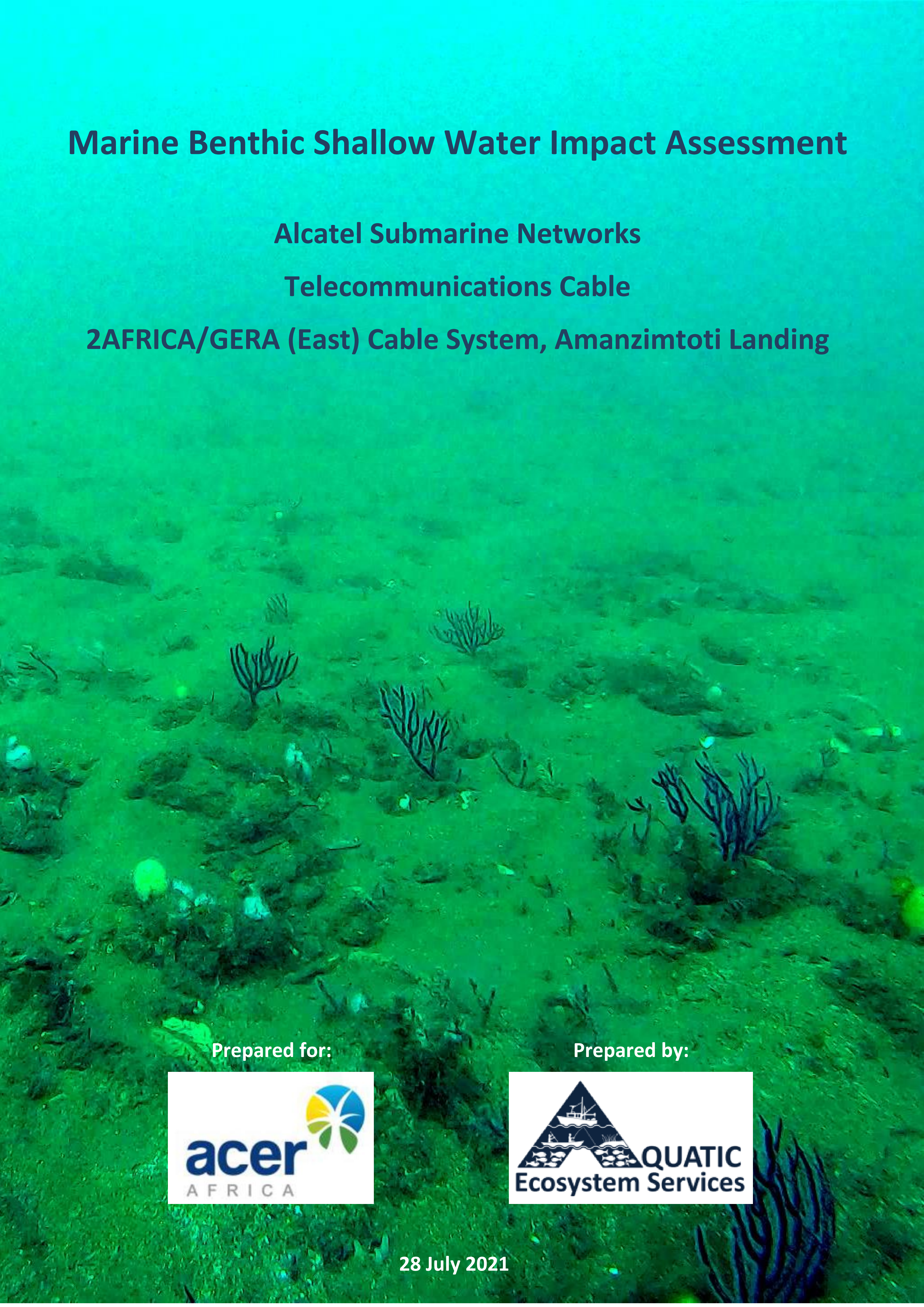


Marine Benthic Shallow Water Impact Assessment

Alcatel Submarine Networks

Telecommunications Cable

2AFRICA/GERA (East) Cable System, Amanzimtoti Landing

Prepared for:

acer AFRICA

Prepared by:

AQUATIC Ecosystem Services

28 July 2021

Executive Summary

Study Background

Alcatel Submarine Networks (ASN) has been contracted to supply and install the proposed 2AFRICA/GERA (East) Cable System which will connect Africa to Europe and parts of the Middle East with optic fibre telecommunications cable. Within South Africa one of the landing points is at Amanzimtoti Pipeline Beach in KwaZulu-Natal. West Indian Ocean Cable Company South Africa (Pty) ltd (WIOCC) is the local landing partner and operator for this landing site in South Africa. ACER Africa, the EIA consultant, has appointed Aquatic Ecosystem Services (AES) to undertake the nearshore marine macrobenthic Specialist Assessment for the Amanzimtoti landing site. The aim of the study was to provide a description of the marine benthic environment along the length of the cable alignment to a depth of 30m based on visual observations. The scope of work did not include sediment sampling, chemical analysis of sediments or the assessment of infaunal and meiofaunal communities.

Project Background

The main 2AFRICA/GERA cable trunk along the east coast of Africa will run approximately 200 to 500km offshore. Branches will run from this main cable trunk inshore to specified landing locations within each country. Within South Africa one proposed landing site is at Amanzimtoti which is the focus of this assessment. The Amanzimtoti branch line is approximately 185km in length passing between the Aliwal Shoal and Thukela Banks Marine Protected Areas (MPA), landing at Pipeline Beach. The installation and operation of the telecommunications cable will involve cable laying and burial in the offshore waters to depths of 1,000m; cable laying in the nearshore and landing at the shoreline; excavation in the intertidal zone and across the beach to bury the cable; and trenching from the beach manhole (BMH) to the cable landing station.

The shallow water (<30m) section of the proposed cable route Landing Site at Amanzimtoti is approximately 1,550m from the BMH to the 30m isobath. The dominant substrate type reportedly comprises coarse sediment and subcropping rock. The first section of the fibre optic cable (approximately 874m) to between 15m to 20m water depth will be buried with the assistance of divers, with the reminder of the shallow water cable (approximately 676m) inserted by plough burial methods which will commence at approximately 15m to 20m water depth. A ridge of outcropping reef runs parallel to the shore at approximately 17-18m water depth and the cable will be routed over the outcropping reef by divers and buried either side to aid in stabilization and prevent any cable movement. The outcropping reef is narrow and there will likely be no need to pin or clamp the cable to the rock surface as it will be stabilised through burial either side of the rock outcrop. The fibre optic cable in water deeper than 20m along the Amanzimtoti Pipeline Beach Landing will be installed using plough burial methods. This section will also be subject to a Pre-Lay Grapnel Run (PLGR) to remove any debris present along the route.

Nearshore installation and cable landing is usually completed within a few days (i.e. feeding cable to shore and burial/encasement/securing). The cable landing itself is normally completed within one day with additional time required for burial and addition of articulated split pipe which is conducted by divers.

Maintenance activities are the main operational phase impacts associated with the cable. Once installed, marine telecommunications cables generally require little to no maintenance unless damaged by natural disasters or human activities. Submarine cables are designed to have a life-span of 25 years. Currently most of the installed cables are operating beyond this lifespan so decommissioning of the 2AFRICA/GERA (East) Cable System is unlikely in the foreseeable future given the current growth in the telecommunications sector within South Africa.

The cable alignment at the proposed Pipeline Beach landing site, Amanzimtoti, traverses Natal Delagoa Intermediate Sandy Shoreline habitat (0-9m) and then Southern KZN Inner (9-26m) and Mid Shelf Mosaic (26m onwards) habitat. Detailed bathymetric, sidescan sonar surveys and sub bottom profiling indicate that 57% of the surveyed route consists of coarse sediments, 41% subcropping reef and less than 1% is outcropping reef. The proposed study area is not located within an area which is defined as a Critical Biodiversity or Ecological Support Area in the National Coastal and Marine Spatial Biodiversity Plan.

The project description has two alternatives for the location of the BMH, one cable alignment, three cable burial alternatives for the inshore zone, and the No Go or No Development Option. The location of the BMH does not affect the cable alignment, and hence only the proposed cable alignment and three cable burial options were assessed in this study of the nearshore together with the No Go alternative.

Assessment Methods

This specialist study undertook a desktop review of available scientific and grey literature on marine benthic communities along the KwaZulu-Natal shallow coastal subtidal environment which was supported through the collection of primary visual field data within the cable servitude and wider study area to obtain information on the substrate composition, and macrobenthic community structure in water depths <30m. The primary data collection made use of a drop camera system equipped with GoPro 7 action cameras, two mounted at 45^{O} to provide a panoramic view of the environment, and a third downward-facing camera to collect imagery on the substate below. Vertical images were used to undertake quantitative analysis of macrobenthic taxa at each site using a point-intercept method. In total 32 sites were assessed directly over the cable alignment with an additional 29 sites from the surrounding area. The full alanysis comprises 95 images from which 28,500 point intercept identifications were undertaken.

Assessment Findings

Analysis of the route specific site data indicates that 81% of the subtidal cable route (BMH to 30m isobath inclusive of supratidal area) traverses sandy substrata (subcropping reef may be present but was not observed). The section of the cable route above the intertidal accounted for 6% and comprised sandy beach habitat. Less than 4% of the route traverses outcropping rock. The remainder of the route (approximately 9%) traverses subcropping reef, limited to the deeper areas of the inshore cable route.

The inshore reef complex consists of a band of flat low to medium profile reef in the nearshore (assigned to two different biotopes) which structurally consists of plateaus, ledges, overhangs and medium profile outcrops. This provides various surfaces to be colonized by a variety of small biota and sparsely distributed larger invertebrates. A third biotope type identified has a larger sand component and the hard substrate is generally covered extensively with a considerable layer of sand (subcropping reef). The occurrence of biota is patch like and these areas are generally found in deeper waters further offshore.

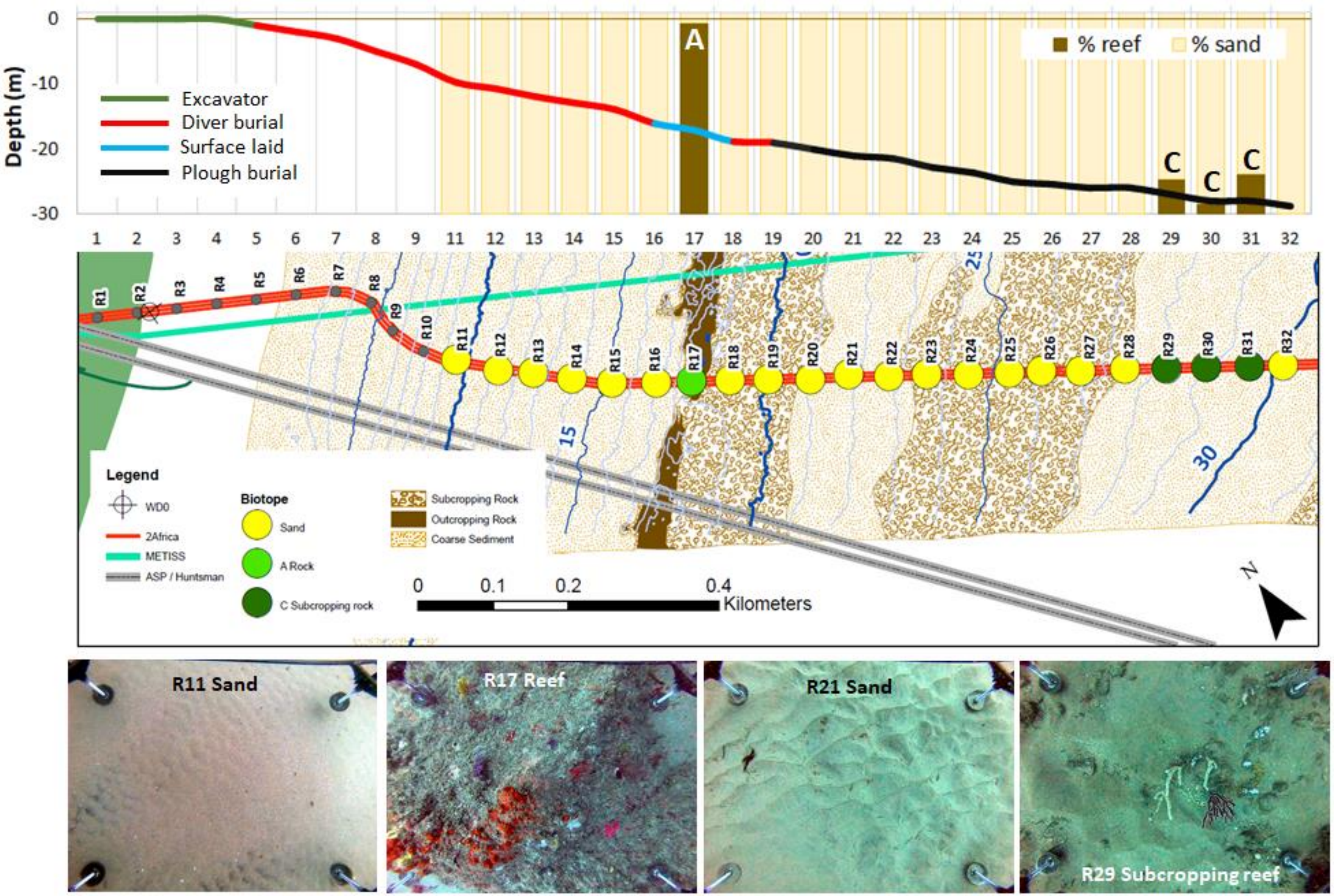
The inshore reef system supported abundant life with no bare rock recorded although sand patches, narrow gullies and areas with a thin sand veneer were present. Growth forms consist of thin encrusting species, present in a patch like mosaic of small individuals or colonies. This is indicative of a highly dynamic, exposed habitat where protection against currents, and possibly sand abrasion, are limited to infrequent crevices and ledges or overhangs. The large characteristic biota observed and recorded at the study site include predominantly sponges, soft corals and ascidians. Species of note, although low in abundance, include the purple and white thorny soft coral *Dendronephthya* sp and white/cream *Leptophyton benayahui* found in the shallower sections. No prominent hard coral colonies were recorded. A few individuals of *Antipathes/ Cirrhipathes* (Black corals) were observed in the panoramic images but none were present in the sample quadrats (quantitative analysis). The abundance of these species was found to be very low. These taxa are not listed or classified on the IUCN Red List, however, *Antipatharia* are listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which list species not necessarily threatened with extinction but highlights the need for strict regulation. Although high biodiversity is suggested by the comprehensive list of species known to occur off the KwaZulu-Natal coast, the small inshore reef ridge at the study site presented relatively few of these species, especially large specimens, and if so at low densities.

Four construction phase and four operational phase impacts were identified. During the construction phase and installation of the cable, the potential re-suspension of contaminants contained within the marine sediments is of concern. The proposed cable route traverses an area identified as having a high level of contamination due to the historic discharge of acid-iron effluent from a marine outfall. Disturbance of these sediments during cable installation could potentially release contaminants which may become bioavailable to marine biota within the surrounding areas. Available data from marine monitoring indicate that the concentration of contaminants are below Probable Effect Limit from local and international guidelines, with the exception of three sites where mercury is elevated. Cable burial by means of mechanical ploughing with no water jetting at the plough/sediment interface will reduce the suspension of sediments and potential release of contaminants and is considered of LOW significance. Accidental spills by heavy machinery during construction is considered of MEDIUM significance. Physical disturbance, and increased turbidity and sedimentation due to construction activities was considered of LOW significance. The construction phase in the inshore region will be of short duration limiting the temporal nature of physical impacts and reducing the potential for dispersion of suspended particulates and contaminants. Due to the nature of the project all operational impacts were rated as of LOW significance. Due to the longevity (>25 years) of the installed cable decommissioning impacts were not rated.

Several marine outfalls are located adjacent to the project area, and there is considerable residential and industrial development which means that the project area is subject to a variety of existing pressures on the marine environment. Once installed, the cable has little to no likely impacts on the nearshore marine environment as the cable itself is benign with no operational discharges. The construction phase may result in short-term impacts, the potential impact of most concern is the re-suspension of contaminants which have originated from the existing marine outfalls at the project location. It is not possible to quantify the potential spatial or temporal effect of this impact. It must be noted that the project activities themselves will not introduce any new harmful substances into the marine environment (unless accidental spillage which is unlikely) and the contribution to cumulative impacts will be negligible from this perspective.

No unique or range restricted species were identified through this survey and all species or taxa observed occur within the region. All construction impacts were rated as LOW significance post-mitigation. Care must be taken to limit disturbance to the seabed and resuspension of contaminants as far as possible using appropriate installation methods, including mechanical plough use (i.e. NO jetting). All operational impacts are considered to be of LOW significance and there will be no long-term impacts on macrobenthic communities.

Based on the findings of the visual assessment of shallow water macrobenthic communities it is feasible to authorise the cable landing, installation and operation through the proposed route at Amanzimtoti Pipeline Beach provided suitable mitigation is in place during cable installation through the contaminated areas.



Distribution of habitats along the cable alignment based on Fugro surveys and visual observations (points) undertaken during this assessment. Proposed cable burial methods are colour coded along the depth chart. Sites indicated as yellow or green on map are actual sites sampled along the alignment, smaller grey dots could not be sampled (R1-R10).

Summary of impacts on the marine environment during construction and operation.

Project Phase	Impact Description	Nature	Extent	Duration	Intensity	Frequency	Probability	Irreplaceability	Reversibility	Significance	Confidence	Mitigation Potential	Post-Mitigation Significance
Construction	Construction Impact 1: Physical disturbance and damage to marine benthic biota.	Negative Direct	Site Specific	Short-term	Low	Once Off	Definite	Low	High	Low	High	Low	Low
	Construction Impact 2: Increased Turbidity, and Sedimentation/Smothering	Negative Direct	Site Specific	Short-term	Low	Once Off	Definite	Low	High	Low	High	Low	Low
	Construction Impact 3: Resuspension of existing contaminants- Alternative 1 Jetting	Negative Direct	Local / Regional	Unknown	Unknown	Once Off	Highly probable	Unknown	Unknown	Unknown	Low	Low	Unknown
	Construction Impact 3: Resuspension of existing contaminants- Alternative 2 No Jetting, burial 2m.	Negative Direct	Local	Short-term	Unknow	Once off	Possible	Low	Moderate	Low	Low	Low	Low
	Construction Impact 3: Resuspension of existing contaminants- Alternative 3 No Jetting, burial 0.5m.	Negative Direct	Local	Short-term	Unknow	Once off	Possible	Low	Moderate	Low	Low	Low	Low
	Construction Impact 4: Accidental spills	Negative Direct	Local	Short-term	High	Once Off	Improbable	Low	Moderate	Medium	Medium	Low	Low
Operation	Operational Impact 1: Presence of hard permanent structure.	Negative Direct	Site specific	Permanent	Negligible	Continuous	Definite	Low	Low	Low	High	Low	Low
	Operational Impact 2: Introduction of electric fields, electromagnetic fields, sound and heat.	Negative Direct	Site specific	Permanent	Negligible	Continuous	Improbable	Low	Low	Low	Medium	Low	Low
	Operational Impact 3: Cable Maintenance and Repair.	Negative Direct	Site specific	Short-term	Negligible	Intermittent	Improbable	Low	High	Low	High	Low	Low
	Operational Impact 4: Protection of marine benthic communities.	Positive Indirect	Local	Permanent	Negligible	Continuous	Definite	Low	High	Low	High	Low	Low

Contents

Specialist Checklist

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	Report Section
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.3; Appendix 3
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 2
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5.4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 3.1; Section 2.7
(g) an identification of any areas to be avoided, including buffers;	Section 5
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 4
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities.	Section 5
(k) any mitigation measures for inclusion in the EMPr;	Section 7
(l) any conditions for inclusion in the environmental authorisation;	Section 7
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised;	Section 7
(iA) regarding the acceptability of the proposed activity or activities; and	Section 8
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	FSR; CRR
(q) any other information requested by the competent authority.	N/A

Acronyms

ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BMH	Beach Manhole
CBAs	Critical Biodiversity Areas
CITES	Convention on International Trade in Endangered Species
CLS	Cable Landing Station
DEA	Department of Environmental Affairs
EEZ	Exclusive Economic Zone
EMF	Electromagnetic fields
CLS	Cable Landing Station
LWM	Low Water Mark
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NOAA	National Oceanic and Atmospheric Administration, United States
PCA	Principle Component Analysis
PEL	Probable Effect Limit
PLGR	Pre-Lay Grapnel Run
ROVS	Remotely Operated Vehicles
SBP	Sub-Bottom Profiler
SSS	Side Scan Sonar
TEL	Threshold Effect Limit
TOPS	Threatened or Protected Species
WIOCC	West Indian Ocean Cable Company South Africa (Pty) ltd

1 Introduction

1.1 Project Background

Alcatel Submarine Networks (ASN) has been contracted to supply and install the proposed 2AFRICA/GERA (east) Cable System which will connect Africa to Europe and parts of the Middle East with optic fibre telecommunications cable. Within South Africa one of the landing points is at Amanzimtoti Pipeline Beach in KwaZulu-Natal. West Indian Ocean Cable Company South Africa (Pty) ltd (WIOCC) is the local landing partner and operator for this landing site in South Africa. ASN has appointed ACER (Africa) Environmental Consultants (hereafter 'ACER') to obtain the environmental authorisations and permits for the landing of the telecommunications cable. The proposed 2AFRICA/DERA Cable System triggers several listed activities in terms of the Environmental Impact Assessment Regulations of 2014, published under the National Environmental Management (Act no 107 of 1998). As a result, the project requires a full Scoping and EIA process. To fulfil all requirements of the EIA ACER has appointed Aquatic Ecosystem Services (AES) to undertake the shallow water macrobenthic Specialist Assessment for the Amanzimtoti landing site. This document provides background on the nearshore (<30m) benthic ecology, the methods used for the assessment and the identification and assessment of impacts which may arise from the installation and operation of the telecommunications cable.

