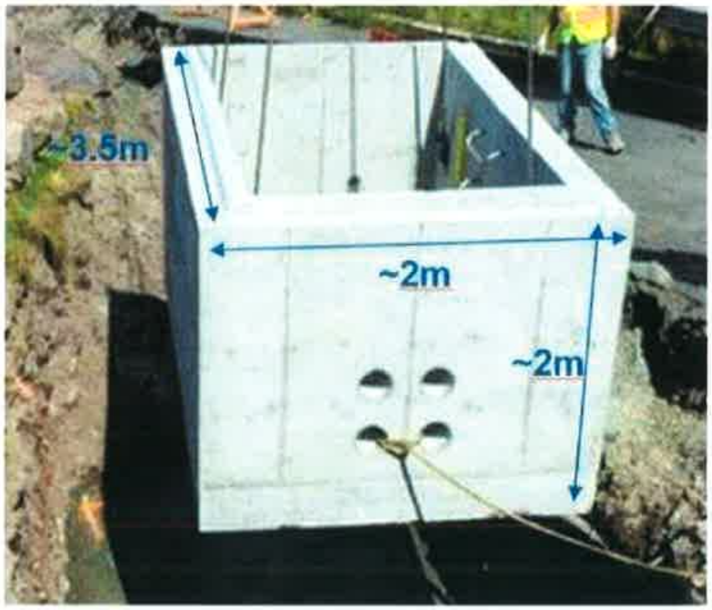


Figure 1-12 Example Beach Manhole

At the Pegasus Site, the Project BMH will be located adjacent to the existing SG-SCS BMH (Figure 1-13). The cable will be trenched, using heavy equipment, along the beach, encased in an articulated pipe for protection from damage. It will cross the seawall in the same manner as the existing SG-SCS cable. Figure 1-14 provides a profile view of the Pegasus BMH and coastal installation.

Figure 1-13 Planned Location for the Pegasus BMH

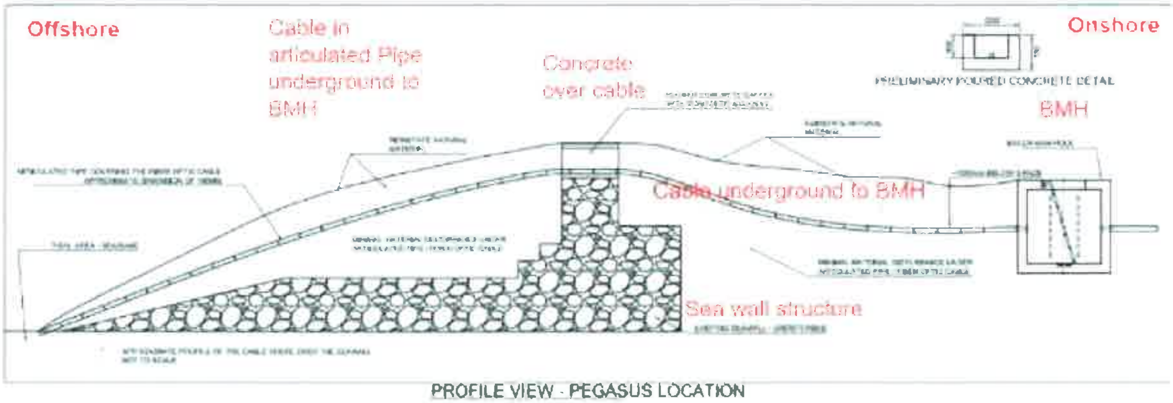


Figure 1-14 Profile View of Pegasus BMH

At the Ogle Service Station Site, the cable will come ashore in an articulated pipe, consistent with the Pegasus Site. Installation of the cable at the Ogle Service Station Site will require the removal of an area of rip rap boulders that make up the seawall (Figure 1-15). Approximately 1 m of seawall length will be temporarily removed. The final design for the site will reduce the seawall disturbance to the extent possible. The rip rap will be replaced to pre-installation condition once the cable is in place. Figure 1-16 provides a profile view of the Ogle Service Station BMH and coastal installation.

Figure 1-15 Planned Location of Ogle Service Station BMH

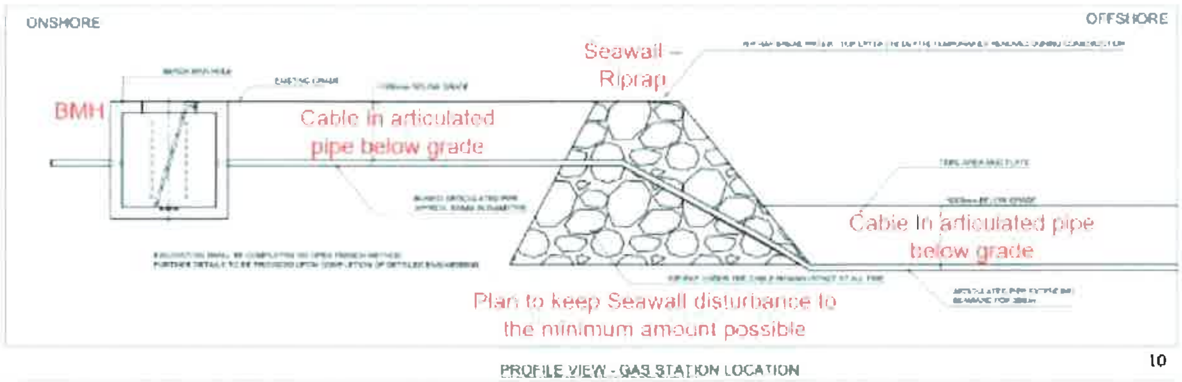


Figure 1-16 Profile View of Ogle Service Station BMH

1.3.2 Cable Landing Stations

CLSs are buildings that house the hardware and infrastructure required to operate transmission equipment, including back-up power generator, racks for electronic equipment, reserve equipment and material, monitoring equipment, line terminating equipment, and climate control. A pre-fabricated CLS will be installed onshore in association with the Pegasus BMH route (CLS1 on Figure 1-2). As noted in Section 1.9, EEPGL has determined that a stand-alone CLS is not required for the route through the Ogle Service Station Site. The CLS for this site (CLS2 on Figure 1-2) will instead be integrated into a planned IT room at the Ogle Office Complex, removing the need for a stand-alone CLS structure. Figure 1-17 shows the typical layout for a CLS. Basic civil works will be required at the CLS1 site (Figure 1-2), including grading, and installation of appropriate foundations. The pre-fabricated CLS will be installed on the prepared site (Figure 1-18) along with supporting infrastructure.