1.2 Terms of Reference

The following Terms of Reference define the Scope of work for the study and informed the design for the field surveys. The scope of work was to:

1. Provide a description of the marine benthic environment along the length of the cable alignment from the shore up to a depth of 30m.
2. The assessment must consider the benthic environment up to 5m either side of the proposed cable alignment.
3. Identify the types of marine habitat and species of conservation importance, including Red Data/CITES species potentially affected by the proposed project.
4. Identify and GPS significant sites that should be conserved, indicate on a suitable map, and motivate why they should be conserved.
5. Identify the likely risks and impacts (negative and/or positive, direct and indirect, including cumulative impacts if relevant) and their significance, which the proposed project may have on marine habitats and benthic communities and vice versa during site establishment, construction, operation and maintenance and/or decommissioning.
6. Recommend mitigation measures for enhancing positive impacts and avoiding or mitigating negative impacts and risks for inclusion in an Environmental Management Programme (EMPr).
7. Identify permit requirements as related to the removal and/or destruction of specific marine species.
8. Address specific issues and concerns raised by stakeholders during the public review phase of the EIA process (an Issues and Responses Report will be provided to specialists).
9. Discuss any other sensitivities and important issues from your specialist perspective that are not identified in these terms of reference.
10. The scope of work was limited to a visual assessment along the proposed cable route and did not include chemical analysis of sediments and assessment of infaunal and meiofaunal communities.

1.3 Specialist Team

Aquatic Ecosystem Services was contracted to undertake the nearshore (<30m) marine benthic specialist assessment for the Amanzimtoti Pipeline Beach Landing Site.

Aquatic Ecosystem Services Pty ltd (AES) was established in 2012 and is an environmental consulting company based in Makhanda, South Africa. AES specialises in providing research and consulting services for fisheries management and ecological assessments for coastal and aquatic (freshwater, estuarine and marine) environments. The company is owned by Dr Russell Chalmers and Naomi Richardson who have a combined experience of 33 years managing and implementing environmental consultancy and research projects. Previous project experience includes implementing baseline surveys, monitoring programmes, impact assessments and fisheries surveys in a wide variety of African countries. AES has worked in a variety of sectors including conservation planning, port and marine infrastructure, municipal planning, mining, agro-industry, aquaculture and tourism.

The specialists involved in the shallow water marine benthic assessment include Dr Russell Chalmers and Dr Shirley Parker-Nance. The curriculum vitaes (CVs) for both specialists are included in Appendix 3.

Dr Russell Chalmers was the Project Manager, General Marine Ecologist, and Impact Assessment Specialist for this study. Russell has a PhD in Ichthyology from the Department of Ichthyology and Fisheries Science, Rhodes University and has twenty years of experience in aquatic and fisheries research. He has been involved in numerous Environmental Impact Assessment (EIA) projects and has conducted specialist studies for both marine and freshwater ecology, macrobenthic communities, fish and fisheries components of EIAs. In addition, he has prepared coastal and environmental management plans and designed and implemented coastal and environmental monitoring programmes. He has also conducted specialist marine assessments for EIAs in South Africa, Madagascar, Mozambique, Guinea-Bissau and Ghana. Russell is SACNASP registered Aquatic Scientist (Pri. Sci. Nat. 400129/13).

Dr Shirley Parker-Nance is a specialist macro-invertebrate taxonomist and she was responsible for the identification and quantitative assessment of the macrobenthic communities in this study. She obtained her BSc degree from the University of Pretoria before moving to Gqeberha where she obtained a fisheries science-focused Master's degree and a PhD degree in ascidian taxonomy. She completed several post-doctorate studies on taxonomy and marine benthic invertebrates including sponge taxonomy. Recently she has undertaken research on marine benthic ecology within Algoa Bay which included the assessment of benthic community distribution and composition and the associated benthic ichthyofauna. This builds on 20 plus years of experience in benthic research and includes work on the identification of algae, sponges, bryozoans, cnidarians, ascidians and fish. She is the owner of Just Blue Environmental Consulting and consults as a marine benthic taxonomist to research groups and scientists globally including Oregon State University (USA), Coral Reef Research Foundation (Palau), Sea Samples (Florida USA), King Abdulaziz University (Saudi Arabia), Kenya and Madagascar. Locally she has consulted for the University of the Western Cape BioTech, Cape Peninsula University of Technology, Rhodes University, EnviroFish and Oceanographic Research Institute (ORI). She is a research associate at the Nelson Mandela University and Rhodes University and the curator for the marine invertebrate and extracts library at the South African Institute for Aquatic Biodiversity (SAIAB).

2 Project Description

2.1 Construction Phase / Cable Installation

This section provides a brief overview of the project activities which are deemed relevant to the nearshore shallow water (<30m) macrobenthic communities located within the Amanzimtoti landing site at Pipeline Beach. A full account of the project description can be found in the Scoping Report (Acer Africa 2021a) or the relevant chapter of the Environmental and Social Impact Assessment Report (Acer Africa 2021b).

The main 2AFRICA/GERA cable trunk along the east coast of Africa will run approximately 200 to 500km offshore. There are two proposed landing locations along the east coast of South Africa, a northern landing at Amanzimtoti in KwaZulu-Natal and a southern landing at Gqeberha. A third landing site is proposed on the west coast at Duynefontein.

This study assesses the Amanzimtoti branch line which will traverse South Africa's Exclusive Economic Zone (EEZ) (200Nm from shore), and Territorial Waters (12Nm from shore) coming ashore at Pipeline Beach, Amanzimtoti. The Amanzimtoti branch line is approximately 185km in length passing between the Aliwal Shoal and Thukela Banks Marine Protected Areas (MPA), landing at Pipeline Beach. Once ashore, the cable will traverse the beach and enter the Beach Manhole (BMH) located at the sea edge of Pipeline Beach car park (Alternative 3 Preferred) (see below for descriptions of alternatives). The optic fibre cable will connect to the Cable Landing Station (CLS) located in Umbogintwini via new ducting.

The installation and operation of the telecommunications cable will involve the following activities:

1. Pre-installation (marine).
    a. Cable Route Survey.
    b. Route engineering.
    c. Route Clearance.
    d. Pre-Lay Grapnel Run.
2. Installation (marine and/or terrestrial).
    a. Cable Surface Lay (>1000m depths - approximate).
    b. Cable Burial (<1000m water depths - approximate).
    c. Shore End Landing.
    d. Beach Burial (including sea earth system).
    e. Post Lay Inspection and Inshore Burial (burial in shallow water off the beach).
    f. Construction of a BMH.
    g. Cable trenching from BMH to CLS.
3. Operation of the cable (maintenance only, should breakages occur).
4. Decommissioning of the cable (only after expected life span of >25 years).

2.2 Nearshore cable laying activities

A purpose-built cable-laying ship will be used to install the optic fibre cable. The ship can install the cable to a minimum depth of 15m. Where cable burial is possible in soft sediments, and water depth allows, the ship will make use of a specially designed plough which is lowered to the seafloor and towed behind the ship. As the plough is towed it trenches, lays, and buries the cable simultaneously. The target depth for burial is 2m, with the actual burial depth dependent on the substrate type and depth of subcropping rock. Burial depth is continually recorded by the plough as installation takes place. The footprint of the cable trench is generally less than 1m in width with the disturbance from the plough skids being limited to less than 3m either side of the trench. The trench created for burial of the cable is narrow and usually closes soon after the plough has passed. No active backfilling is undertaken, and the trench re-closes naturally. The plough method of burial is only used where the seafloor substrate is soft, and the soft substrate is of sufficient depth (no shallow subcropping rock) to allow plough burial. Where hard substrate is present, and no re-alignment to avoid reef areas is possible, the cable with be surface laid, and no effort will be made to trench or excavate through the rock. These factors are determined during the pre-installation cable route survey and have already been taken into consideration during the design of the cable alignment (Fugro 2020).

During plough burial the cable is fed from the cable-laying ship as it proceeds. In the nearshore once the water depth is too shallow for ship and plough operation (this is usually 12-15m depth) the fibre optic cable will be fed from the ship to the shore by floating it using buoys. A small craft capable of working in the nearshore environment will be used to pull the cable to the shoreline from where sufficient cable will be pulled to reach the Beach Manhole (BMH). Once the cable has been landed the aim is to bury it to 2m depth (beach and subtidal) wherever possible as this provides protection from possible snagging by anchors and bottom fishing gear during the operational phase. Burial in such instances will be undertaken by divers using a jetting method where water is pumped into the soft sediment and used to clear a trench while inserting the cable. Horizontal Directional Drilling (HDD) will be used to bury the cable through the primary dune from the BMH for approximately 30m, thereafter an excavator will be used to trench across the beach to the intertidal.

The landing operation (getting the cable for the ship to shore) for the cable in the nearshore is usually completed within one day with work, commencing at sunrise and ending at sunset. Activities such as diver burial and cable protection with articulated slit pipe will continue for a few days after cable landing until such time as the work is complete. Preparation activities on the beach above the intertidal will commence a few days before cable landing is planned and continue for a few days after to allow cable burial to the Beach Manhole and rehabilitation and landscaping of the beach.

2.3 Cable Laying Methods at Pipeline Beach

The shallow water (<30m) section of the proposed cable route Landing Site at Amanzimtoti is approximately 1,550m from the BMH to the 30m isobath (Fugro 2020). The dominant substrate type comprises coarse sediment and subcropping rock (Fugro 2020) (Table 2.1 & Table 2.3). The first section of the fibre optic cable (approximately 874m) will be buried with the assistance of divers, with the remainder of the shallow (<30m) water cable (approximately 676m) inserted by plough burial methods (Table 2.2) which will commence at between 15m to 20m water depth (Fugro 2020). Diver burial will therefore take place over 56% of the route and will be limited to the inshore in water depths less than 20m, while plough burial will take place over the remaining 44% of the shallow water route (Fugro 2020). A ridge of outcropping reef runs parallel to the shore at approximately 17-18m water depth (Fugro 2020). The outcropping reef at the Amanzimtoti site occurs within the depth range in which diver burial will take place and the cable will be routed over the outcropping reef by divers and buried either side to aid in stabilization and prevent any cable movement. The outcropping reef is narrow, measuring approximately 17m wide (based on information derived from the side scan sonar survey (Fugro 2020)) and there will likely be no need to pin or clamp the cable to the rock surface (Acer 2021a) as it will be stabilised through burial either side of the rock outcrop.

The cable will be fed and floated from the cable laying ship and towed to shore from approximately 874m offshore and once the cable has been landed and secured at the Beach Manhole, divers will add articulated split pipe and use jetting techniques to bury the cable in areas of sand, and sand over subcropping rock to a target depth of 2m and water depth of 15-20m. The fibre optic cable in water deeper than 15-20m along the Amanzimtoti Pipeline Beach Landing will be installed using plough burial methods. This section will also be subject to a Pre-Lay Grapnel Run (PLGR) to remove any marine debris. The PLGR will only occur in sections where plough burial is the preferred installation method for the cable (i.e. >20m at Amanzimtoti). The grapnels penetrate the seabed to a depth of 40-80cm and hook linear obstacles. Usually only a single tow is required along the route to clear obstructions.

External protective measures will be installed around the marine fibre optic cable in shallow nearshore water up to a water depth of approximately 10 m (approximately 500m distance from BMH) (Fugro 2020) to further protect against any damage. Once such protective measure is the use of articulated iron split pipes (Figure 2.1), which increase the cable weight, and therefore aid in burial and stability of the cable on the ocean floor. Articulate split pipe is generally used to protect and secure the fibre optic cable from the BMH to beyond the surf zone.

The double armoured fibre optic cable which will be used in the shallow water nearshore is approximately 50mm in diameter (Figure 2.2) and the articulated split pipe ranges in diameter from 55mm to 148mm (Figure 2.1).

One cable crossing point will occur in the nearshore where the 2Africa cable (this project) will cross another fibre optic cable, the METISS cable (Fugro 2020). Where crossing in anticipated the industry standard is to cross like with like, i.e. armoured cable crosses armoured cable, or un-armoured across un-armoured. Once the cable is installed additional protective measures can be put in place at the crossing point, in this case mostly probably by divers due to the shallow working depth of the crossing point. No other crossing of linear infrastructure is foreseen along the Amanzimtoti (inshore <30m) landing site alignment and the cable runs near parallel to other existing infrastructure.

Table 2.1: Geophysical composition of the substrate from the Beach manhole to the 30m isobath and proposed cable burial methods (Fugro 2020).

Start km	End km	Distance (km)	Water Depth (m)	Habitat	Burial Method	Cumulative distance (km) per burial method
0	0.767	0.767	0-18	Fine sand >2m	Diver burial	0.767
0.767	0.874	0.107	18-20	Fine sand over subcropping rock 0.5-2m	Diver burial	0.874
0.874	0.91	0.036	20-21	Fine sand over subcropping rock 0.5-2m	Plough	0.036
0.91	1.055	0.145	21-23	Fine sand >2m	Plough	0.181
1.055	1.288	0.233	23-27	Fine sand over subcropping rock 0.5-2m	Plough	0.414
1.288	1.55	0.262	27-30	Sand >2m	Plough	0.676
		1.55				

Table 2.2: Summary of total distances per burial method at the Amanzimtoti Pipeline Beach Landing Site (Fugro 2020).

Burial Method	Distance (km)	%
Diver burial	0.874	56%
Plough	0.676	44%
TOTAL	**1.55**	**100%**

Table 2.3: Summary of benthic substrate composition along the nearshore Amanzimtoti Pipeline Beach Cable landing route (Fugro 2020).

Habitat	Distance (km)	%
Fine sand	1.174	76%
Subcropping rock	0.38	24%
TOTAL	**1.55**	**100%**

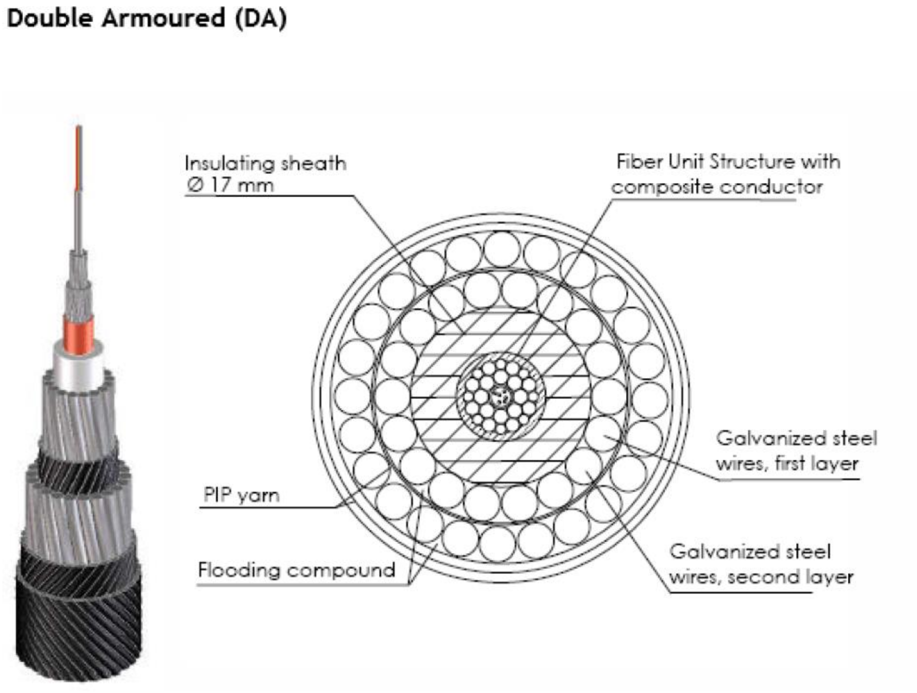


Figure 2.1: Double Armour cable which will be used in the nearshore, it is approximately 50mm in diameter.

Figure 2.2: Articulated spilt pipe used for cable protection in the shallow inshore regions. The pipe ranges in diameter from 55mm at the narrowest end to 148mm at the coupling.

Nearshore installation and cable landing is usually completed within a few days (i.e. feeding cable to shore and burial/encasement/securing). Cable landing is completed within one day with additional time required for burial and addition of articulated split pipe which is conducted by divers (ASN pers. comm.). Preparation of the beach landing site will commence a few days before, and rehabilitation and landscaping will continue for a few days after cable landing (ASN pers. comm.). The duration of installing impacts in the shallow nearshore (0-30m) will therefore likely be one to three days, and slightly longer in the intertidal as result of beach operations (excavation and rehabilitation).

In the shallow coastal waters (<200m) a double armoured marine fibre optic cable is used. This cable is approximately 50mm in diameter (Figure 2.2) and will be protected by articulated split pipe. The articulated split pipe has a diameter of between 55 to 148mm. Repeaters are optical amplifiers which are installed along the length of the cable and are larger in size (270mm in diameter, sea case length of 980mm, with a total length of the repeater section being 3,900 to 4,200mm depending on the cable coupling). No repeaters will be located in the shallow water (<30m) region at the Amanzimtoti landing site.

The following activities have already been undertaken to optimise the alignment and avoid hard structure and sensitive areas as far as practically possible.

1. A geophysical survey of the proposed cable route (500m width) - To determine the geological properties of the seafloor and sub-seafloor, such as shape and hardness.
2. Side Scan Sonar (SSS) and Sub-Bottom Profiler (SBP) – To provide remote imaging of the seafloor (SSS) and assess the physical properties of the seafloor and sub-seafloor (SBP).
3. Bottom sampling every 10km – To determine the composition of seafloor sediments.
4. Multi-beach echo sounder survey – To map the seafloor profile.
5. Cone Penetrometer Tests every 4km where cable burial is planned (Burial assessment survey) – To determine the suitability of sediments for cable burial.
6. Diver video and bar probe survey at landing sites – To identify potential hazards and engineering constraints.
7. Processing of collected data to verify accuracy and review proposed routes and adjust where necessary.

2.4 Cable characteristics

This section provides a description of the physical properties of the cable and operational characteristics which may result in impacts on the nearshore marine benthic biota.

External Chemical Properties

The external protection of the cable comprises a naturally occurring bitumen (asphalt) on the armoured shallow water cables. No form of additive to prevent bio-degradation or anti-fouling is used in the cable's outermost layers. The other cable components in contact with the seawater are the galvanized steel armour wires and the polyethylene sheath, which also contain no additives harmful to marine life (Acer 2021a).

Electrical Current

Optical fibre cables carry a constant direct current of 1.6 Amps to power the repeaters. Several thousands of volts are required to maintain the current due to the length of the cable. Standard practice is to apply half the voltage at positive polarity to one end of the system and the other half at negative polarity to the opposite end to achieve zero-voltage at the cable midpoint. This serves to reduce voltage stress on the cable and repeaters. Despite the high voltage there is no external electric field associated with the power on the inner conductor. The ratio of the conductivity of the polyethylene insulations to that of seawater means that the electric filed remains only within the cable insulation.

Electromagnetic Fields (EMFs)

Electromagnetic fields (EMFs) are generated by current flow passing through cables and can be divided into electric fields (called E-fields, measured in volts per metre, Vm^{-1}) and magnetic fields (called B-fields, measured in μT) (Taormina et al., 2018). The dc current in the inner conductor does set up a stationary magnetic field in the form of concentric rings emanating from the cable. The magnetizing force produced by this field diminishes with increasing radius from the cable. EMFs are generally effectively confined inside cables by armouring

(Taormina et al., 2018). For a cable carrying 1.6 amps the magnetic flux density 1m from the cable is two orders of magnitude lower than the vertical component of the earth's magnetic field (Acer 2021a). This means that marine biota would need to approach to within less than 13mm of the cable to detect a stronger magnetic field than that of the earth itself.