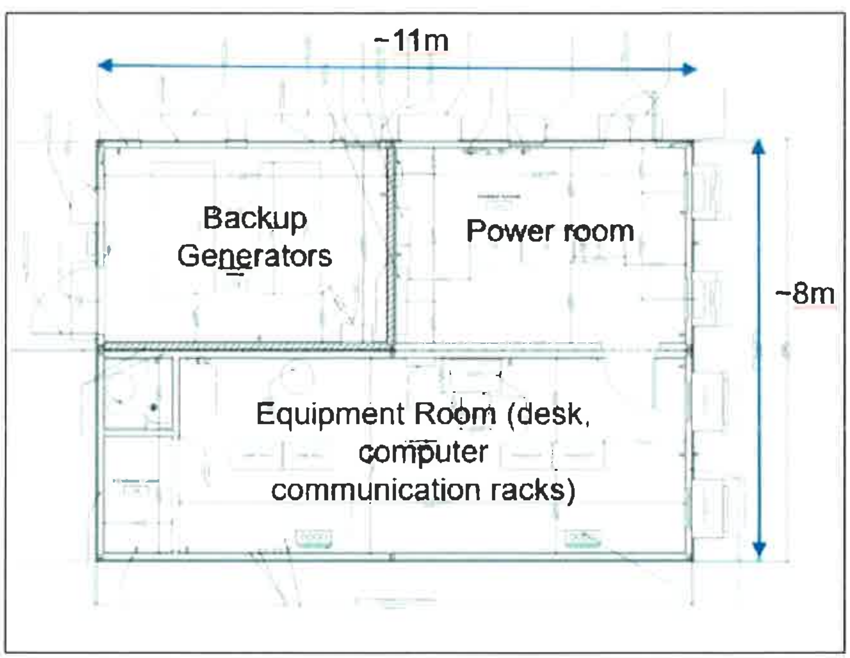
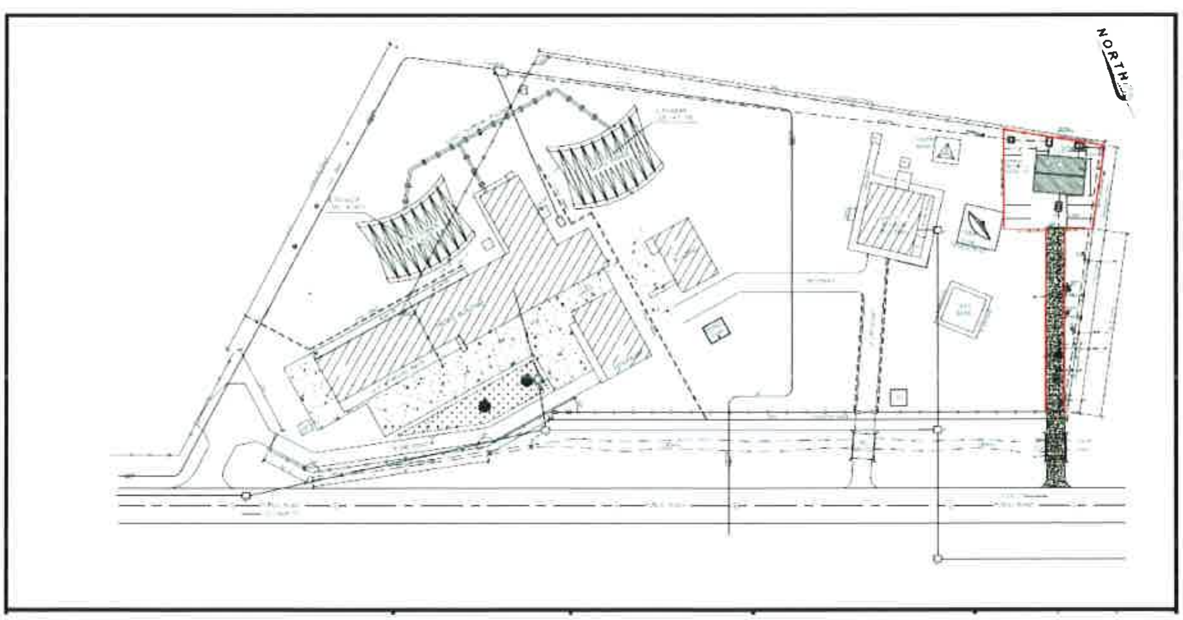


Figure 1-17   Typical Cable Landing Station Layout

Figure 1-18   Example of Pre-fabricated Cable Landing Station Placement

CLS1 will be located on property owned and maintained by GTT+, under a lease agreement with EEPGL. The total land area occupied by the CLS is approximately 17 m x 17 m. CLS1 will be in a segregated area in the north east corner of the property, and a short, separate gravel access road will be constructed from Carifesta Avenue to CLS1 for construction and long-term access to the CLS. This access road will require a culvert-type crossing to be added across the drainage canal. The planned site layout is provided in Figure 1-19. The site will include a diesel fuel supply for short-term use of back-up generators. Diesel fuel will be stored within the CLS in a double walled, 740 gallon (approximately 2,800 L) tank, with the CLS also serving as secondary containment.



Note: EEPGL CLS is in the red area

Figure 1-19 Site Plan for Cable Landing Station at GT&T Cable Station (Carifesta Ave)

1.3.3 Transmission Infrastructure

The Project includes two types of terrestrial transmission infrastructure: underground routing of cables within buried ducts, and aerial transmission on existing poles. The preliminary on-land routes for transmission are provided on Figure 1-2 and summarized below in Table 1-4.

Table 1-4 Transmission Infrastructure Along the Proposed Route

Route	Transmission Type
BMH1 Pegasus to CLS1 (GTT+ at Carifesta Avenue)	Existing Buried Conduit
CLS1 to Duke Street (EEPGL Offices)	Aerial Cable
CLS1 to CLS2 (Ogle Office Complex)	Aerial Cable
BHM2 (near Ogle Service Station) to CLS2	New Buried Conduit

1.3.3.1 Cable Ducts

Buried ducts will be used to carry the terrestrial cable between the Pegasus BMH1 and CLS1, and between the Ogle Service Station BMH2 and CLS2 (at the Ogle Office Complex) (Table 1-4).

Existing buried ducts will be used between the Pegasus BMH1 and CLS1. These ducts were installed as part of the SG-SCS cable project and will be used in agreement with GTT+. The seawall crossing will be similar to the SG-SCS crossing; cable will be buried within polyvinyl chloride (PVC) pipe and the conduit will be encased in concrete or covered with boulders, where appropriate for protection.

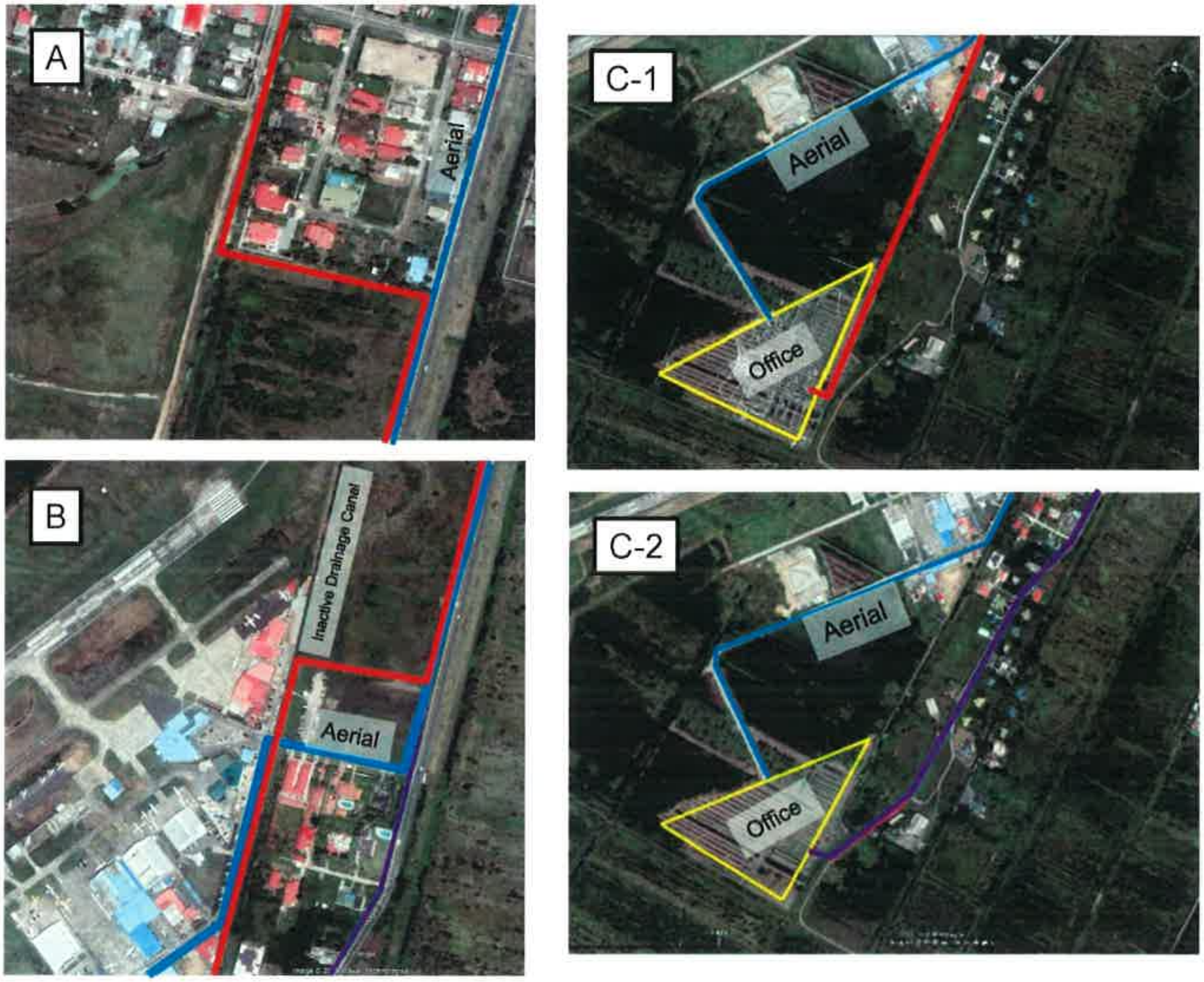
The route from BMH2 at the Ogle Service Station to CLS2 at the Ogle Office Complex will require new buried conduit, which will be routed via a PVC duct, south of the Ogle Airport (Figure 1-2 and Figures 1-20, 1-21, and 1-22). The PVC conduit will be encased in concrete for protection and buried at a depth of 1 m. The total distance required for trenching and burial, from the BMH2 to Ogle Office, is approximately 3 km. The cable route will follow Rupert Craig Highway, cross a body of water, cross the highway and then follow the Old Ogle Airstrip Road (Figure 1-20), crossing another body of water (Figure 1-21). It will then have a short connection to Ogle Airstrip Road to provide clearance from the Ogle Airport property, and back to Old Ogle Airstrip Road, proceeding on to EEPGL's Ogle Office Complex (Figure 1-22). The cable will be routed into a planned Information Technology room at the Ogle Office Complex. The preferred routing into the EEPGL Office (see Images B and C-2 on Figure 1-22) follows the proposed interim main entrance to the EEPGL Ogle Office Complex. This will avoid disturbances from future construction efforts at the airport, ring road, and modifications to drainage canals in the area. This route will require trenching across Rupert Craig Highway and two water crossings (Figure 1-20 and Figure 1-21). Water crossing methods will be determined in consultation with the government and in consideration of environmental impacts, but will either be attached to existing bridges or buried.