Audible sound and frequency association with "toning"

Fibre optic cables do not emit sound in the audible range (15 to 40,000 Hertz). However, during installation the cable vibrates and emits low frequency sound at approximately 10 Hertz, but this stops one the cable is on the seafloor.

"Toning" involves the injection of low frequency electrical signal from a land station and is used to aid in detecting the location of a cable for maintenance purposes. An electrode trailed from a maintenance vessel can detect the maximum level of the tone and thereby locate the cable. Toning is undertaken infrequently and only during a repair operation, or for locating existing cables during the installation of new cables or other marine infrastructure. The level of signal injected is approximately 160mA at 25 Hertz. Based on video observations using Remotely Operated Vehicles (ROVs), the short-term presence of low frequency, low level electric field in seawater does not appear to have an influence on fish behaviour, which are mobile and able to move away from the area of impact. The impacts of 'toning' on slow moving and non-mobile marine benthic biota is not known .

Heat Dissipation

Transport of electrical energy results in the loss of heat leading to an increase in temperature at the cable surface which may be transferred to the surrounding environment. The effect of this thermal radiation caused by electric cables of benthic communities have rarely been examined and in situ investigations are lacking (Taormina et al. 2018). However, it is anticipated that due to the narrow, linear nature, and expected weakness of the potential thermal radiation, in combination with high levels of water exchange (for surface cables) the impacts are not considered significant (Taormina et al. 2018).

2.5 Operational Phase

Maintenance activities are the main operational phase impacts associated with the cable. Once installed, marine telecommunications cables generally require little to no maintenance unless damaged by natural disasters or human activities. If damaged, a repair ship is dispatched which locates the damaged section by means of "toning" (see above) and recovers it to the ship by means of a grapnel and winch. The damaged section is cut out from the cable and replaced with a new section. The cable is then tested to ensure transmission and then re-buried on the same alignment, or repositioned on the seafloor over hard substrata where burial is not possible. Any major cable repair in the nearshore will involve replacing a length of cable from the BMH to a suitable working depth for the cable laying ship as it is difficult to work and conduct repairs in the high energy and dynamic shallow coastal waters. Major damage is, however, unlikely as double armoured cable is used which has additional protection in the coastal zone in the form of articulated spilt pipe when surface laid, or it is buried to minimise damage and hence the low likelihood of requiring repair. Should maintenance be required in the nearshore it will entail a similar process to the initial installation of the cable.

Cables within the EEZ (200Nm) or the Territorial Waters (12Nm) are afforded legal protection from damage through the proclamation of a cable protection zone. In South Africa marine telecommunication cables are afforded a legislated buffer of 500m either side of the cable as defined in the Marine Traffic Act (Act 2 of 1981) read together with the Maritime Zones Act (Act 15 of 1994). This servitude prevents cable damage by prohibiting bottom trawling activities and anchoring of vessels.

2.6 Decommissioning

Submarine cables are designed to have a life-span of 25 years. Currently most of the installed cables are operating beyond this lifespan so decommissioning of the 2AFRICA/GERA (East) Cable System is unlikely in the foreseeable future given the current growth in the telecommunications sector within South Africa. If, and when decommissioning takes place, all activities would be subject to legislation relevant at the time.

2.7 Alternatives

Alternatives are different means of achieving the purpose and need of a proposed development and include alternative sites, layouts or designs, technologies and the "No Development" or "No Go" alternative.

The project description includes the following alternatives from the Scoping Phase which have been carried through for assessment in the specialist studies of the Environmental Impact Assessment, and which may affect the nearshore marine environment:

1. Two alternatives for the location of the BMH:
    i. BMH Alternative 2 located at Amanzimtoti Main Beach Carpark
    ii. BMH Alternative 3 located at Amanzimtoti Pipeline Beach Carpark. This is the preferred option.
2. One cable alignment which is routed from BMH Alternative 3.
3. Three nearshore cable burial alternatives as outlined below:
    i. Nearshore burial Alternative 1 - Undertake cable burial as planned to a depth of 2.0 m using plough burial (at appropriate depths) with use of the water jet system. Use of the water jet system increases the plume of suspended sediments in the water, compared with mechanical ploughing without the water jet. This alternative may result in the release of deeper sediments (for which the exact chemical properties are unknown) into the water column, with possible remobilisation of contaminants.
    ii. Nearshore burial Alternative 2 - Undertake cable burial as planned to a depth of 2.0 m using mechanical ploughing only, the water plough jet system will not be used. This means that the water jet system which is used to lubricate the plough shear would not be turned on, thus, limiting the potential for contaminated sediment to become suspended in the water column. The cable burial at this depth ensures that the cable cannot be snagged by the grab bucket when annual sampling of the contaminated sediments in the outfall area takes place.
    iii. Nearshore burial Alternative 3 - Undertake cable burial to a depth of approximately 0.5 m using only mechanical ploughing, the plough water jet system will not be used. This means that the water jet system which is used to lubricate the plough shear would not be turned on, thus, limiting the potential for contaminated sediment to become suspended in the water column. This alternative would also reduce the depth of the ploughed trench, appreciably reducing the volume of potentially contaminated sediments that are disturbed. A burial depth of 0.5 m would still provide protection from being snagged by the grab bucket when annual sampling of the sediments takes place.
4. The No Go or No Development Option.

Several factors were taken into consideration when deciding upon the preferred cable route alignment and included the following:

1. Possibility of placing the cable close to and along existing alignments of decommissioned submarine telecommunications cables entering South African Waters.
2. Identification of suitable landing beach that minimises onshore environmental and infrastructure constraints.
3. Avoidance of high intensity fishing or known trawling areas.
4. Avoidance of Marine Protected Areas (MPAs).
5. Diversity of cable alignments – to create a 'robust' network which maximises separation between cable systems which will create redundancy should a single cable be damaged.
6. Long-term cable maintenance operations in the landing zone.
7. Bathymetry – slope angles, avoidance of seabed depressions, ridges, canyons, seamounts etc.
8. Features – avoidance of specific navigation angles across rock outcrops, seabed debris, minefields, boulders and other physical features including pipeline crossings.
9. Conditions (substrate and currents) for cable burial.
10. Current and angles to current to minimise risk of movement and abrasions from currents.
11. Avoidance of offshore reefs and canyons.

2.7.1 No-Go Alternative

The No-Go alternative would involve WIOCC not installing the proposed 2AFRICA/GERA (East) Cable System. This would eliminate all potential negative impacts on the marine and terrestrial environments, but would also eliminate the positive socio-economic impacts resulting from improved international telecommunications.

3 Nearshore Macrobenthic Impact Assessment Study Methods

This specialist study undertook a desktop review of available scientific and grey literature on marine benthic communities along the KwaZulu-Natal shallow coastal subtidal environment (Table 3.1). This was supported through the collection of primary field data within the cable servitude and wider study area to obtain information on the substrate composition, and macrobenthic community structure in water depths 0-30m.

Primary data on benthic communities along the cable route was obtained during field surveys conducted in May 2021 using robust scientific methods as outlined below. The information provided is therefore recent and builds on available information for the area to assess possible impacts.

No known noticeable seasonal changes have been shown for macrobenthic cover and a once-off survey is sufficient for the requirements of this assessment. The methodologies used are based on previous studies conducted within different coastal areas along the South African coast (Table 3.1).

Table 3.1: Summary of studies based on data collected using digital image quadrats for subtidal benthic community composition assessment and description for South African shallow coastal marine habitats.

Area	Data collection per sample collection point	Depth	Reference
St Lucia / Kosi Bay	0.32 m^2 along transect	6-28 m	(Schleyer and Celliers 2005)
Sodwana Bay	0.35 m^2 quadrats along a transect	9-27 m	(Celliers and Schleyer 2008)
Sodwana Bay	0.25 m^2 permanent marked sites	13-17 m	(Porter and Schleyer 2017)
Aliwal Shoal	Point on transect	8-22 m	(Schleyer et al. 2006)
Aliwal Shoal	0.26 m^2 and 0.29 m^2 along transect (n = 35)	10-25 m	(Brash 2006, Olbers et al. 2009)
Pondoland	0.17 m^2 quadrate (~n=50) along transect	< 31m	(Celliers et al. 2007)
Algoa Bay	0.43 m^2 random	5-30 m	Parker-Nance, 2021
Algoa Bay	0.33 m^2 along transect	10-30 m	Chalmers 2012
Tsitsikamma MPA	0.2 m^2 transect (n = 30)	11-75 m	(Heyns et al. 2016)
Betty's Bay	0.33 m2 along a 50 m transect (n = variable)	10-29 m	(Joshua et al. 2018)

The objective of the field assessment was to characterise macrobenthic community compositon along the inshore (0-30m) cable aligment to identify Threatened or Protected Species (TOPS), rare or sensitive speices, or Convention on International Trade in Endagered Species (CITES) listed species. Information collected during the field assessment was used in conjunction with the literature review to contextualise the marine benthic commuities within the cable servitude on a local and regional scale.

The primary data collection sampling strategy made use of a camera structure constructed of a metal frame equipped with GoPro 7 action cameras, two mounted at 45 ^{O} to provide a landscape view of the environment, and a third downward-facing camera to collect imagery on the substate below (Figure 3.1). The vertical images collected by this camera were used to undertake quantitative analysis of macrobenthic taxa at each site using a point-intercept method (Carleton and Done 1995, Celliers et al. 2007, Seager 2008). The drop camera frame is designed so that the downward-facing camera is a set distance from the substrate and therefore captures footage of the same standardised frame size (photo quadrat = 0.64 m^2) each time to allow for quantitative analysis and comparison. All three cameras were set to record video footage (30 frames per second or faster) from which still images were captured after the survey.

The survey design was based on two main approaches to ensure full coverage along the route, while still obtaining sufficent data from the broader study area for detailed quantitative assessment of community composition within the main habitats and within a feasible amount of field and image processing time. Each approach is described in more detail below.

The field surveys were undertaken in May 2021. The marine benthic communities are not subject to known seasonal changes which would infleunce the results of the field observations.

3.1 Quantitative Assessment

Information on the substrate composition along the inshore cable route was available from the cable route planning survey (Fugro 2020). Marine benthic reef communities are strongly influenced by depth, current and sand movement with generally a change from algal dominated to ascidian, porifera or bryozoan dominated communities with increasing depth (Heyns et al. 2015, Parker-Nance 2021). The quantitative assessment aimed to collect sufficient data from habitat and depth strata to facilitate the identification of different biotopes within the study area. The Fugro Survey (Fugro 2020) identified three substate types (sand, rock outcrop/reef and sub cropping rock) and sampling sites were selected to obtain data from within each habitat type. For the quantitative (Q sites) data collection five replicate deployments of the drop camera were undertaken at each site (compared to 1 for R sites see below), with 30-second video recordings captured from each replicate. Still images were captured from the 30-second video clips from all three cameras.

Three replicate image quadrats collected from the vertical down-facing camera were used from each site for quantitative analysis using a point intercept method. Each image quadrat was a standard size of 0.64m^2. A grid of 300 points was superimposed over each image quadrat and all biotic and abiotic variables were recorded. A total area of 1.92m^3 (n_{points} = 900) was therefore assessed per Q site (3 images x 0.64m^2) with point cover analysis at a resolution of 0.002m^2. A total of 22 Q sites ($n_{quadrats}$ = 66, n_{points} = 19,800) were included in the analysis. An additional 29 non-replicated sites were also included in the quantitative analysis and comprised the 22 sites along the cable alignment (R Sites not replicated, see below) and a further seven rapid sites from the surrounding area (n_{sites} = 29, n_{points} = 8,700). This resulted in a total analysis that included 28,500 point identifications from 95 quadrats covering an area of 60.8 m^2. This data was subsequently used in the description of the environment and biotopes using multivariate methods. Information from the lateral cameras was used to provide a descriptive account of the marine benthic communities and the profile of the habitat.

3.2 Rapid Habitat Assessment

The rapid habitat assessment (R Sites) was designed to provide an account of the macrobentic community structure and substrate compostion along the entire cable route in the neashore (0-30m). It was therefore undertaken directly over the proposed cable alignment from as shallow as practically possible for the survey vessel, to a depth of 30m. This involved deploying the drop camera at 50m intervals along the cable route. The starting point (R1) was located at the BMH (first sites were not sampled as they crossed the beach and intertidal) with R32 located at the approximated 30m isobath. In order to facilitate the field work and improve the accuracy, a 5m buffer either side of the cable route was created and loaded onto a chart plotter together with the designated Rapid (R) sampling locations (Figure 3.2). In total 32 Rapid sampling locations were identified covering a distance of 1,550m from the stating point (R1, on the beach). At each site the skipper manouvered the vessel directly over the demarcated sampling location and the drop camera was deployed to the seafloor. Once lowered to the sea floor the drop camera was left to record footage for approximately 30 seconds on all three cameras. Only one deployment was undertaken at each site as the objective of this component of the field survey was to obtain information from directly along the alginment, and no drift was therefore allowed. No repicate video/images were therefore taken at the R sites. This data was used to verify the habitat maps (Fugro 2020) and provide an account of marine biota along the entire cable route to depths <30m. These sites were also used for quantitative point-intercept analysis as outlined above (Q sites) from which the biotope classification was undertaken. This provides a longitudinal account of the change in biotopes with increasing depth and distance from shore.

Photographic illustrations of each R site from this assessment are included in Appendix 4.

Figure 3.1: The drop camera system used for the marine benthic assessment along the Amanzimtoti Pipeline Beach Landing Site.

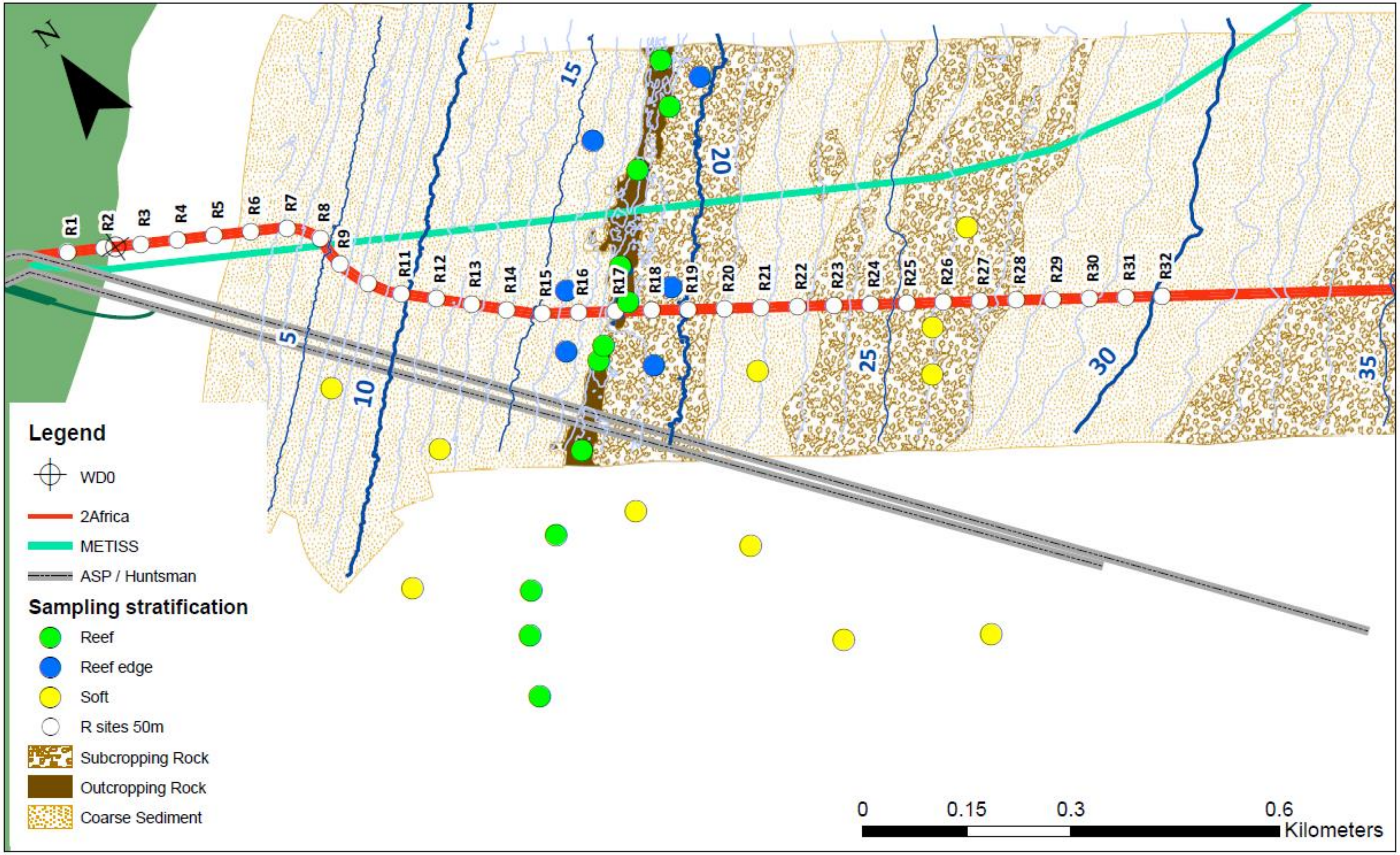


Figure 4.2: Survey design and distribution of main habitat types (Fugro 2020) along the nearshore cable route at the Amanzimtoti Pipeline Beach Landing Site. R sampling sites (white circles) were selected along the cable route from 0 to 30m depth (Red line) at 50m intervals. Additional sites were selected off the alignment to collect data on reef (green circles), reef edge (blue circles) and soft sediments / subcropping areas (yellow circles) to characterise the biota in these habitats in the broader study area. Red line = proposed route for new cable; blue line = existing METISS cable; grey lines = marine outfall pipes

4 Description of Nearshore Macro Benthic Communities

4.1 Regional Oceanographic Context

The subtropical Natal ecoregion includes an area from Cape Vidal in the north to the Mbashe River in the south. This is comprised of the southern KwaZulu-Natal coast, the Wild Coast and the KwaZulu-Natal Bight subregions (Sink et al. 2019). The strong southwards flowing western boundary current, known as the Agulhas current, flows close alongshore due to a characteristic narrow and steep continental shelf in this area of the coastline. The Agulhas current sources its waters from the Mozambique Channel as well as from the East Madagascar Current and contributes to the Indian Ocean Gyre through the Agulhas Return Current (Lutjeharms 1976, Beal et al. 2006, Dencausse et al. 2010, Lutjeharms and Bornman 2010). The KwaZulu-Natal Bight is a feature characterised by widening of the shelf edge, in effect pushing the current more offshore. This section of coast is located between Cape St Lucia and Durban, thereafter the shelf narrows, and the current is pushed closer inshore. A semi-permanent mesoscale cyclonic circulation trapped in the lee of the bight, the Durban Eddy, forms to the south offshore between Durban and the Sezela River mouth at Sezela south of Amanzimtoti. This process is believed to be a driver of productivity, although variable and inconsistent (Guastella and Roberts 2016).

Consolidated reef benthos along the southern KwaZulu-Natal coast colonise fossil dune and beach rock (Ramsay and Mason 1990) and does not consist of coral built reef systems and are not classified as true coral reefs (Riegl et al. 1995). The study site is situated along the shoreline off Amanzimtoti to the north of Umkomaas and the Aliwal Shoal Marine Protected Area (Brash 2006, Schleyer et al. 2006). This area is situated within the transitional zone between tropical/subtropical Maputaland reefs off the northern coast of KwaZulu-Natal off Sodwana Bay (Riegl et al. 1995), and warm temperate Pondoland reefs to the south located offshore between the Mtamvuna River and Port St Johns in the Eastern Cape Province (Mann et al. 2006). The closely located Aliwal Shoal is a large reef system situated four kilometres offshore between a depth of 8-22m and consists of aeolianite or dune limestone formations. This reef system has been the focus of biological assessment in the past (Bosman et al. 2005, Brash 2006, Schleyer et al. 2006, Olbers et al. 2009) and in addition to several taxonomic studies (Monniot and Monniot 2001, Samaai et al. 2019, 2020) provides some insight into the benthic invertebrate species that are found in the focus area (Appendix 5).

4.2 Site Context

The cable alignment at the proposed Pipeline Beach landing site, Amanzimtoti, traverses Natal Delagoa Intermediate Sandy Shoreline habitat (0-9m) and then Southern KZN Inner (9-26m) and Mid Shelf Mosaic (26m onwards) habitat (Sink et al. 2019). Detailed bathymetric, sidescan sonar surveys and sub bottom profiling indicate that 57% of the surveyed route consists of coarse sediments, 41% subcropping reef and less than 1% is outcropping reef (Fugro 2020).