Note: Red line indicates preferred buried cable route; Purple line indicates alternative option for crossing Rupert Craig Highway

Figure 1-20 Route BHM2 to CLS2, Water Crossing 1 and Rupert Craig Highway Crossing

Note: Red line indicates buried cable route

Figure 1-21 Route BHM2 to CLS2, Water Crossing 2



Note: Purple line on Image B and C-2 indicate preferred buried routing option

Figure 1-22 Route BHM2 to CLS2, Old Ogle Airstrip Road onto Ogle Airstrip Road (Image A), Ogle Airstrip Road back to Old Ogle Airstrip Road (Image B), and onto Ogle Office Complex (Images C-1 and C-2)

1.3.3.2 Aerial Transmission

Aerial transmission will be used between CLS1 and EEPGL's Duke Street office and the new Ogle Office Complex (Figure 1-22). This will enable redundant communication and control from EEPGL's onshore offices. EEPGL is engaged in talks with utilities for the use of existing aerial transmission poles with the goal of using existing infrastructure.

1.4 CONSTRUCTION WORKFORCE ESTIMATE

The estimated workforce needed for Project installation are provided in Table 1-5. The majority of workers completing the marine installation of the cable will be technical specialists employed by the installation contractor. Installation of the terrestrial portion will be largely sourced locally by Guyanese workers and companies. Installation will be completed over a short period of time, an approximately three-month period.

Table 1-5 Estimated Construction Workforce

Project Activity	Estimated Workforce	Onshore	Offshore
Site Surveys	Approximately 4 persons maximum on two different occasions. An early survey of secondary CLS locations and an engineering phase site survey are forecasted.	3 locals, 1 foreigner	None
Route Clearance / Pre-lay	Approximately 60 persons, including use of cable lay vessel	None	All are expected to be foreigners
Main Cable Installation	Approximately 80 persons at peak, including cable lay vessel operators	None	All are expected to be foreigners
Cable Landing Station Installation	Approximately eight persons: four local laborers and four onshore technicians	6 – 8 locals, 2 – 4 foreigners	None
Platform Connections	Approximately six persons, including use of ROV	None	All are expected to be foreigners
Platform Installation Operations	Approximately six persons, including offshore and onshore testers	None	All are expected to be foreigners
Post-lay Inspection	Approximately 60 persons	None	All are expected to be foreigners
Demobilization	Approximately two persons	2 – 4 locals, 1 foreigner	None

1.5 OPERATION AND MAINTENANCE

Operation of the cable system will consist of the transmission of an optical signal along the cable. System equipment incorporates the ability to send and receive data and allow status and performance monitoring. CLS1 will not be continuously staffed, but operations personnel will be present in communications / control rooms at office locations. The Duke Street office will be used for communication and the new Ogle Office Complex will include a control room, staffed with operations personnel.

Maintenance will include periodic repairs in response to cable system interruptions (i.e., cable faults caused by external damage or internal component failure). Repair procedures typically require removing the damaged section of the cable and replacing it with a new segment that is joined / merged with the rest of the system via cable splicing.

In the case in which a buried cable is damaged, a de-trenching grapnel can be towed across the path of the cable, cutting it and salvaging it for onboard repair. Alternatively, damaged cables on and below the seabed can be retrieved by ROV. Once on-vessel splicing repairs have been completed, the cable can be replaced on the seabed. If reburial is required, the cable can be diver-jetted or buried by a jet-equipped ROV.

The need for support vessels to temporarily establish a Project exclusion zone (PEZ) around vessels engaged in cable repairs will be evaluated on a case by case basis. If enforcement of the exclusions zone is deemed necessary, fishers and other ocean users will be notified of an exclusion zone through established channels and/or appropriate mechanisms until repairs are complete.

The as-built cable route will be marked on relevant marine navigational charts.

1.6 DECOMMISSIONING

Prior to the end of the anticipated life of the Project (estimated at approximately 35 years), EEPGL will initiate detailed planning for decommissioning in compliance with the contracts and licenses governing the Project and the applicable laws and regulations, while also considering the technology available at that time. The decommissioning plan and strategy will be based on a notice of intent for decommissioning the Project which will be provided to the Guyana Geology and Mines Commission and Ministry of Natural Resources, Department of Energy to obtain approval in accordance with the requirements of the *Guyana Petroleum (Exploration and Production) Act (1988)* and the *Guyana Environmental Protection Act*. It is anticipated that cable will be abandoned in place on the seafloor in accordance with standard industry practice as it is least disruptive to the seabed and the growth attached to the cable. .

1.7 EFFLUENTS, EMISSIONS, WASTES AND HAZARDOUS MATERIALS

Routine effluents and operational discharges produced by cable-laying and support vessels (e.g., grey and black water, bilge water, deck drainage, discharges from machinery, and non-hazardous waste material) will be managed in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL) and International Maritime Organization (IMO) guidelines and applicable regulations under the *Guyana Environmental Protection Act.*

Ship-source air emissions contain quantities of carbon monoxide (CO), nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter consistent with diesel engines, as well as greenhouse gases (GHG) (e.g., carbon dioxide (CO_2)). Air emissions from the cable ship will be consistent with those released by other large ships currently operating in the region. Exhaust emissions from Project vessels and equipment will comply with relevant regulations under MARPOL.

The management (i.e., storage, handling, and disposal) of lubricants and other petroleum products, including waste oils, will be conducted in compliance with MARPOL and IMO guidelines. Hazardous materials, if used or generated, will be transported according to applicable legislation, including IMO's International Maritime Dangerous Goods Code and regulations under the *Guyana Environmental Protection Act.* A licensed waste contractor will be used for waste returned to shore, and hazardous materials disposed of at an approved facility. Waste management for this Project will be conducted in accordance with EEPGL's venture-wide Waste Management Plan (WMP).

The sheath used to cover submarine fiber optic telecommunications cables is essentially inert in the ocean and is not coated with anti-fouling agents. The effects of potential degradation of the sheath by ultraviolet light, the main cause of degradation in most plastics, is reduced through the use of lightstabilized materials, trenching into the seabed, and lack of light penetration at the depths at which most of the cable will be deployed. Armouring and burial of the cable reduces potential for fine-grained particles of plastic to be released to the marine environment due to mechanical breakdown of the sheath on the energetic continental shelf (Carter et al. 2009).

A study conducted by Southampton University in England involved immersing various types of fiber optic cables in seawater to test for the following potential leachates from the conductors and armour: copper, iron, and zinc. Of these elements, only zinc passed into the seawater at concentrations of 6 parts per million (ppm) for intact cables and 11 ppm for cut cables with exposed wire armour ends. Zinc is a naturally occurring element in the seawater, with concentrations in fish and shellfish ranging from approximately 3 to 900 ppm (Carter et al. 2009).

Data is transported along fiber optic cables by pulses of light rather than electric current. Therefore, potential generation of electromagnetic fields and heat is not a concern, as it is for power transmission cables or co-axial telecommunications cables (OSPAR Commission 2009).

1.8 PROJECT SCHEDULE

The preliminary Project installation schedule is provided in Figure 1-23. The Project has an anticipated operational life of 35 years. The daily construction schedule for offshore activities will operate 24 hours, seven days per week; and onshore activities will operate seven days per week, with hours of operation to be determined.