4.3 Critical Biodiversity Areas

The National Coastal and Marine Spatial Biodiversity Plan has recently been released in Draft form (2021/02/26). The plan identifies Critical Biodiversity Areas (CBAs) in the coastal and marine environments, and sets management objectives for each area of classification, and sea-use guidelines for activities in each area. The CBA maps and associated guidelines aim to aid decision making for future Environmental Impact Assessments, Marine Spatial Planning and Integrated Coastal Zone Management (Harris et al. 2020).

The proposed study area is not located within an area which is defined as a Critical Biodiversity or Ecological Support Area in the National Coastal and Marine Spatial Biodiversity Plan.

The proposed beach landing site is approximately 9.5km north of the start of the Aliwal Shoal MPA on the coast. The deep-water section of the cable was re-aligned to avoid crossing the MPA and is located 600m from the north-eastern seaward corner of the MPA at its closest point. The Thukela MPA is located over 75km to the north along the coastline from the landing point, with Critical Biodiversity Areas and Ecological support areas over 25km to the north. There are no MPAs, CBAs or ESAs in the immediate area surrounding the proposed landing site and shallow water cable route (Harris et al. 2020).

4.4 Quantitative Field Study Results – Identification of Biotopes within the Project Area

4.4.1 Substrate types

Analysis of drop camera imagery shows a clear distinction between main habitats within the study area (Figure 4.1), with a clear separation of reef, sub-cropping rock and sand substrates based on the abundance of biota. The study area was dominated by unconsolidated sediments with 78.8% of the images collected from areas containing soft sediment. The sediment was predominantly fine sand, occasionally with shell fragments. Surface rippling due to current movement of the sand surface was evident but there was no indication of burrows or any associated biota.

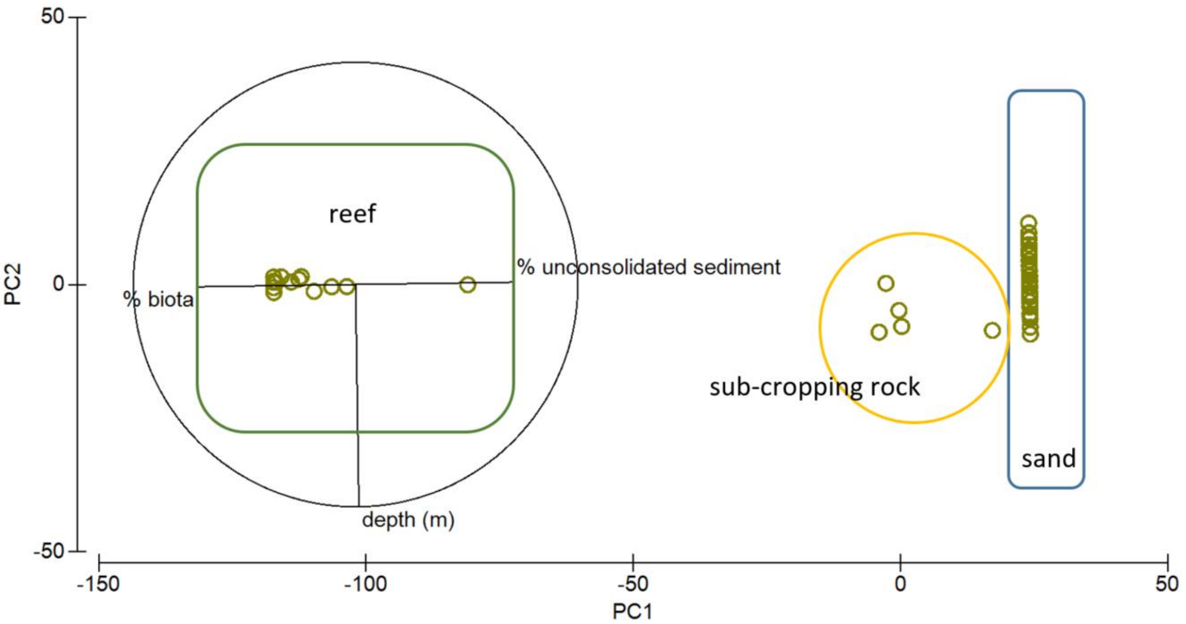


Figure 4.1: Principle Components Analysis (PCA) in PRIMER for all substrate type data (n = 95).

A previous investigation on the impact of effluent (liquid waste) on the nearshore off Amanzimtoti involved a study of the nearshore unconsolidated sediment and identified the impact of the disturbance (pollution) on soft sediment biota. This study found that the presence of macrofauna and small invertebrates, nematodes and copepods found off Amanzimtoti vary over time for the area (Newell et al. 1991b).

4.4.2 Reef Substrata

Sites with components of biota associated with reef could be categorised into two broad types. The inshore reef complex consisting of a band of flat low to medium profile reef in the nearshore (assigned to two different biotopes) which structurally consists of plateaus, ledges, overhangs and medium profile outcrops. This provides various surfaces to be colonized by a variety of small biota and sparsely distributed larger invertebrates (Figure 4.2, Group A and 4.2, Group B). The third biotope type has a larger sand component and the hard substrate is generally covered extensively with a considerable layer of sand (subcropping reef). The occurrence of biota is patch like (Figure 4.2, Group C). These areas are generally found in deeper waters further offshore.

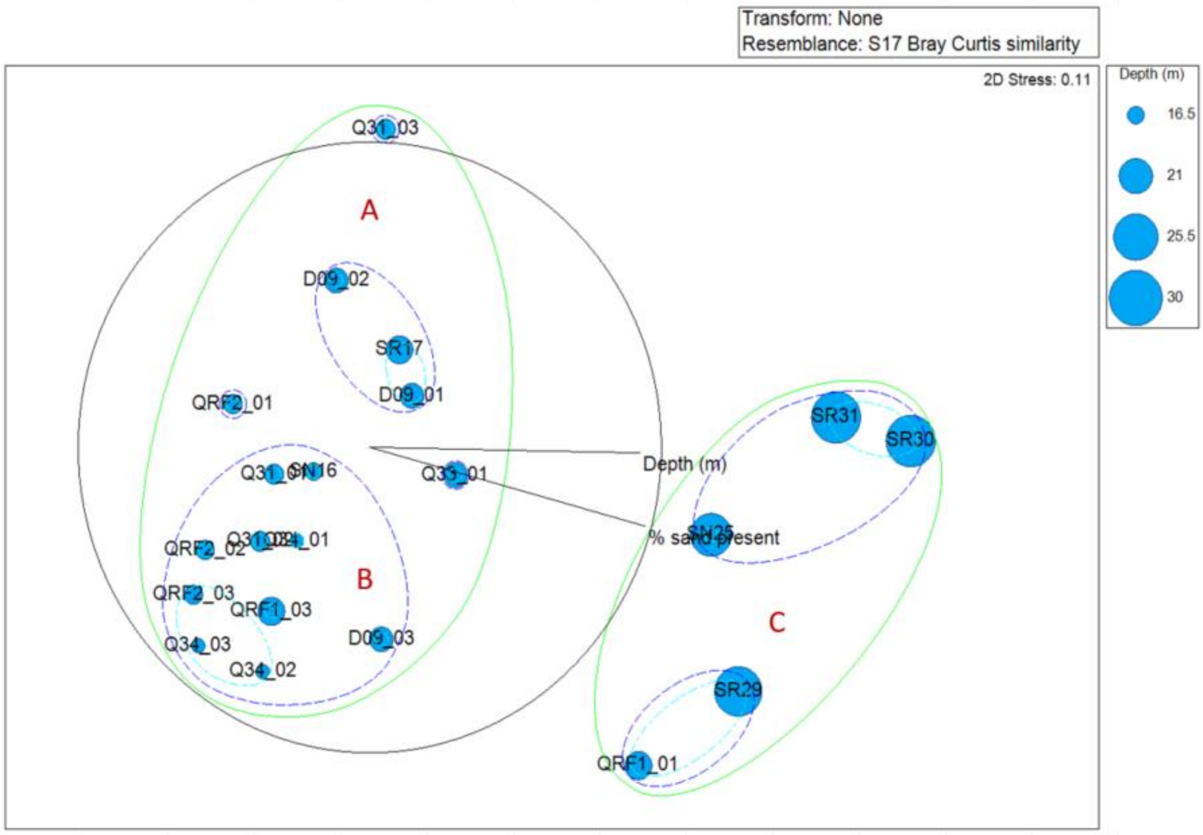


Figure 4.2: Multi-Dimensional Scaling (MDS) plot of variables associated with increased depth (m) as superimposed bubble plot for reef substrata. The dotted contour indicates the resemblance between biotopes (A - C) for samples sites with reef or reef element (green solid contour 25 %, blue dashed contour 50 % and light blue contour 75 % similarity). Data was not transformed and a Bray Curtis similarity was used.

The inshore reef system supported abundant life with no bare rock recorded although sand patches, narrow gullies and areas with a thin sand veneer were present. Growth forms consist of thin encrusting species, present in a patch like mosaic of small individuals or colonies. This is indicative of a highly dynamic, exposed habitat where protection against currents, and possibly sand abrasion, are limited to infrequent crevices and ledges or overhangs. Due to the small size of many species, this characteristic assemblage was clumped together and recorded as mix biological mat comprising of tuft-like and encrusting species including sponges, hydroids, ascidians and algae (Figure 4.3). Due to their size (many less the 10mm in size), it was not possible to identify these specimens individually.

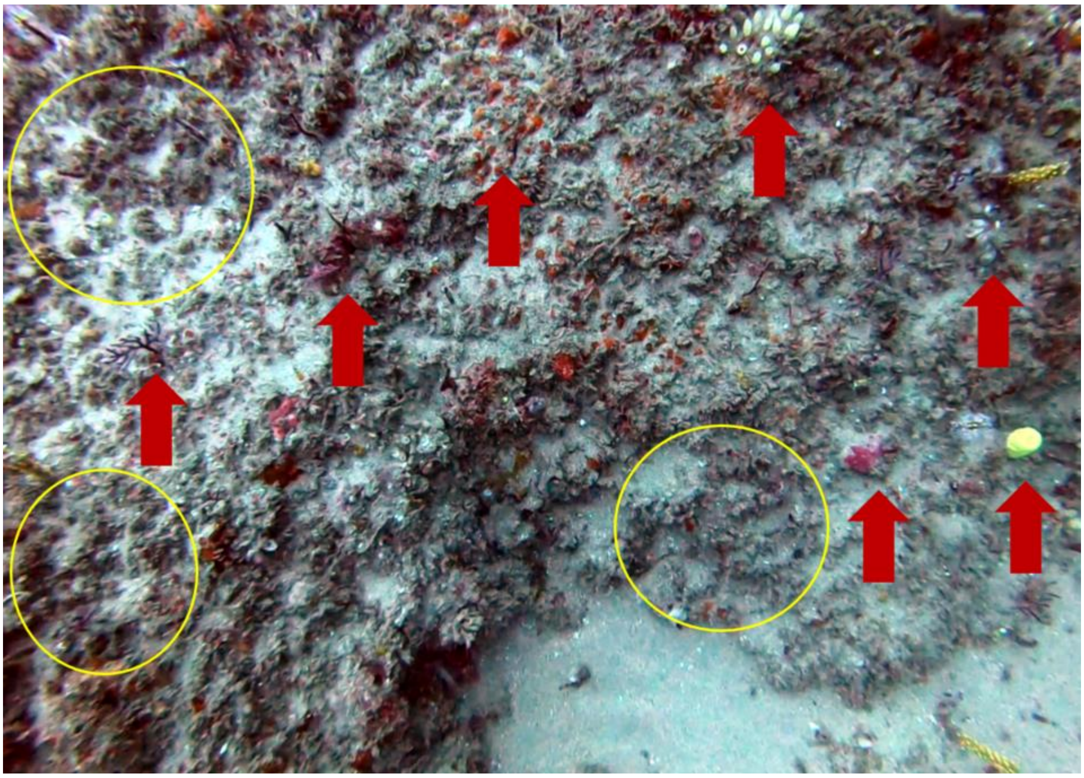


Figure 4.3: Close up of the reef substrate with yellow circles indicating a mix biological mat comprising of tuft-like and encrusting species including sponges, hydroids, ascidians and algae. The red arrows indicate examples of larger species that were identified and used to describe the biotopes.

Cluster analysis in PRIMER suggests the presence of three broad biotopes (Figure 4.4). SIMPER analysis indicates an average similarity within these biotopes of between 45.5 and 56.6% (Table 4.1).

Biotope A and Biotope B are present on reef structures which may have a small amount of sand veneered on the reef surface or sand present in shallow depressions or crevices.

Biotope A consists of both low and medium reef with varied rugosity dominated by mats of mixed biota tufts (71.6%) and sponges (9.6%) (predominantly grey encrusting *Psammocinia*-like and encrusting orange cf *Thalysias*-like sponges).

Biotope B is dominated by medium profile reef predominately consisting of ledges and flat reef covered by 90.0% mix biota tufts with a 5.0% fine sand component. It supports a higher density of *Leptogorgia/Acabaria* sea fans, both branched and short unbranched specimens, than Biotope A.

Biotope C consists generally of low profile reef covered in sand referred to as subcropping reef habitat consisting of 89.0% fine sand as well as sand with small shell fragments and 6.6% mats of mix biota tufts (Figure 4.4).

The dominant groups contributing to each defined biotope are illustrated in Figure 4.5 with sample images shown in Figure 4.6.

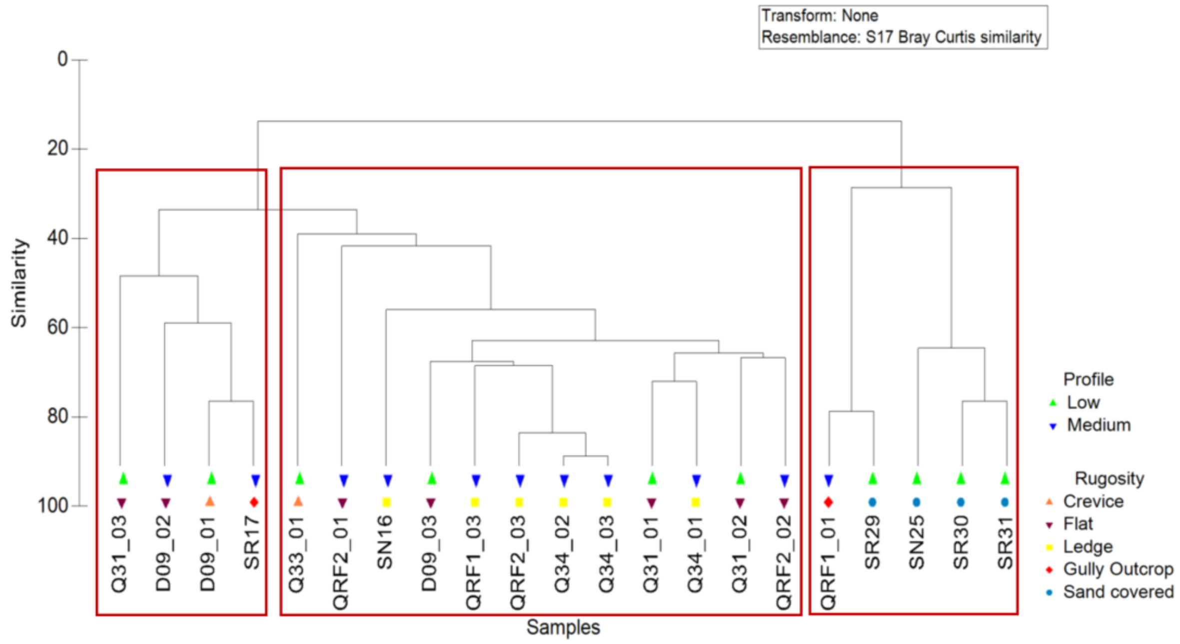


Figure 4.4: CLUSTER (PRIMER) analysis of untransformed Bray Curtis similarity identifies three broad reef biotope groups. Reef profile and rugosity indicated with key symbols.

Table 4.1: Average abundance (%) of species within the reef biotopes. Average similarity between components in the groups (Av. Sm), the deviation (Sim/SD) the contribution to the similarity (Contrib%) and the accumulative contribution (Cum %) is shown. Depth (m) for the defined group is also indicated.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Group A	**Average similarity: 56.50**			**17 to 18.8m**	
Grey encrusting cf *Psammocinia* sp	33.0	25.8	6.6	45.7	45.7
Mats of mixed biota	17.8	12.7	1.9	22.4	68.1
Orange encrusting sponge (cf *Thalysias* sp)	10.8	8.8	6.2	15.6	83.8
Pycnoclavella sp or *Clavelina* sp (may include *Euherdmania divida*)	9.3	2.4	0.8	4.3	88.1
Dark red /purple seafan *Leptogorgia* sp	2.4	1.6	2.3	2.9	91.0
Group B	**Average similarity: 56.62**			**16.0 to 18.9m**	
Mats of mixed biota	55.1	43.4	2.9	76.7	76.7
Dark red /purple seafan (unbranched) *Leptogorgia* sp	4.5	2.5	1.7	4.4	81.1
Pycnoclavella sp or *Clavelina* sp (may include *Euherdmania divida*)	6.5	2.3	0.7	4.1	85.2
Dark red /purple seafan *Leptogorgia/Acabaria* sp	3.4	1.3	0.9	2.3	87.5
Grey encrusting cf *Psammocinia* sp	4.5	1.2	0.4	2.2	89.7
Orange button sponge *Tedania* sp	2.9	1.1	0.8	2.0	91.7
Group C	**Average similarity: 45.53**			**18.9 to 28.0m**	
Fine sand with shell fragments	41.9	19.5	0.8	42.9	42.9
Fine sand without shell fragments	39.0	18.3	0.9	40.2	83.1
Mats of mixed biota	6.0	3.3	1.8	7.2	90.3

*Mats of mixed biota consist of small growth form of porifera, cnidarian, ascidians and algal tufts

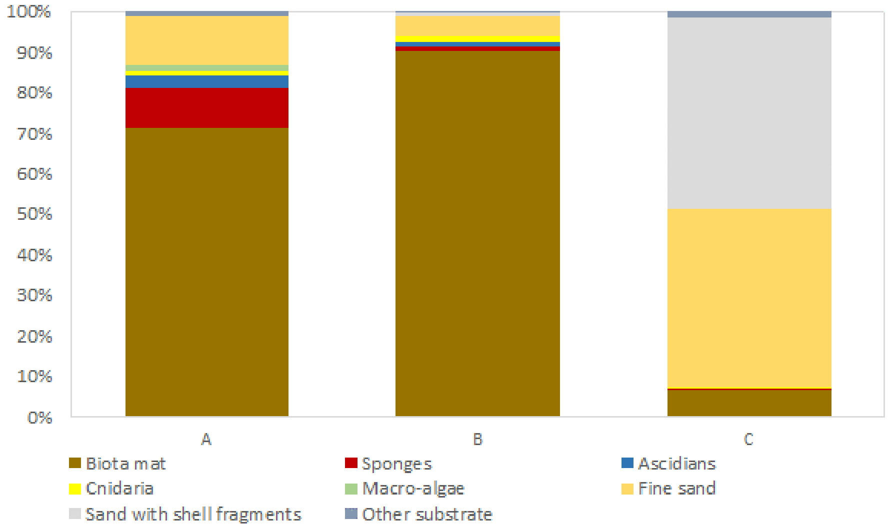


Figure 4.5: Percentage contribution of dominant taxa and substrate per reef biotope.

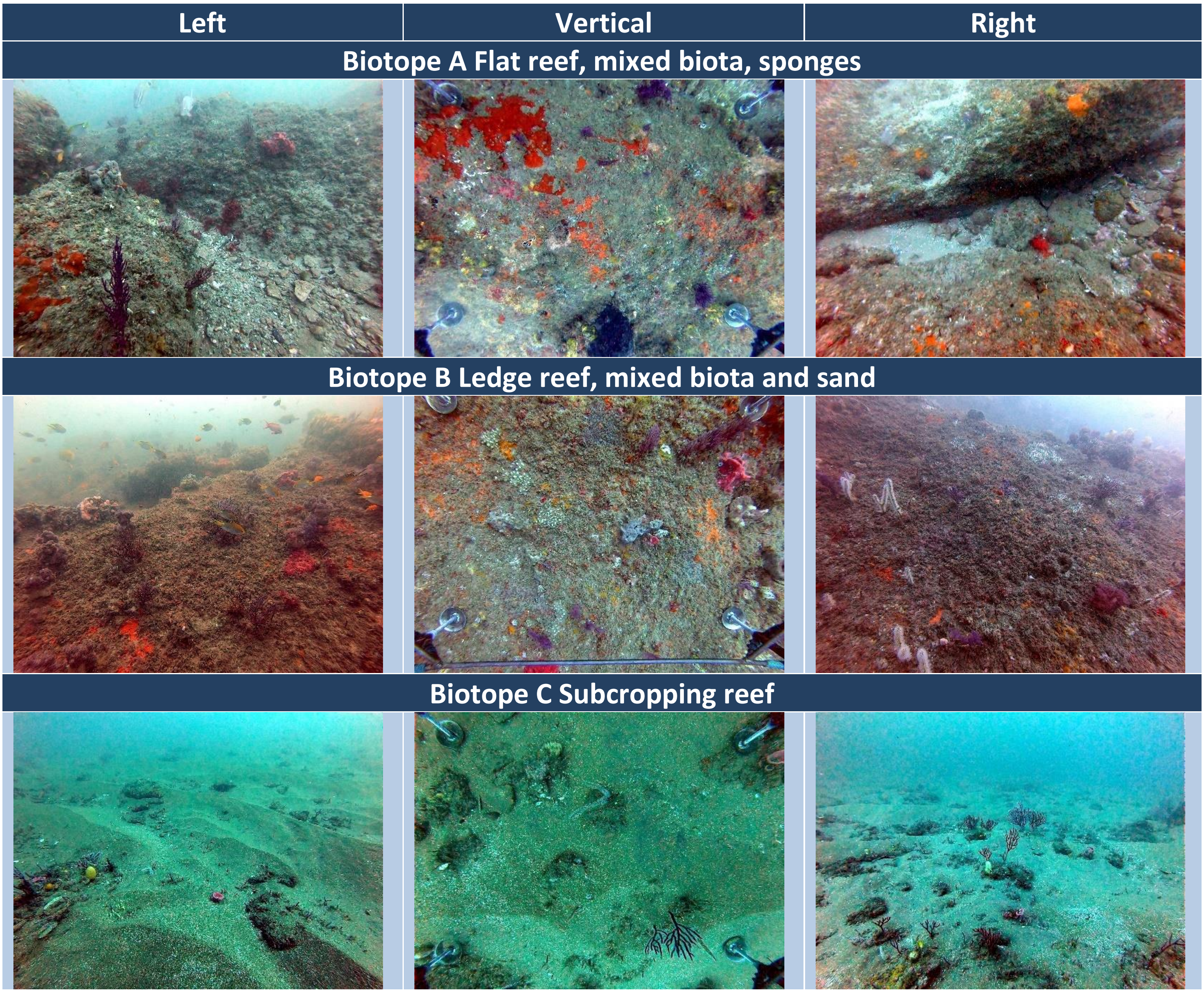


Figure 4.6: Representative images of reef biotopes dsitinguished in the study area using multivariate analysis of primary field data.

The large characteristic biota observed and recorded at the study site include predominantly sponges, soft corals and ascidians. Species of note, although low in abundance, include the purple and white thorny soft coral *Dendronephthya* sp and white/cream *Leptophyton benayahui* found in the shallower sections of Biotope B (with an abundance of between 1.3 to 8.0% when present and was present at only 19.0% of the sampled sites). No prominent hard coral colonies were recorded.

Large specimens of the sponges *Spheciospongia excentrica* and *Hemiasterella vasiformis* were prominent. A large yellow *Axinella*-like cup sponge was also recorded but at was present at a low abundance. These were observed on vertical reef surfaces only. Several ascidian species both colonial (*Didemnum* and *Lissoclinum* sp) and solitary species (*Polycarpa insulsa*, *Pyura stolonifera* and etc.) are present. These are however difficult to positively identify on morphology alone, especially in small colonies. Many didemnid species (encrusting colonial ascidians or tunicates) may look similar but when microscopically examined may belong to different genera or a single species may present in different growth forms or colour morphs and in the instance of the solitary species individuals may be heavily overgrown and cryptic. Positive conclusive identification of many of the species present, including sponges, needs microscopic examination of internal structures and spicules for positive identifications. A short summary of species likely to be found in the area is given in Appendix 5. Those species identified to some degree of certainty are given in Table 4.2 below.

A few individuals of *Antipathes*/*Cirrhipathes* (Black corals) were observed in the panoramic images but none were present in the sample quadrats (quantitative analysis). The abundance of these species was found to be very low, and based on the area of reef sampled this would suggest a density of less than one individual per 14m^2 of sampled area. These taxa are not listed or classified on the IUCN Red List, however, *Antipatharia* are listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which list species not necessarily threatened with extinction but highlights the need for strict regulation.

Although high biodiversity is suggested by the comprehensive list of species (Appendix 5) known to occur off the KwaZulu-Natal coast the small inshore reef ridge at the study site presented relatively few of these species, especially large specimens, and if so at low densities.

Table 4.2: List of additional species identified (the species listed here are preliminary identification is based on similarities in morphological structure)

Main group	Preliminary species identification
Sponge	*Psammocinia* cf *hawere*
	Spheciospongia excentrica
	Cliona cf *grandis*
	Cyclacanthia cf *mzimayiensis*
	Proteleia sollasi
	Hemiasterella vasiformis
	Xestospongia viridengra
	Spheciospongia globularis
Soft coral	*Parasphaerasclera aurea*
	Eunephthya cf *susanae*
	Malacacanthus capensis
Sea fan	Leptogorgia cf gilchristi
Black coral	*Cirrhipathes* sp
	Antipathes sp
	Homophyton verrucosum
Ascidian	*Clavelina robusta*
Algae	*Halimeda cuneata*
	Amphiroa ephedraea
	Peyssonnelia capensis

4.5 Cable Route Results (R Sites)

In total 22 sites were assessed directly over the cable alignment (R11 to R32) (Figure 4.7). Sites inshore of R11 could not be assessed due to the sea conditions which limited the use of the drop camera in the shallow inshore. Visual observations of this area suggests it is dominated by sand cover which is supported by the Frugo (2020) data. The depth covered by the field survey primary data collection therefore ranged from 9 to 29m. A full account of all images from each R Site is included in Appendix 4.

The approximate length of the cable route is 1,550m from the BMH to the 30m isobath (Figure 4.7). Sites R1 to R2 are located above the 0 water depth indicated on the survey data (Frugo 2020) and are therefore located on the beach above the intertidal. Sites R3 to R5 comprises the intertidal and shallow subtidal and observations suggest this area is predominantly sand. Sites R6 (no direct observations were made on R6 to R9) to R16 comprised coarse sediment. Site R17 was the only site in which visible outcropping rock was observed along the cable route (at 50m intervals) (other reef sites were sampled adjacent to the transect – Q sites) highlighting the narrow nature and limited extent of outcropping reef in the study area. The area where it is proposed that the cable crosses the reef was measured in GIS using the habitat data provided by ASN (Fugro 2020) and indicates that the reef crossing will be approximately 17m in width. Sites R18 to R28 were all visually assessed to be comprised on sandy sediments, while Sites R29, R30, and R31 showed evidence for subcropping reef as biota was observed in these areas.

These results indicates that 81% of the subtidal cable route (BMH to 30m isobath inclusive of supratidal area) traverses sandy substrata (subcropping reef may be present but was not observed) (Table 4.3). The section of the cable route above the intertidal accounted for 6% and comprised sandy beach habitat. Less than 4% of the route traverses outcropping rock which is composed of Biotopes A and B as defined above. Although the single reef site along the cable route (site R17) was defined as Biotope A, additional reef sites surveyed on the narrow linear reef complexes suggested two separate community types, largely based on the complexity of the reef structure itself, and a second outcropping reef biotope was defined (Biotope B) but not observed along the transect itself. The remainder of the route (approximately 9%) traverses subcropping reef, limited to the deeper areas of the inshore cable route, and was defined as Biotope C in this study.

Table 4.3: Summary of marine benthic biotopes identified along the cable alignment and approximate distances for each (BMH to 30m isobath).

Habitat	No Camea Sites	Biotope	Approximate distance (m)	% of route
Supratidal	2	Beach	100	6%
Sand	25	Sand	1,250	81%
Reef / outcropping rock	1	Biotope A/B	50	3%
Subcropping rock	3	Biotope C	150	9%

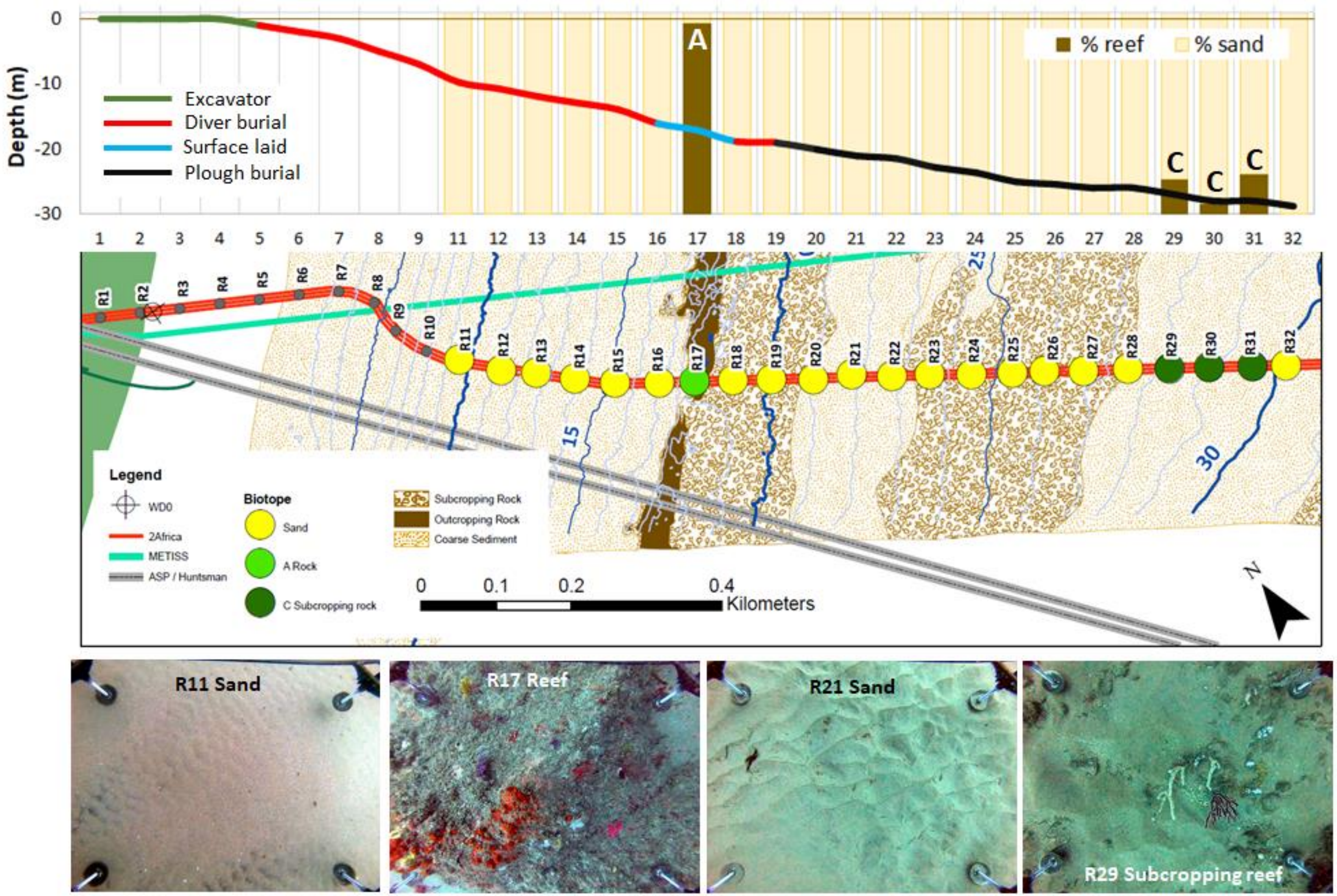


Figure 4.7: Reef biotope classification (letters in top graph), substrate type and depth along Amanzimtoti Pipeline Beach Landing site based field data collected using a drop camera system. Proposed cable burial methods are colour coded along the depth chart. Sites indicated as yellow or green on map are actual sites sampled along the alignment, smaller grey dots could not be sampled (R1-R10).

5. Identification and Assessment of Impacts

Impacts on the nearshore marine benthic environment have been identified and rated according to the three main project phases, namely Construction (cable laying/installation), Operation, and Decommissioning. A standard EIA methodology provided by ACER was used in the assessment of impacts and is provided in Appendix 1 for reference.

5.1 Construction Phase (Cable Installation)

The cable laying phase will result in the most disturbance to the nearshore marine benthic biota due to disturbance caused by both marine and land-based equipment for installation.

Construction Impact 1: Physical disturbance and damage to marine benthic biota.

Cable installation at the Amanzimtoti Pipeline Beach Landing Site will involve the use of a large cable laying vessel, smaller inshore vessels, divers and land-based equipment to haul sufficient cable onshore to reach the Beach Manhole.

The overall distance of the nearshore cable laying operation from the Beach Manhole (-m 0) to the 30m isobath is approximately 1,550m (Fugro 2020), with some of this including the beach above the low water mark (approximately 110m). The dominant substrate along the route is fine (or coarse) sand which accounts for 76% (1,174m) (Table 2.3). Subcropping rock accounts for the remaining 25% (380m). The charts produced by the cable route survey also indicates the presence of an outcropping reef in 17-18m of water, however, the distance to be traversed by the currently proposed cable alignment is minimal (<20m).

Due to the presence of subcropping rock and shallow overlaying sediments the greatest part of the cable will buried by divers (56%) which will cover the section from the intertidal to the 20m isobath (Table 2.2). The use of the cable laying ship and plough burial will only commence in waters deeper than 20m which will account for 44% of the shallow water (<30m) cable route. No effort will be made for burial over the short section of outcropping reef and the cable will be surface laid, secured on either side by burial in the soft sediments as well as the use of articulated split pipe, which prevents abrasion on the reef and contributes additional weight to the cable.

Damage to the hard substrata marine macro-benthic communities will be limited due to the small amount of reef which occurs along the cable route, and the narrow linear zone of impact. All species encountered on hard substrata within the project servitude occur within the region and no unique or endangered species were observed. Should any benthic reef macro fauna or flora be damaged during installation it will be able to recover to pre-impact health within a reasonable time. The cable and articulated split pipe will also likely be overgrown by these fauna as has been demonstrated elsewhere (Figure 5.1).

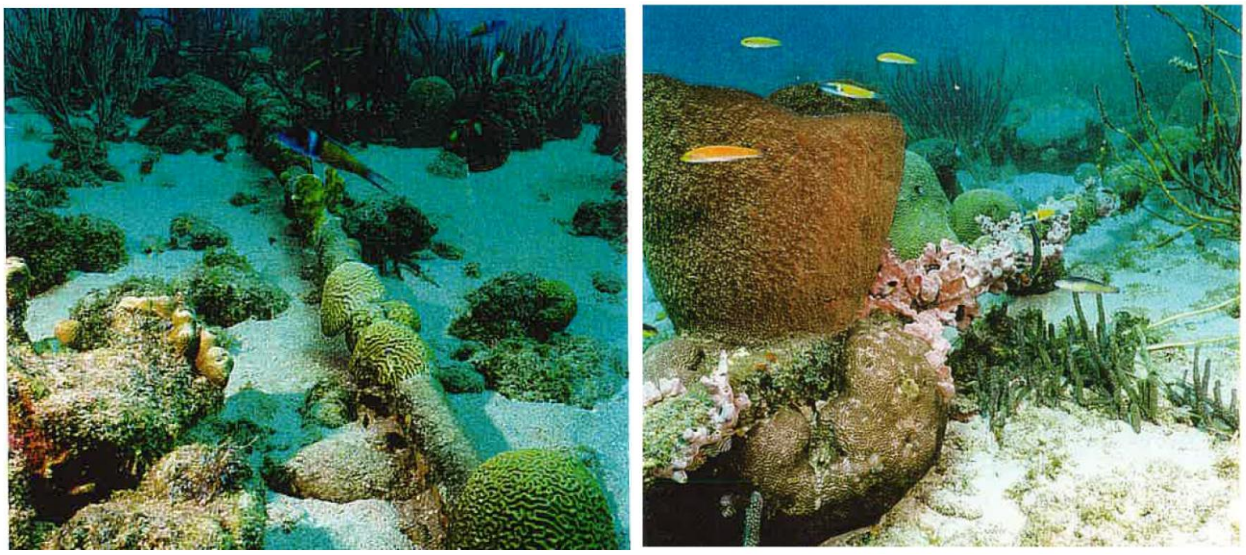


Figure 5.1: Examples of coral growth over surface laid cables (ASN 2020).

In areas where sand occurs over subcropping rock cable burial will be undertaken by divers using a purpose-built sledge which is towed along the seafloor by a surface support vessel. The sledge is guided by divers with water being pumped from the surface vessel creating a high volume flow which is used to create a trench and bury the cable to a pre-determined depth. Diver burial will be attempted along 874m (56%) of the cable route from the intertidal to approximately 20m water depth. The success of this burial will depend on the depth of the sediments over the subcropping rock at the time of the operation. Observations from the field surveys showed that benthic biota was observed attached to the hard substrates in these areas and indicates very shallow subcropping rock. It is unlikely that burial will be effective in these areas. Cable laying and attempted cable burial may result in some damage to the biota in these habitats which are scattered along the cable route. No species in these habitats are of key concern and occur widely in the region.

No infaunal burrows were observed along the cable route in fine or coarse sand areas suggesting the absence of larger burrowing macrofauna, however, this does not preclude the presence of smaller interstitial species. Such species are however likely to be widely distributed in the sandy areas and the extent of direct damage resulting from plough burial on such organisms will be minimal. The PLGR will also create disturbance on the sandy areas up to depths of 80cm, however, these sandy areas are widely distributed throughout the region and recovery of damaged areas will likely occur rapidly.

Both the reef and soft benthic habitats are located in a naturally dynamic environment which are subject to rough sea conditions, strong currents and large-scale sand movement. As such they are resilient to short-term impacts. Cable landing will be completed within one day, with an additional few days required for burial and installing articulated split pipe. The duration of impact is therefore short term and limited in extent. The habitat which will be affected through this activity are widely distributed and the overall significance of this impact is therefore considered as LOW.

Proposed mitigation measures for this impact include the following:

- Follow the cable route plan as accurately as possible during landing of the cable at the Beach Manhole to prevent lateral drag across the seafloor.
- Divers to limit the working area to as narrow a corridor as possible during burial, attachment of articulated split pipe and pinning of the cable.
- If cable requires re-alignment over the hard substrata by divers, the cable should be lifted to minimise damage to macro-benthic biota (gorgonians etc.).

Table 5.1: Rating for Construction Impact 1 - Physical disturbance and damage to marine benthic biota.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Site Specific	Site Specific
Duration	Short-term	Short-term
Intensity	Low	Low
Frequency	Once Off	Once Off
Probability	Definite	Definite
Irreplaceability	Low	Low
Reversibility	High	High
Significance	Low	Low
Confidence	High	High
Degree impact can be mitigated	Low	Low

Construction Impact 2: Increased Turbidity, and Sedimentation/Smothering

Pre-lay grapnel runs over the soft sediments and use of the plough will lead to the suspension of sediment particles into the water column. Similarly, diver operated cable burial water jetting activities will also lead to elevated suspension of particulate materials during the installation phase. This may lead to two impacts on the marine benthic biota, firstly increased turbidity affecting light penetration and therefore the ability of algae to photosynthesize, and secondly, smothering of biota due to the deposition of the suspended particles.

The sediment type within the nearshore cable route has been classified as fine and coarse sand over the subcropping rock where diver burial pre-lay grapnel runs and plough use will occur. These are the areas which are likely affected by the suspension of sediments. Visual observation of the sediments, and suspension and deposition of sediments after disturbance by the drop camera frame confirmed that the soft sediments were characterised by coarse sand particles and no areas of mud or silt were identified. Sand particles are larger than mud or silt and therefore settle out of the water column quickly. This limits both the potential for dispersion, as well as the duration of suspension in the water column and therefore the duration of elevated turbidity. This means that the extent of the impact will be highly localised and of short duration. This nearshore coastal area in the study site is subject to strong currents which will also aid in rapid dispersal and dilution of suspended particles. Biota occurring in these habitats are adapted to these conditions. Hard substrata was limited within the study area and no algal beds were observed. Impacts of increased turbidity due to the short duration and limited extent will likely be negligible.