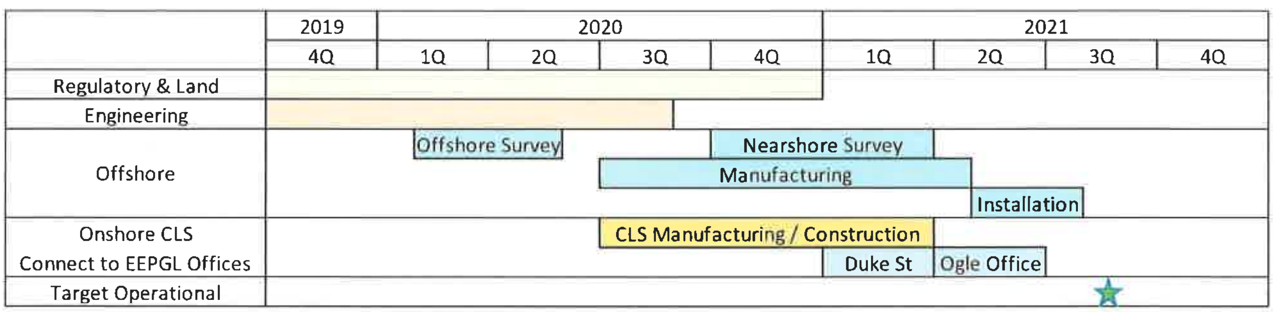


Figure 1-23 Preliminary Project Installation Schedule

1.9 ALTERNATIVE OPTIONS CONSIDERED IN PROJECT PLANNING

The Environmental Management Plan (EMP) Guidelines (EPA 2013) require that a proponent provide consideration of alternative options for their project. In the planning and design of the Project, EEPGL has considered alternative options for marine routing, location of BMHs, location of CLSs, and on-land routing for connections between the BMHs and CLSs and between the CLSs and the EEPGL offices.

1.9.1 Alternative Marine Routing Options

EEPGL considered the option of routing around the possible future CMI area based on the coordinates provided in CMI's EPA Project Summary. After discussions between EEPGL and CMI in 2018, the CMI project area was revised to a much smaller area. In 2020, the fiber optic cable route was optimized and the cable route does not go through the CMI proposed area and is more than 1 km away from the proposed growout area. Both the fiber optic cable and the growout area can coexist in the offshore environment, with no identified spatial overlap.

1.9.2 Alternative Landing Sites Options

Four potential onshore landing sites were identified during the course of a desktop study. The current two landing sites were selected in line with EEPGL's objectives to reduce the footprint of the Project and to define a seawall crossing method and location that was suitable to the government.

1.9.3 Alternative Cable Landing Station Location Options

EEPGL originally selected two CLSs for the Project: one near Camp Road and the Seawall, and one at the Ogle Service Station Site. Through consultation with regulators, it was determined that these CLSs would not be approved due to planned improvements for the seawall.

The Camp Road site was moved to the existing GTT+ site on Carifesta Avenue through a lease agreement with GTT+. This site will require less site preparation, and will allow EEPGL to use GTT+'s existing duct infrastructure for their SG-SCS cable to bring the cable from the BMH to the CLS.

Through engineering and design of the Project, it was determined that a stand-alone CLS was not required at the Ogle Service Station Site. The cable will be routed from the BMH through buried ducts to the telecommunications center at the EEPGL office in Ogle. An integrated CLS at the Ogle Office complex eliminates the needs for the construction of an additional building and reduces the requirements for internal supporting mechanical/electrical equipment, such as generator/HVAC maintenance, and therefore reduces associated environmental effects.

1.9.4 Alternative Terrestrial Routing Options

In selecting the route for the terrestrial portion of the Project, the goals were to:

- Reduce the impact of Project infrastructure (i.e., BMH, CLS, and cable footprint) where possible and to select a route that aligned with requirements and policies of various government agencies
- Select a cable route and installation method (i.e., buried versus aerial) that was suitable to government and considered existing infrastructure such as conduits, roads, bridges, waterways and drainages
- Allowed for installation of the cable between the BMHs and CLSs to be underground (for protection) and separated to provide required redundancy

The route provided in this EMSP is reflective of EEPGL's preferred route. Specific details related to crossing locations may need to be further aligned with specific government agencies and land owners. In addition, other minor adjustments may be required as the detailed design of the Ogle route is progressed.