Deposition of the sediments can potentially lead to smothering of benthic biota and may impact on feeding of suspension feeders. This may potentially influence benthic community structure on reef or hard substrata more significantly than unconsolidated substrata as soft sediment biota are generally mobile or able to withstand short periods of inundation due to the nature of the habitat in which they reside. Areas of rock outcropping within the cable route were extremely limited, being restricted to a span of less than 20m wide. The narrow reef does, however, run perpendicularly to the cable alignment and areas further away may also impacted to some degree as sediments are transported and dispersed by currents. The inshore coastal waters are typically highly dynamic and experiences strong currents and wave action, particularly during large storms which lead to large scale sediment movement. It is therefore probable that the inshore benthic communities are able to withstand temporary inundation as they occur in a naturally dynamic environment where sediment movement is common. Any impacts from sedimentation will be highly localised to the cable route and more specifically adjacent to areas where the plough and diver burial methods will be used. The impacts of smothering on reef macro-benthic communities will therefore be extremely limited and cable installation in the nearshore will also be short duration (approximately one day) further limiting the severity of this potential impact. Based on these considerations the overall significance of this impact is considered LOW.

Proposed mitigation measures for this impact include the following:

- Undertaking the work on a calm sea day will result in suspended sediments settling out quicker.

Table 5.2: Rating for Construction Impact 2 – Increased Turbidity and Sedimentation/Smothering

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Site Specific	Site Specific
Duration	Short-term	Short-term
Intensity	Low	Low
Frequency	Once Off	Once Off
Probability	Definite	Definite
Irreplaceability	Low	Low
Reversibility	High	High
Significance	Low	Low
Confidence	High	High
Degree impact can be mitigated	Low	Low

Construction Impact 3: Resuspension of existing contaminants

Background to the outfalls and sediments adjacent to the cable alignment

The fibre optic cable alignment runs inshore almost parallel to two existing effluent discharge pipelines which emanate from Pipeline Beach, Amanzimtoti (Figure 4.2). AECI Property Services (APS) provides utility services to the Umboqintwini Industrial Complex (UIC). APS receive wastewater from various points within the industrial complex which is treated at the onsite effluent treatment plant. Once treated this effluent is discharged into the nearshore through a marine outfall (the Acacia pipeline). Routine monitoring of the effluent water quality before it is discharged is conducted to ensure compliance with discharge permit conditions. This pipeline is 1.5km in length and discharges wastewater of largely organic content to depths of approximately 26m (CSIR 2015,2016). The outfall operated by APS (CWDP 2011/001/KZN/HeartlandLeasing) discharges approximately 3,572m^3.day^{-1} (based on 2019 data) (Acacia 2020) and several parameters are monitored daily (NH3, COD, pH, TSS, conductivity), weekly (Cu, Pb, Cr, Hg, Fluorides, SOG, As, Sulphides) and monthly (Zn, Se, Cd, Mn, Cn).

The second pipeline is the former Tioxide SA outfall which is 1.8km in length and was previously used by Huntsman Tioxide for the release of wastewater from the manufacture of pigments. The outfall release was at a depth of approximately 32m (CSIR 2015,2016). The discharge from the tioxide pipeline was characterised by acid-iron effluent with low pH and the presence of a suite of metals (CSIR 2015, 2016). Previous sampling of the effluent indicated the particulate matter comprised 90% Ti (wet weight) with the dried supernatant being rich in Fe and Ca. Distribution of Ti and Fe from the Huntsman Tioxide pipeline has been documented (Gregory et al. 2001; Gregory et al. 2005) and 'hotspots' have been identified up to 200m north-east and 200m west of the outfall for Ti, and 600m north/north-east and 400m west of the pipeline outfall for Fe. Gregory et al. (2005) developed a contamination index combining both Ti and Fe components which is presented spatially in Figure 5.2 below. The use of this pipeline for discharge of effluent was discontinued in June 2017 (Physalia 2019).

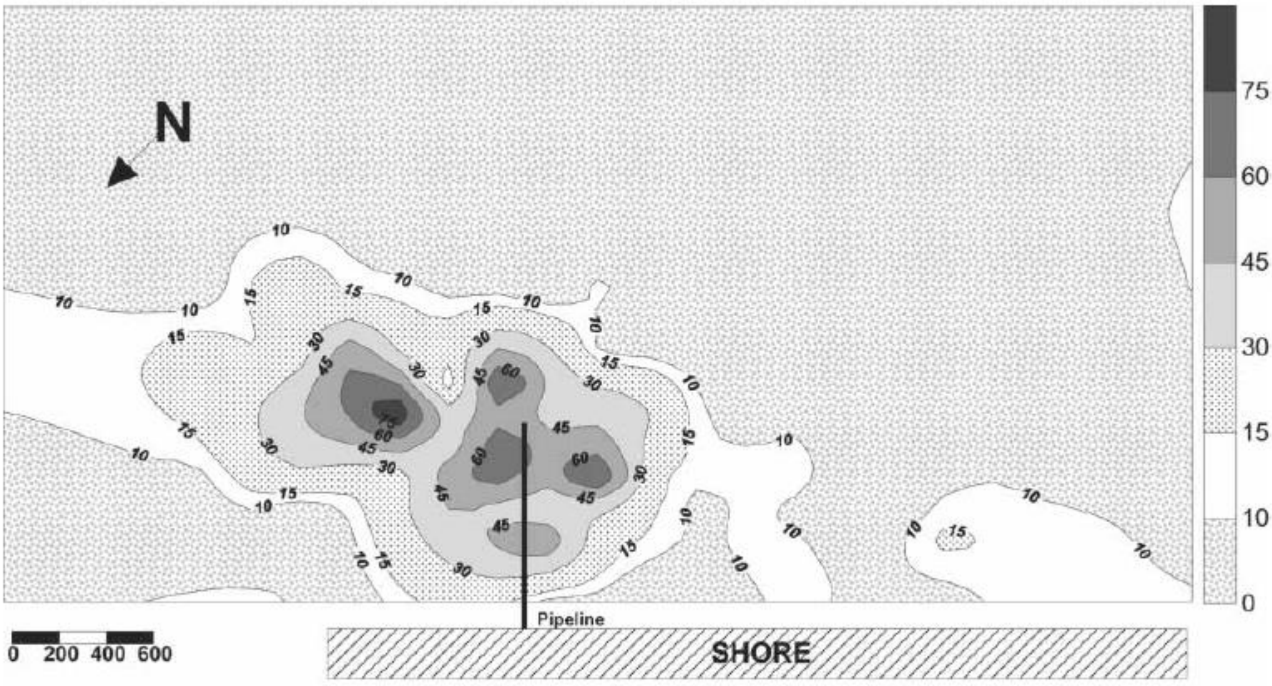


Figure 5.2: Contour map showing the distribution of the contamination index (I) derived by Gregory et al. 2005 (combination of Ti and Fe) in the vicinity of the Huntsman Tioxide pipeline (Maps taken from Gregory et al. 2005).

Previous work on the impact of acid-iron wastes from the titanium dioxide industry on the benthic community structure around the point of effluent discharge has shown a lower population density and diversity in the 'biological impact zone' around the effluent discharge point and dispersion zone which is relational to the current speed and direction (Newell et al. 1991a). The biological impact zone was shown to be nearly symmetrical due to the weaker and variable currents (than comparative studies in rivers with unidirectional currents) and extended to an area of roughly 1-1.2km either side of the discharge point (Newell et al. 1991a). The area of modified community structure (biological impact zone) was larger than the zone of reduced pH (dispersion zone) (typical of acid-iron waste) indicating that the metallic components of the effluent are responsible for the changes in invertebrate communities rather than the acidity of the effluent stream itself (Newell et al. 1991a; Newell et al. 1991b). This was confirmed by the presence of elevated concentration of zinc, lead, manganese, vanadium, copper, chromium and iron in the sediments adjacent to the outfall when compared to the sediment from the wider area (i.e. away from the outfall).

SA Tioxide (Pty) Ltd commenced operations in 1961 (Newell et al. 1991b) and the effluent pipeline was in operation for several decades. The amount of trace metal discharged over this period is unknown, however, past studies (e.g. Gregory et al. 2005) have shown that they precipitated out of the water column in close proximity (<1km) to the outfall location (Figure 5.2).

Metals bind to the sediment particles and are not bioavailable to the marine biota when in this state. However, disturbance of the sediments during cable installation may lead to the oxidation of the sediments, which could in turn lead to metals becoming more soluble and therefore more bioavailable to surrounding marine biota (Caille et al. 2003). This may create a potentially toxic environment for marine biota. The solubility of metals depends on a range of factors, including rates of re-adsorption, the concentration and composition of organic material and the oxidative environment (Caille et al. 2003). The mechanisms through which the metal species are re-adsorped are complex and driven by multiple factors.

Cable burial alternatives in the nearshore

Cable burial is the preferred option for cable installation particularly in the shallow coastal waters as it minimises the risk of damage to the cable infrastructure arising from snagging (anchor drag, bottom fishing etc.) during the operational phase. The greater level of protection afforded through burial reduces the likelihood of maintenance and repairs being required during the operational phase which minimises disturbance impacts in the long-term. Due to this cable burial is the only alternative being considered for the 2AFRICA/GERA (East) Cable System.

Conventional narrow blade ploughing is regarded as having the lowest level of disturbance for cable burial in sands, silts, gavels and clays as compared to other forms of mechanical burial (BERR 2008) as they result in minimal displacement of sediments and the cable is simultaneously buried and laid (PSR 2019). Plough burial will be undertaken at a rate of 10m.minute^{-1} and the only visible disturbance to the seafloor will be the tracks made by the plough skids and the plough scar into which the cable is buried which will self-close.

Three alternatives for cable burial in the nearshore area are proposed for the 2AFRICA/GERA (East) Cable System, based on the way the plough is operated, and the depth to which the cable will be buried. These alternatives are only relevant where plough burial will take place which will commence at approximately 20m water depth, cable burial in waters shallower than this will be facilitated by divers. Areas that are less than 20m deep (0-770m distance from shore) are also less likely to contain contaminated sediments as the Tioxide outfall discharged at a water depth of 32m (1,500m distance from shore).

The first plough burial alternative involves the use of the plough in combination with water jets for cable burial to a target burial depth of 2.0m. The use of water jets at the sediment-plough interface facilitates lubrication as the plough proceeds through the sediments and reduces drag. While this method is preferred from an engineering perspective water jetting creates more disturbance at the plough/sediment interface resulting in an increased plume of suspended sediments in the water column compared to mechanical ploughing alone. This alternative considers cable burial to a depth of 2.0m which may result in the disturbance of deeper sediments for which the chemical properties are unknown. Given the history of the nearby marine outfall and reported contaminants within the sediments (Newell et al. 1991a; Newell et al. 1991b; Gregory et al. 2001; Gregory et al. 2005) the use of water jetting during plough operation increases the potential for the release of contaminants currently contained within the sediments.

The two remaining nearshore cable burial alternatives are based on using mechanical ploughing alone and water jetting will not be used, the difference between these two alternatives being the target burial depth of 2.0 and 0.5m for burial alternatives 2 and 3 respectively. There is a slightly higher risk of releasing contaminants using the deeper of these two burial options should they be present (see below). However, the impact rating scales are too coarse to differentiate this.

In the absence of water jetting at the plough/sediment interface the level of disturbance and resuspension of sediments is greatly reduced. This therefore has the advantage of minimising the potential release of contaminants currently contained within the sediments.

Available data on the sediment

While the scope of this nearshore assessment was limited to a visual assessment of marine habitats and biota and did not include a detailed assessment of the sediments and contaminants therein; the nature of the project activities, and the history of the project location (outfalls) necessitates due consideration of the potential contamination of the sediments. While a detailed assessment of contaminants and toxicity is well beyond the scope of this study, a synthesis of available information from a marine monitoring programme (Physalia 2019) is provided below for context and to enable an assessment of the impact.

This information is synthesized from the 2019 marine monitoring report (Physalia 2019) which has been contextualized in terms of local and international sediment quality guidelines in relation to dredging and ocean disposal of dredged material. While the proposed project activities are more localized and far less destructive than dredging and ocean disposal of dredge spoil, the guidelines are relevant in that they provide guidance on Threshold Effect Level (TEL) and Probable Effect Level (PEL) of contaminants on biota which aids in understanding the possible implications these contaminants may have on biological communities. They therefore provide guidance for assessing the probability of an impact occurring should any of these contaminants be released at or above certain levels during cable laying activities, while taking into consideration the greatly reduced scale of the impact. Thus, although the sediment guidelines referenced in this section were developed for informing management of large-scale dredge and dredge spoil disposal projects, they provide a reference point for assessing impacts of contaminants on biological function.

The marine monitoring programme was undertaken in terms of the coastal discharge permit requirements for the discharge pipelines at Amanzimtoti. Marine monitoring has been undertaken in this area since the 1980s to detect and delineate the potential environmental and ecological effects of wastewater discharges into the area. In the 2019 survey sediment samples were collected from the upper 30cm (maximum depth) of the seafloor using a Day Grab for the analysis of physico-chemical and biological components of the marine environment adjacent to the outfall locations. Physico-chemical analysis included the determination of sediment types (particle size distribution) and concentrations of a range of chemical parameters in the sediments. The biological component assessed the meiofaunal and macrofaunal community composition, which served as bioindicators in the evaluation of the influence of discharged wastewater from the discharge points on the marine environment. The programme is a robust scientific assessment which now comprises a large temporal dataset, but only provides information on the upper sediment layers which are subject to collection via a grab sampler. The results summarized below therefore do not provide any information on the potential level of metals and contaminants in the deeper sediments (>30cm) through which the cable route will pass and be buried. The potential release of contaminants contained within these deeper sediments remains unknown, as does their bioavailability to marine organisms. In the absence of further information on the status of the deeper sediments, the results from the upper sediment layers are assumed to be representative of the deeper layers, but this assumption is not supported by further evidence.

The surface sediments collected in 2018 were dominated by sands with a size range of 125µm to 1,000µm, while the proportion of fine sediments comprising of fine sands (63-125µm) and silts and clays (<63µm) was low. The lack of fine sediments was attributed to the low run-off due to persistent droughts in KZN leading up to the 2018 survey which reduced the alluvial input of silts and clays to the area. The samples collected in 2019 had higher proportions of silts and clays, which were attributed to the increased rainfall and therefore run-off and alluvial input from the neighbouring rivers. Sediment chemistry in the 2018 samples revealed elevated levels (above natural background levels) of iron, manganese, chromium, zinc, vanadium, lead and tin in the vicinity if the outfalls which were attributed to the TiO_2 outfall with no attenuation apparent from previous surveys. The 2019 survey indicated that manganese, chromium, zinc, vanadium and lead were all elevated above natural background levels (not guideline values) at sites adjacent and to the north-east of the two discharge points. These parameters are all components of the former TiO_2 production process and therefore these areas represent a residual contamination footprint associated with the outfall.

In total 35 sites were sampled in 2019 and sediment chemical analyses were conducted. The average and maximum values for parameters were compared to the US NOAA Marine Sediment Guidelines (Buschman 2008), the ANZECC/ARMCANZ Sediment Quality Guidelines (Simpson et al. 2005; Simpson et al. 2013), and the South African Screening Guidelines for Dredged Material (DEA 2012). As mentioned above these guidelines for handling dredge material are conservative in the context of this project given the nature of impact in comparison to the scale and degree of impact which would result for ocean disposal of dredge material, yet they do provide guidance on levels at which contaminants are likely to have an impact on biota. The NOAA and ANZECC guidelines have two values, a lower Threshold Effect Level (TEL) and a higher Probable Effect Level (PEL). The TEL provides an indication of the level at which a contaminant begins to have a toxic effect on benthic organisms, while the PEL is the concentration at which a large proportion of benthic organisms show a toxic response and impacts resulting from the contaminant are therefore probable. The South African Screening guidelines provide a Warning Level, Level I and Level II values. The Warning Level values for most metals in the South African guidelines correspond to the Probable Effects Levels in other guidelines.

Although the 2019 marine monitoring survey (Physalia 2019) indicates that five metals (chromium, manganese, lead, vanadium, and zinc) were present in the sediments at levels above the expected natural background concentrations, none of these metals occurred at levels above the ANZECC lower guideline value (TEL), or the South African Screening Guideline warning values, whilst chromium exceeded the NOAA TEL at one site with the average value across all sites being approximately half the NOAA TEL value. The site which exceeded the NOAA TEL chromium level was below the PEL level. Based on these results, the sediments and contaminants within the study area would likely not result in major effects to marine biota and there would be a low risk of lethal effects for these contaminants. No guideline values were available for manganese or vanadium.

Whilst no elevated levels (i.e. above guideline values) of mercury were detected during the 2018 survey, three of the 35 sites sampled during 2019 had levels above the NOAA and ANZECC TEL levels and a further three sites had concentrations above the PEL. In terms of the South African Screening values for disposal of dredged material, mercury levels at 32 of the 35 sites were below the warning level (i.e. PEL), with three sites being above Level II guideline values. The three sites with higher levels of contamination occurred in water depths >30m. The distribution of the elevated levels of mercury was not related to distribution of coarse or fine sediments, nor were they related spatially to the location of either of the two outfall pipelines. The source of mercury remains unknown, but the most plausible explanation is that it was imported into the area with riverine alluvial silts from recent rains (Physalia 2019).

As mentioned, the guideline values were established for large scale ocean disposal of dredge material, whereas the current project and proposed activities are minor in comparison, as is the likely disturbance to the sediments resulting from plough use. In the context of this study the guidelines are used to provide support as to at what concentration contaminants may begin to have an impact on marine biota. With the exception of mercury levels at three sites the data available for all contaminants showed concentrations below guideline PELs.

Furthermore, the above reported contaminant concentration results must be interpreted bearing in mind the bioavailability of contaminants. Contaminant bioavailability is greatly affected by sediment physical and chemical properties, and toxic effects due to contaminants are not exhibited in sediments in which the contaminants are not bioavailable, regardless of the total contaminant concentrations (Simpson 2013). Thus, the presence of contaminants does not necessarily mean that these contaminates are toxic; their toxicity can only be determined through further laboratory testing. Contaminant values below ocean disposal sediment guidelines values are considered safe for ocean disposal (in terms of dredging projects) without further bioavailability studies, and therefore in the context of this project where the scale of impact would be greatly reduced this would also be applicable.

Proposed mitigation measures for this impact include the following:

This impact has been assessed using the available data based on the particle size distribution of surface sediments and the reported level of total metal contaminant concentration within these. The coastal zone in the project area is highly dynamic with prevalence of strong currents which will aid in dispersal and dilution of any suspended sediments which may occur as a result of cable burying activities.

The only feasible mitigation measure for this impact is to ensure that the disturbance to sediments is kept to a minimum. The use of water jetting at the sediment plough interface should therefore be avoided, especially in areas of known high contaminations. Furthermore, disturbance during diver burial should be minimised as far as possible. The following mitigations should be implemented:

- Use mechanical plough only in the nearshore area, no water jetting to be used during plough burial.
- Avoid pre-lay grapnel runs in the contaminant 'hotspot' areas where possible.
- Limit cable burial to periods of good sea conditions with minimal longshore currents (as far as practically possible).
- Monitor the plumes during cable burial to ascertain the spatial extent with the aim to limit the plume to less than 1km of the cable alignment (approximate distribution of existing contamination based on available data).
- Cease burial during periods of strong current, rough sea conditions or development of a large visible plume.

Table 5.3: Rating for Construction Impact 3 – Resuspension of contaminants based on the proposed burial alternatives.

Impact Description	Burial Alternative 1	Burial Alternative 2	Burial Alternative 3
	Plough with jetting, 2m burial depth	Plough No jetting, 2m burial depth	Plough No Jetting 0.5m burial depth
Nature of impact	Negative Direct Impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Local / Regional	Local	Local
Duration	Unknown	Short-term	Short-term
Intensity	Unknown	Unknown	Unknown
Frequency	Once Off	Once Off	Once Off
Probability	Highly probable	Possible	Possible
Irreplaceability	Unknown	Low	Low
Reversibility	Unknown	Moderate	Moderate
Significance	Unknown	Low	Low
Confidence	Low	Low	Low
Degree impact can be mitigated	Low	Low	Low

Construction Impact 4: Accidental spills

The use of construction vehicles, excavators and generators within the coastal zone for the beach landing may result in accidental spillage of fuels and/or oils which could find their way into the marine environment. Vessels will also be used in the nearshore for cable laying and floating and hauling the cable to shore which may be a potential source of pollution. Working with small vessels in the surf zone for cable landing introduces an additional risk of a potential boating accident which although highly unlikely would lead to spillage. Hydrocarbons are highly toxic to marine organisms and any larger spills reaching the aquatic environment disperse rapidly and are difficult to contain. Any spills which occur at sea during an onshore wind would be result in hydrocarbons being pushed to the shoreline which would affect the intertidal beaches as well as the recreational beach users (swimmers, surfers etc.).

All machinery used in the coastal zone for the construction of the pipeline must be maintained in good working order and checked regularly for leaks. Vehicles and machinery should not be parked on the beach unnecessarily and for periods longer than required. No re-fuelling is to take place in the coastal zone, all refuelling must be undertaken at correctly installed bunded fuelling stations. Contingency plans to handle accidental spillage must be developed and spill and containment kits must be available onsite.

The likelihood of accidental spills is low if good management practices are followed and any spills which do occur are likely to be small and affect a localised area. The overall significance is therefore considered LOW.

Proposed mitigation measures for this impact include the following:

- Limit the number of vehicles and machinery to those essential for cable installation.
- All vehicles and machinery used in the coastal zone to be maintained in good working order.
- No maintenance of machinery to be undertaken in the coastal zone.
- No re-fuelling to be undertaken in the coastal zone.
- A contingency plan must be developed to deal with accidental spillages.
- Appropriate training of construction personnel must be undertaken so that they are aware of the restrictions, mitigation measures and the use of spill and containment kits.

Table 5.4: Rating for Construction Impact 4 – Accidental spills.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Medium
Frequency	Once Off	Once Off
Probability	Improbable	Improbable
Irreplaceability	Low	Low
Reversibility	Moderate	High
Significance	Medium	Low
Confidence	Medium	Medium
Degree impact can be mitigated	Low	Low

5.2 Operational impacts

Operational Impact 1: Presence of Hard Permanent Structure.

The installation of the cable will result in the presence of a hard permanent structure. This impact is only relevant in areas where cable burial is not undertaken. For the Amanzimtoti Pipeline Beach Landing Site only a very small section of cable is unlikely to be buried. The cable will be colonised and overgrown by naturally occurring marine benthic species in time (see example images in Figure 5.1). Introduction of the hard cable structure to areas of subcropping rock is not seen as a major issue as these areas comprise a mix or hard and soft substrata in the natural state, and the new hard substrate will be colonised by naturally occurring species. The cable will be buried in the soft substrata and this will not be an issue in the deeper waters (>20m) where cable burial will occur. The overall significance is considered LOW.

Proposed mitigation measures for this impact include the following:

- Bury cable in areas of soft sediment where feasible.
- Pin cable to hard substrata in areas where it is surface laid to prevent movement.

Table 5.5: Rating for Operational Impact 1– Presence of hard permanent structure.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Site specific	Site specific
Duration	Permanent	Permanent
Intensity	Negligible	Negligible
Frequency	Continuous	Continuous
Probability	Definite	Definite
Irreplaceability	Low	Low
Reversibility	Low	Low
Significance	Low	Low
Confidence	High	High
Degree impact can be mitigated	Low	Low

Operational Impact 2: Introduction of Electric Fields, Electromagnetic Fields, Sound and Heat.

Optical fibre carries high voltage, however, there is no external electric field associated with the power on the inner conductor as the electric field is contained within the cable insulation (Section 2.4).

The electromagnetic field at more than one meter from the cable is two orders of magnitude lower than the vertical component of the earth's magnetic field. Electromagnetic fields will therefore have no impact on the marine benthic communities (Section 2.4).

Sound is generated during routine maintenance activities which requires 'toning' to identify cable breaks. No impact on fish behaviour due to 'toning' has been observed. As fish are likely more sensitive to such impacts than marine benthic biota it is improbable that marine benthic communities will be affected, but information on this aspect is not available at present. If there is an impact on benthic communities it is likely to be very localised and short term (Section 2.4).

Transport of electrical energy results in the loss of heat leading to an increase in temperature at the cable surface which may be transferred to the surrounding environment. The narrow, linear nature, and expected weakness of the potential thermal radiation, in combination with high levels of water exchange makes it unlikely that this will impact the marine benthic biota (Section 2.4). The overall significance is considered LOW.

Table 5.6: Rating for Operational Impact 2– Introduction of electric fields, electromagnetic fields, sound and heat.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Site specific	Site specific
Duration	Permanent	Permanent
Intensity	Negligible	Negligible
Frequency	Continuous	Continuous
Probability	Improbable	Improbable
Irreplaceability	Low	Low
Reversibility	Low	Low
Significance	Low	Low
Confidence	Medium	Medium
Degree impact can be mitigated	Low	Low

Operational Impact 3: Cable Maintenance and Repair.

The predicted lifespan of the fibre optic cable is 25 years. It is anticipated that over this period maintenance and repairs will be required. No repeaters will be located within the nearshore (<30m) and no servicing will therefore be required. Due to the highly dynamic nature of the coastal zone cable abrasion may occur, and the possibility exists of a cable break due to ongoing abrasion, or a major storm event. However, this is highly unlikely as only a short section of cable will be surface laid at the Amanzimtoti Pipeline Beach site. The surface laid cable in this area will also be protected in articulated split pipe. It is therefore highly unlikely that cable damage will occur in the nearshore during the project period. Should a break occur in the nearshore it is probable that the cable from the Beach Manhole to a safe workable depth will be replaced in its entirety. The impacts of this will be as for the construction phase and include direct disturbance and damage to marine benthic biota along the cable route, and suspension of sediments leading to increased turbidity and sedimentation, and potential resuspension of contaminants contained within the sediments (depending on the method of deployment selected). The significance of these construction impacts is as listed in the construction phase. The probability of maintenance being required is improbable and the frequency is intermittent, and as a result this operational impact is considered LOW.

Proposed mitigation measures for this impact include the following:

- Ensure cable protection in the nearshore by burial or articulated split pipe.
- Ensure cable protection is installed along all sections that are surface laid.
- Pin cable to rock outcropping to prevent movement and limit abrasion.

Table 5.7: Rating for Operational Impact 3– Cable maintenance and repair.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Negative Direct Impact	Negative Direct Impact
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Intensity	Negligible	Negligible
Frequency	Intermittent	Intermittent
Probability	Improbable	Improbable
Irreplaceability	Low	Low
Reversibility	High	High
Significance	Low	Low
Confidence	High	High
Degree impact can be mitigated	Low	Low

Operational Impact 4: Protection of marine benthic communities.

Once the telecommunications cable has been installed a servitude will be declared along its length with a width of 500m either side, creating a servitude 1km wide. This serves to protect the cable from physical damage and no vessel may drop or drag anchor or deploy bottom fishing gear (bottom trawl nets) (Marine Traffic Act 2 of 1981). This will afford protection to the marine benthic biota from major anchor and fishing damage (resource use is still permitted) within this servitude. This will be a positive indirect impact because of the project. Other resource use activities will be permitted (e.g. fishing, diving, spear fishing) so benefits are limited to the benthic biota (however, damage from diving may still occur). The impact is therefore rated as of a LOW positive significance.

Proposed mitigation measures for this impact include the following:

- Publicise the 2Africa servitude once permitted and declared.

Table 5.8: Rating for Operational Impact 4– Protection of marine benthic communities.

Impact Description	Pre-Mitigation	Post Mitigation
Nature of impact	Positive Indirect Impact	Positive Indirect Impact
Spatial extent	Local	Local
Duration	Permanent	Permanent
Intensity	Negligible	Negligible
Frequency	Continuous	Continuous
Probability	Definite	Definite
Irreplaceability	Low	Low
Reversibility	High	High
Significance	Low	Low
Confidence	High	High
Degree impact can be mitigated	Low	Low

5.3 Decommissioning impacts

Submarine fibre optic cables are designed to have a life-span of 25 years and most cables installed are operating beyond this life-span. No decommission of the cable has therefore been planned and impacts cannot be rated.

5.4 Cumulative impacts

The KwaZulu-Natal south coast is subject to considerable residential and industrial development. Several estuaries occur along this section of coast which are likely subject to anthropogenic pollution from inland sources, which is ultimately discharged into the nearshore marine environment. As discussed previously, there are also several marine outfalls located on the south coast. In addition to the two located at the project site (Tioxide and AECI) which were discussed previously, there is another discharge approximately 20km to the south at Umkomaas through which effluent from a cellulose mill operated by Sappi is released at 40m depth approximately 6.5 km offshore (CSIR 2016). A further two outfalls are operated by the eThekwini Municipality to the north, the first approximately 11km north and the second approximately 25km north. Both pipelines discharge domestic and industrial wastewaters at depths between 45 and 60m, approximately 3.2-4.2km offshore (CSIR 2015, 2016). All these discharges mean that the project area is subject to a variety of existing pollutant inputs into the marine environment. Water and sediment quality are both likely to have been impacted by inland wastewater and the marine outfalls which discharge into the nearshore. The cumulative effect of these existing impacts has not been quantified and is difficult to predict. However, the proposed cable will have no likely impacts on the nearshore marine environment during the operational phase since once installed, the cable is benign with no meaningful chemical discharges.

The construction phase may, however, result in short-term impacts, and the potential impact of most concern is the re-suspension of contaminants which have originated from the existing marine outfalls at the project location. It is not possible to quantify the potential spatial or temporal effect of this impact using the data that is currently available. It must be noted that the project activities themselves will not introduce any new harmful substances into the marine environment (unless accidental spillage which is unlikely) and the contribution to cumulative impacts will be negligible from this perspective. The project activities may however resuspend and release EXISTING harmful substances currently bound within the sediments thereby potentially creating a short-term harmful plume. At this stage the extent, likelihood and significance of this occurring are unknown.

Whilst the construction phase may add to the cumulative effects on the local environment, the operational phase of the project will have little to no contribution to the cumulative impacts within surrounding areas.

5.5 Assessment of Alternatives

Cable route alternatives

There is no proposed alternative alignment for the telecommunications cable in the nearshore at the Amanzimtoti Pipeline Beach Landing Site. The only alternative is therefore the No-Go Alternative. This would eliminate all construction and operational impacts on the marine benthic communities. However, the significance of all operational impacts identified through this study are considered LOW post-mitigation.

Cable burial alternatives

Cable burial alternatives 2 and 3 (Plough with mot water jetting) are the preferred options for cable installation as they will minimise the disturbance of sediments and therefore the potential release of contaminants. Due to the manner in which the plough operates (without water jetting) there is likely little difference in the impact of resuspension of sediments and contaminants between burial Alternatives 2 and 3 as the interaction of the sediments/water interface will be similar. Should contaminants be present in deeper sediments (currently unknown) the risk of releasing these contaminants would be higher during the deeper mechanical plough burial alternative. Burial Alternative 2 has the added advantage of additional protection of deeper burial and therefore reduces potential future damage.

Table 5.9: Summary of impacts on the marine benthic communities.

Project Phase	Impact Description	Nature	Extent	Duration	Intensity	Frequency	Probability	Irreplaceability	Reversibility	Significance	Confidence	Mitigation Potential	Post-Mitigation Significance
Construction	Construction Impact 1: Physical disturbance and damage to marine benthic biota.	Negative Direct	Site Specific	Short-term	Low	Once Off	Definite	Low	High	Low	High	Low	Low
	Construction Impact 2: Increased Turbidity, and Sedimentation/Smothering	Negative Direct	Site Specific	Short-term	Low	Once Off	Definite	Low	High	Low	High	Low	Low
	Construction Impact 3: Resuspension of existing contaminants- Alternative 1 Jetting	Negative Direct	Local / Regional	Unknown	Unknown	Once Off	Highly probable	Unknown	Unknown	Unknown	Low	Low	Unknown
	Construction Impact 3: Resuspension of existing contaminants- Alternative 2 No Jetting, burial 2m.	Negative Direct	Local	Short-term	Unknow	Once off	Possible	Low	Moderate	Low	Low	Low	Low
	Construction Impact 3: Resuspension of existing contaminants- Alternative 3 No Jetting, burial 0.5m.	Negative Direct	Local	Short-term	Unknow	Once off	Possible	Low	Moderate	Low	Low	Low	Low
	Construction Impact 4: Accidental spills	Negative Direct	Local	Short-term	High	Once Off	Improbable	Low	Moderate	Medium	Medium	Low	Low
Operation	Operational Impact 1: Presence of hard permanent structure.	Negative Direct	Site specific	Permanent	Negligible	Continuous	Definite	Low	Low	Low	High	Low	Low
	Operational Impact 2: Introduction of electric fields, electromagnetic fields, sound and heat.	Negative Direct	Site specific	Permanent	Negligible	Continuous	Improbable	Low	Low	Low	Medium	Low	Low
	Operational Impact 3: Cable Maintenance and Repair.	Negative Direct	Site specific	Short-term	Negligible	Intermittent	Improbable	Low	High	Low	High	Low	Low
	Operational Impact 4: Protection of marine benthic communities.	Positive Indirect	Local	Permanent	Negligible	Continuous	Definite	Low	High	Low	High	Low	Low

6 Assumptions and limitations

This study was based on visual primary data collection during the field surveys and there were no limitations or assumptions which affect the findings of this survey based on the defined scope. The survey was limited to visual macrobenthic assessment and did not include sediment analysis or infaunal and meiofaunal surveys.

Visual primary data were collected specifically for this project in a robust and scientific manner.

7 Proposed mitigation measures

Mitigation options are limited due to the nature of the project, however, the following mitigation and monitoring measures are proposed:

1. Follow the cable route plan as accurately as possible during landing of the cable at the Beach Manhole to prevent lateral drag across the seafloor.
2. Divers to limit the working area to as narrow a corridor as possible during burial, attachment of articulated split pipe and pinning of the cable.
3. If cable requires re-alignment over the hard substrata by divers, the cable should be lifted to minimise damage to macro-benthic reef biota.
4. Limit the number of vehicles and machinery used for beach landing to those essential for cable installation.
5. All vehicles and machinery used in the coastal zone to be maintained in good working order.
6. No maintenance of machinery to be undertaken in the coastal zone.
7. No refuelling to be undertaken in the coastal zone.
8. A contingency plan must be developed to deal with accidental spillages.
9. Appropriate training of construction personnel must be undertaken so that they are aware of the restrictions, mitigation measures and the use of spill and containment kits.
10. Minimise disturbance of sediments as far as practically possible.
11. Limit any cable burial to periods of good sea conditions with minimal longshore currents (as far as practically possible).
12. Use mechanical plough only in the nearshore area, no water jetting to be used during plough burial.
13. Avoid pre-lay grapnel runs in the contaminant ‘hotspot’ areas where possible.
14. Limit cable burial to periods of good sea conditions with minimal longshore currents (as far as practically possible).
15. Monitor the plumes during cable burial to ascertain the spatial extent with the aim to limit the plume to less than 1km of the cable alignment (approximate distribution of existing contamination based on available data).
16. Cease burial during periods of strong current, rough sea conditions or development of a large visible plume.
17. Ensure cable protection measures are installed on all surface laid sections of the cable in the shallow inshore waters (<30m).
18. Publicise the 2Africa servitude once declared.

8 Environmental Statement and Conclusion

The field survey along the proposed cable alignment revealed that the nearshore (<30m) marine substrate composition was dominated by soft sands, and both reef (outcropping rock) and subcropping reef habitats were limited. No unique or range restricted species were identified through this survey and all species or taxa observed occur within the region.

The project activity is linear in nature (but will not create a barrier) limiting the extent of impacts on surrounding habitats. The impacts are mainly limited to the construction phase and are short term in duration. All construction impacts were rated as LOW significance post-mitigation. Care must be taken to limit disturbance to the seabed and resuspension of contaminants as far as possible using appropriate installation methods, including mechanical plough use (i.e. NO jetting).

All operational impacts are considered to be of LOW significance and there will be no long-term impacts on macrobenthic communities.

Coastal development and the existing marine discharges along this section of coastline contribute to the cumulative impacts on the nearshore marine environment. Despite these existing pressures, the operational phase of the project will not contribute to any further impacts over the life of project (25 years), as once installed it is unlikely that further disturbance to the surrounding marine environment as a result of this project will occur. Impacts of concern are related to the construction phase which will be short-term in nature and most likely restricted in spatial extent. The contribution of the overall project to the cumulative impacts is therefore considered LOW. For this reason, no follow on or long-term monitoring is required. During cable burial in areas of high contamination visual monitoring of the underwater plume by ROV/divers should be undertaken as well as surface water monitoring from a vessel located in close proximity to the plough and diver burial operation. Should the plume exceed 1km operations should be halted.

Based on the findings of the visual assessment of shallow water macrobenthic communities it is feasible to authorise the cable landing, installation and operation through the proposed route at Amanzimtoti Pipeline Beach provided suitable mitigation is in place during cable installation through the contaminated areas.

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Appendix 1: Impact Rating Scale Methods provided by Acer Africa (Pty) ltd

The EIA Team has adopted a set of conventions for purposes of the integrated assessment of potential impacts, and the determination of impact significance. The following list of conventions must be used by specialists when undertaking their discipline-specific assessments.

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place as the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- **Indirect impacts** of an activity are indirect or induced changes that may occur because of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place because of the activity.

- **Cumulative impacts** are those that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over time and can include both direct and indirect impacts.

- **Nature** – the evaluation of the nature is impact specific. Most negative impacts will remain negative, however, after mitigation, significance should reduce:
  - **Positive.**
  - **Negative.**

- **Spatial extent** – the size of the area that will be affected by the impact:
  - **Site specific.**
  - **Local** (limited to the immediate areas around the site; < 2 km from site).
  - **Regional** (would include a major portion of an area; within 30 km of site).
  - **National** or **International**.

- **Duration** – the timeframe during which the impact will be experienced:
  - **Short-term** (0-3 years or confined to the period of construction).
  - **Medium-term** (3-10 years).
  - **Long-term** (the impact will only cease after the operational life of the activity).
  - **Permanent** (beyond the anticipated lifetime of the project).

- **Intensity** – this provides an order of magnitude of whether the intensity (magnitude/size/frequency) of the impact would be negligible, low, medium, or high):
  - **Negligible** (inconsequential or no impact).
  - **Low** (small alteration of natural systems, patterns, or processes).
  - **Medium** (noticeable alteration of natural systems, patterns, or processes).
  - **High** (severe alteration of natural systems, patterns, or processes).

- **Frequency** – this provides a description of any repetitive, continuous, or time-linked characteristics of the impact:
  - **Once Off** (occurring as single events any time during construction).
  - **Intermittent** (occurring from time to time, without specific periodicity).
  - **Periodic** (occurring at more or less regular intervals).
  - **Continuous** (without interruption).

- **Probability** – the likelihood of the impact occurring:
  - **Improbable** (very low likelihood that the impact will occur).
  - **Probable** (distinct possibility that the impact will occur).
  - **Highly probable** (most likely that the impact will occur).
  - **Definite** (the impact will occur).

  - **Irreplaceability** – of resource loss caused by impacts:
  - **High** irreplaceability of resources (the project will destroy unique resources that cannot be replaced).
  - **Moderate** irreplaceability of resources (the project will destroy resources, which can be replaced with effort).
  - **Low** irreplaceability of resources (the project will destroy resources, which are easily replaceable).

- **Reversibility** – this describes the ability of the impacted environment to return/be returned to its pre-impacted state (in the same or different location):
  - Impacts are **non-reversible** (impact is permanent).
  - **Low** reversibility.
  - **Moderate** reversibility of impacts.
  - **High** reversibility of impacts (impact is highly reversible at end of project life).

- **Significance** – the significance of the impact on components of the affected environment (and, where relevant, with respect to potential legal infringement) is described as:
  - **Low** (the impact will not have a significant influence on the environment and, thus, will not be required to be significantly accommodated in the project design).
  - **Medium** (the impact will have an adverse effect or influence on the environment, which will require modification of the project design, the implementation of mitigation measures or both).
  - **High** (the impact will have a serious effect on the environment to the extent that, regardless of mitigation measures, it could block the project from proceeding).

- **Confidence** – the degree of confidence in predictions based on available information and specialist knowledge:
  - **Low.**
  - **Medium.**
  - **High.**

Appendix 2: Specialist declarations

Appendix 3: Curriculum vitae of specialists

CURRICULUM VITAE: RUSSELL CHALMERS

PERSONAL DETAILS

Year of Birth: 1977
Nationality: South African
Civil status: Single
Place of Birth: Port Elizabeth, South Africa
Languages: English & Afrikaans

CONTACT DETAILS

7 Schonland Avenue
Grahamstown, 6139
South Africa
Tel: +27(0)46 622 2687
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QUALIFICATIONS

PhD Rhodes University, Ichthyology, 2011
MSc Rhodes University, Ichthyology & Fisheries Science, 2002
BSc (Hons) First Class Pass Rhodes University, Ichthyology & Fisheries Science, 2000
BSC Rhodes University, Majors Zoology and Microbiology, 1999

OTHER RELEVANT QUAILIFICATIONS AND ASSOCIATIONS

- *Honorary Research Associate*, South African Institute for Aquatic Biodiversity
- *Professional Natural Scientist*; Aquatic Science (Pr. Sci. Nat.) with the South African Council for Natural Scientific Professions (SACNASP). Registration Number 400129/13 – August 2013.

KEY AREAS OF EXPERTISE

- Fisheries biology and ecology
- Marine ecology
- Ichthyology
- Specialist impact assessment studies
- Fisheries and ecological monitoring

ADDITIONAL COURSES AND EXPERIENCE

- Aquatic Biomonitoring (2003)
- Environmental Impact Assessment (2003)
- Class IV commercial/scientific SCUBA diver (2006); NAUI Master Diver (1996)
- Class IV commercial/scientific SCUBA diver Supervisor (2011)
- Small boat (<9m) skipper, Category C with endorsements for diving operations and surf launching (2002)
- Restricted Radiotelephone Operators Certificate (2008)
- Level 3 First Aid (valid 2014-2017

PROFESSIONAL EXPERIENCE

Jan 2013 – Present	Director Aquatic Ecosystem Services (Pty) ltd
Jan 2012 – Dec 2012	Freelance Environmental and Fisheries Consultant
Jan 2006 – Dec 2011	Fisheries Consultant, Enviro-Fish Africa (Pty) ltd, PhD Candidate, Rhodes University;
Aug 2002 – Dec 2005	Environmental Consultant, Coastal & Environmental Services (Intern, Junior, Senior consultant).
Jan 2001 – Aug 2002	Field researcher, Eastern Cape Estuaries Management Programme, South African Institute for Aquatic Biodiversity (SAIAB). Field researcher, Rural Fisheries Project, Department of Ichthyology and Fisheries Science, Rhodes University.

COUNTRIES OF WORK EXPERIENCE

Angola; Cameroon, Ghana; Guinea Bissau; Kenya; Lesotho; Madagascar; Mozambique; Sierra Leone; South Africa; Tristan da Cunha; Zambia;

SELECTED RESEARCH PUBLICATIONS AND REPORTS

Chalmers, R., Oosthuizen, A., Götz, A., Paterson, A. & Sauer, W.H.H. 2014. Assessing the suitability of commercial fisheries data for local scale marine spatial planning in South Africa. African Journal of Marine Science 36(4):467-480.

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P.D. Cowley, A.D. Wood, B. Corroyer, Y. Nsubuga & R. Chalmers. 2004. *A survey of fishery resource utilization on four Eastern Cape estuaries (Great Fish, West Kleinemonde, East Kleinemonde and Kowie).* Protocols Contributing to the Management of Estuaries in South Africa, with a Particular Emphasis on the Eastern Cape Province; Volume III, Project C, Supplementary Report C5.

RELEVANT PROJECTS

Marine, Estuarine & Coastal Management Reports

Holness, S., Harris, L., Chalmers, R., De Vos, D., Goodall, V., Truter, H., Lombard, A.T., Vermeulen, E., Oosthuizen, A., Dorrington, R.A., Pichegru, L., and Pattrick, P. 2019. *Algoa Bay Systematic Conservation Plan*.

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Chalmers, R., Bennett, R.H., Turpie, J.K., Andrew,M., Andrew,T., Clarke,B.M., Hutchings, K. & de Wet, J. 2009. *Ecology, value and management of the Garden Route Coast.* Prepared for the WWF-SA & C.A.P.E. Marine Programme. Enviro-Fish Africa, 22 Somerset Street, Grahamstown, 6139, South Africa.

Chalmers, R. 2004. *Eastern Cape State of Environment Report – Coastal Chapter.* Coastal & Environmental Services, 67 African Street, Grahamstown, 6139.

Chalmers, R. & Carter, A. 2003. *Amatole District Municipality State of Environment Report – Coastal Chapter.* Coastal & Environmental Services, 67 African Street, Grahamstown, 6139.

Environmental Monitoring Reports

Chalmers, R. 2017. *DST KZN Aquaculture Development Project, Richards Bay Cage Culture Environmental Monitoring Report: Peak Production Survey.* Aquatic Ecosystem Services Pty (ltd), 4 Parry Street, Grahamstown.

Chalmers, R. 2016. *Diamond Coast Abalone Environmental Monitoring Report: Monitoring Survey 3.* Aquatic Ecosystem Services Pty (ltd), 4 Parry Street, Grahamstown.

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Chalmers, R. 2014. *Habitat assessment of Diamond Coast Abalone Ranching Sites, Hondeklipbaai, South Africa.* Aquatic Ecosystem Services Pty (ltd), 4 Parry Street, Grahamstown.

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EIA Reports

Chalmers, R. 2019. *Marine Impact Assessment for the proposed Pearly Beach Abalone Farm*. Prepared from Lornay Environmental Consulting. Prepared by Aquatic Ecosystem Services, P.O. Box 7065, Grahamstown, 6148, South Africa.

Chalmers, R. 2017. *Marine Specialist Assessment for the Coega Land-based Aquaculture Development Zone*. Aquatic Ecosystem Services Pty (ltd), 4 Parry Street, Grahamstown.

Paulet TG, Richardson N, Chalmers R. 2016. *Biosecurity and Biodiversity Risk Assessment for the Coega Development Corporation Land-Based Aquaculture Development Zone, Eastern Cape, South Africa*. Aquatic Ecosystem Services Pty (ltd), 7 Schonland Avenue Grahamstown.

Richardson, N. & Chalmers, R. 2014. *Aquatic assessment field report, London Mining Corporation. Mine Site Creeks and Port Loko Creek.* Aquatic Ecosystem Services Pty (ltd), 4 Parry Street, Grahamstown.

Chalmers, R. & Shipton, T. 2008. *Irvin & Johnson's proposed aquaculture project, Mossel Bay. Marine Benthic Assessment.* Prepared for CCA Environmental (Pty) Ltd. on behalf of Irvin & Johnson Ltd. Enviro-Fish Africa (Pty) Ltd. 22 Somerset Street, Grahamstown, 6139, South Africa.

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Lubke, R.A., Chalmers, R., Avis, A.M., Carter, A. & Bosman, L. 2004. *Volume 1: General overview of the Coffee Bay and Hole-in-the-Wall region.* Prepared for the Development bank of South Africa and the Eastern Cape Development Corporation. Coastal & Environmental Services, 67 African Street, Grahamstown, 6139.

Lubke, R.A., Chalmers, R., Avis, A.M., Carter, A. & Bosman, L. 2004. *Volume 3: Ecological economic and social viability analysis of proposed Coffee Bay and Hole-in-the-Wall projects.* Prepared for the Development bank of South Africa and the Eastern Cape Development Corporation. Coastal & Environmental Services, 67 African Street, Grahamstown, 6139.

Paterson, A.W. & Chalmers, R. 2003. *Luanda Marginal and Marina Development Pre-feasibility study.* Coastal & Environmental Services, 67 African Street, Grahamstown, 6139.

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Chalmers, R. 2019. *WWF Upper Zambezi Programme - Electronic Catch Assessment Survey and database reporting system development and training*. Prepared for WWF-Zambia. Prepared by Aquatic Ecosystem Services, P.O. Box 7065, Grahamstown, 6148, South Africa.

Chalmers, R and Richardson, N. 2020. Baseline Assessment of Fish and Fisheries of Lake Oguemoué, Gabon. Prepared for The Nature Conservancy. Prepared by Aquatic Ecosystem Services, P.O. Box 7065, Grahamstown, 6148, South Africa.

Bok, A, Chalmers, R, and Richardson, N. 2019. *Assessment of alternative designs and locations of the proposed fishway on the Kikagati-Murongo hydropower plant on the Kagera River, Uganda*. Prepared for Kikagati Power Company. Prepared by Aquatic Ecosystem Services, P.O. Box 7065, Grahamstown, 6148, South Africa.

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CONFERENCE PRESENTATIONS

Oosthuizen, A., Chalmers, R. & Holness, S. *A systematic conservation plan for the proposed Addo ENP MPA.* Presented at the South African Marine Science Symposium (SAMSS) 2011: Estuarine, coastal and oceanic ecosystems: Breaking down the boundaries, 4-7 April 2011, Grahamstown, South Africa.

Oosthuizen, A., Holness, S. & Chalmers, R. 2011. Marine conservation planning versus MPA implementation. Presented at the Western Indian Ocean Marine Science Association (WIOMSA) Symposium, 24-29 October 2011, Mombasa, Kenya.

Chalmers, R., Götz, A. & Sauer, W.H.H. 2009. *Strategic assessment of resources and resource use for the proposed Greater Addo MPA, Eastern Cape, South Africa*. Poster presentation at the Western Indian Ocean Marine Science Association (WIOMSA) Symposium, 24-29 August 2009, Saint Denis, Reunion.

Chalmers, R., Götz, A., Sauer, W.H.H. & Holness, S. 2009. *Coastal bays, MPAs and fisheries – trying to balance conservation and socio-economic objectives.* Presented at the Western Indian Ocean Marine Science Association (WIOMSA) Symposium, 24-29 August 2009, Saint Denis, Reunion.

Chalmers, R., Götz, A. & Sauer, W.H.H. 2008. *Development of a spatially based conservation and management plan for the Addo Elephant National Park Marine Protected Area.* Presented at the Southern African Wildlife Management Association Symposium. Biodiversity Conservation: The Science Management Interface, 16-19 September, Mpekweni South Africa 2008.

Chalmers, R., Götz, A. & Sauer, W.H.H. 2008. *Strategic planning for the Greater Addo MPA – Understanding the key issues.* Presented at the South African Marine Science Symposium (SAMSS) 2008: Our changing seas, 29 June – 3 July, Cape Town South Africa.

Götz, A., Chalmers, R., Bennett, R., Kerwath, S.E. & Cowley, P.D. 2008. *Marine protected areas as a tool for long-term monitoring of marine biota: Separating climate from anthropogenetic influence.* Presented at the ICES International Symposium: Effects of Climate Change on the World Oceans, 19-23 May, Gijon, Spain.

Götz, A., R. Chalmers, R. Bennett, S.E. Kerwath & P.D. Cowley. 2007. *Marine protected areas (MPAs) as a tool for long term ecological research and monitoring.* Presented at the 1st SAEON Student Symposium, 11-13 September 2007, Cape Town, South Africa.

Chalmers, R. & Götz, A. 2007. *Development of a long-term monitoring protocol for marine biota in the proposed Greater Addo Marine Protected Area (MPA).* Presented at the 1st SAEON Student Symposium, 11-13 September 2007, Cape Town, South Africa.

Chalmers, R., Götz, A. & Sauer, W.H.H. 2007. *Assessment of the ichthyofaunal and macro-benthic community structure in the proposed Greater Addo Marine Protected Area (MPA): Experimental design and preliminary results.* Presented at the Western Indian Ocean Marine Science Association (WIOMSA) Symposium, 27-31 October 2007, Durban, South Africa.

Vorwerk, P.D., Chalmers, R., Avis, T.A., Scott, L.E.P., Andrew, T.G. & Ngwadla, X. 2003. *Optimising the benefits of the Eastern Cape Coastal Zone through the implementation of the White Paper on Coastal Zone Management.* Poster presentation at the International Association for Impact Assessment (IAIA) Conference, Wilderness.

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Dr Russell Chalmers Date: 6 April 2021

Curriculum vitae of Dr Shirley Parker-Nance

Shirley Parker-Nance

Reef Ecology, marine invertebrate and ascidian taxonomy researcher Elwandle Coastal Node

South Africa Environmental Observation Network

Profession: Researcher/Scientist

Positions:

- Current SAEON researcher – Ecologist, taxonomist and managing the Benthic Ecosystem Long-term Ecological Research (BELTER) project
- ACEP Research programme: Co-investigator, Benthic Biodiversity from the Agulhas Bioregion as a source of new pharmaceuticals, 2015-2017
- Research Associate: Nelson Mandela Metropolitan University (NMMU), 2013-2022
- Research Associate: Department Biochemistry and Microbiology, Rhodes University, Prof R. Dorrington
- SARChI Natural Marine Product Research, 2016-2022
- Research Associate: South African Institute for Aquatic Biodiversity (SAIAB), Curator Tunicate and MDC Extract Library Collection, 2016 to 2021
- *ReefDiversity* NPO: Director, Public partition in Science Initiative
- *JustBlue Environmental* consulting
- SACNASP: 114047 pending

Academy

- Philosophiae Doctor (Ph.D) submitted 2021: Baseline description of the Benthic Biotopes for two Long-Term Ecological Research (LTER) stations in Algoa Bay, Agulhas ecoregion, South Africa. Rhodes University
- Philosophiae Doctor (Ph.D) 2003: Aplousobranch ascidians (Tunicata: Ascidiacea) from southern Africa, University of Port Elizabeth.
- Magister Scientiae (M.Sc) 1996: An investigation into the reproductive biology of the pilchard *Sardinops sagax* in eastern Cape waters., University of Port Elizabeth.
- Bachelor of Science Honnores (B.Sc. (Hons)). 1994: The genus *Haliotis* with special reference to the ecology of *Haliotis spadicea*, University of Port Elizabeth
- Bachelor of Science (B.Sc.) 1992: University of Pretoria.

Personal information

Surname: Parker-Nance née Kuiters
First name: Shirley
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Gender: Female
Identity Number: 7104110102087
Date of birth: 11 April 1971
Home address: 22 Galpin Street, Summerstrand, 6001
Postal address: P. O. Box 13995, Humewood, Port Elizabeth, 6013
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Cell: 082 498 1039
Home language: English and Afrikaans
Criminal offenses: None
Nationality: South African
Health: Excellent
Spouse: Timothy Craig Parker-Nance
Children: Kayra (31 Dec 2004) and Jorja (23 Feb 2006).

Other Qualifications and competencies

Driver's license - Code EB (0)
Diver Scientist class IV (Registered at Department of Manpower) (since 1994 medically in date).
Diver Scientist class IV Supervisor (Registered at Department of Manpower) (since 1995 medically in date).
South African Underwater Union (SAUU) CMAS (Brevet International P2-ZA-8436) Two Star.
Technical Diving International (enriched air diving) Advanced Technical Nitrox Diver (AND 230 SA)
Technical Diving International (enriched air diving) Gas Blender User (GB 230 SA)
Technical Diving International (enriched air diving) Decompression Procedures (DPD 230 SA), TDI.
Radio Operator – Short Range Certificate (SCR/0207/2018/005/SSTG PE)
Safety Familiarisation (SFT/2604/2018/010/SSTG PE)
Medical Care (CMC/3010/2017/071 SSTG PE)
SAMSA Category C certificate of competence (Day skipper endorsed to engage in diving operations)
Pilotage Exemption Licence Port of Port Elizabeth SAEON RV *Calanus* and RV *Honckenii*
St John First Aid Level 3 certificate (01/07/2016)
Professional Personal Assistant NQF 5 (with distinction), November 2009, NMMU, Business School.
Orcid identification: orcid.org/0000-0003-4231-6313
Google Scholar: Citations (271), h-index (8)
MegaX with data storage in Benching, Primer, PAST, QGIS, Gaphi, Specify, SeaGIS CAL,TransectMeasture and EventMeasure

Employment record last five years

Current	South African Environmental Observation Network (SAEON) Elwandle Coastal Node – Manager: Benthic Ecosystem Long-term Ecological Research (BELTER) project
2020-2022	SARChi Community of Practice in Marine Spatial Planning for Algoa Bay Phase II Project Title: The influence of management strategies on the benthic invertebrate and associated ichthyofauna community structure in Algoa Bay
2017-2019	SARChi Community of Practice in Marine Spatial Planning for Algoa Bay Phase I
2015	ACEP Benthic Biodiversity from the Agulhas Bioregion as a source of new pharmaceuticals – collections and species and habitat classification. SAIAB Ascidian and MDC Extract Library Curation. SAEON Research collaboration SEAKeys Unlocking foundational biodiversity knowledge (SANBI-NMMU collaboration) Pro Dive Watersport, Conservation and Marine Education Centre: Marine Biologist – Citizen science initiatives.
2014	RU Research Fellow: Collections and taxonomy - Department Biochemistry and Microbiology. SAIAB Ascidian and MDC Extract Library Curation. Soft Corals of Madagascar (Hons student). SEAKeys Unlocking foundational biodiversity knowledge (SANBI-NMMU collaboration) Pro Dive Watersport, Conservation and Marine Education Centre: Marine Biologist.

Recent peer-reviewed publications

Kalinski, J.C., Krause, R., **Parker-Nance, S**., Waterworth, S. 2021 Rosemary Dorrington Unlocking the Diversity of Pyrroloiminoquinones Produced by Latrunculid Sponge Species. Marine Drugs.

Waterworth, S.C., Kalinski, J.C.J., Madonsela, L.S., **Parker-Nance, S**., Kwan, J.C. and Dorrington, R.A., 2020. Family matters: The genomes of conserved bacterial symbionts provide insight into specialized metabolic relationships with their sponge host. bioRxiv. https://www.biorxiv.org/content/10.1101/2020.12.09.417808v1.abstract

van Losenoord, W., Krause, J., **Parker-Nance, S.**, Krause, R., Stoychev, S. and Frost, C.L., 2019. Purification and biochemical characterisation of a putative sodium channel agonist secreted from the South African Knobbly sea anemone Bunodosoma capense. Toxicon, 168, pp.147-157. https://www.sciencedirect.com/science/article/abs/pii/S0041010119303976

Parker-Nance, S., Hilliar, S., Waterworth, S., Walmsley, T. and Dorrington, R., 2019. New species in the sponge genus Tsitsikamma (Poecilosclerida, Latrunculiidae) from South Africa. ZooKeys, 874, p.101. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6746741/

Kalinski, J.C.J., Waterworth, S.C., Siwe Noundou, X., Jiwaji, M., **Parker-Nance, S.**, Krause, R.W., McPhail, K.L. and Dorrington, R.A., 2019. Molecular networking reveals two distinct chemotypes in pyrroloiminoquinone-producing Tsitsikamma favus sponges. Marine drugs, 17(1), p.60. https://www.mdpi.com/1660-3397/17/1/60

Bromley, C.L., Raab, A., **Parker-Nance, S**., Beukes, D.R., Jaspars, M. and Davies-Coleman, M.T. 2018. Hyphenated LC-ICP-MS/ESI Identification of Malogenated Metabolites in South African Marine Ascidian Extracts. South African Journal of Chemistry 71:111-117. https://www.ajol.info/index.php/sajc/article/view/178323

Dorrington, R.A., Lombard, A.T., Bornman, T.G., Adams, J.B., Cawthra, H.C., Deyzel, S.H.P., Goschen, W.S., Liu, K., Mahler-Coetzee, J., Matcher, G.F., McQuaid, C., **Parker-Nance, S.,** Paterson, A., Perissinotto, R., Porri, F., Roberts, M., Snow, B. and Vrancken, P. 2018. Working together for our oceans: A marine spatial plan for Algoa Bay, South Africa. South African Journal of Science 114(3/4), Art. #a0247, 6 pages. http://dx.doi. org/10.17159/sajs.2018/a0247.

Waterworth, S. C., Jiwaji, M., Kalinski, J-C., J., **Parker-Nance, S.** and Dorrington, R.A. 2017. A Place to Call Home: An Analysis of the Bacterial Communities in Two *Tethya rubra* Samaai and Gibbons 2005 Populations in Algoa Bay, South Africa. Marine Drugs. 15, 95; doi:10.3390/md15040095. https://www.mdpi.com/1660-3397/15/4/95

Matobole, R.M., van Zyl, L.J., **Parker-Nance, S.**, Davies-Coleman, M.T. and Trindade, M., 2017. Antibacterial Activities of Bacteria Isolated from the Marine Sponges *Isodictya compressa* and *Higginsia bidentifera* Collected from Algoa Bay, South Africa. Marine Drugs, 15(2), p.47. https://www.mdpi.com/1660-3397/15/2/47

Zhang, Y., Adnani, N., Braun, D.R., Ellis, G.A., Barns, K.J., **Parker-Nance, S.**, Guzei, I.A. and Bugni, T.S., 2016. Micromonohalimanes A and B: Antibacterial Halimane-Type Diterpenoids from a Marine Micromonospora Species. Journal of Natural Products, 79(11), pp.2968-2972 (Published November, 2016). https://pubs.acs.org/doi/abs/10.1021/acs.jnatprod.6b00555

Appendix 4: Rapid Transect Images

Appendix 5: Species recorded or species with a known distribution off the Natal shallow coastal region

Species recorded or species with a known distribution off the Natal shallow coastal region up to Sodwana Bay for works published since 2000.

Sponges	Black corals	Tunicata continued
Ancorina nansclera[1]	*Antipathes* sp[1,2]	*Polycarpa insulsa*[1,2,5]
Anthosigmella orientalis[1,2]	*Cirrhipathes* sp[1,2,3]	*Polycarpa mytiligera*[5]
Axinella sanguinea[2,3]	**Anemones**	*Polycarpa rubida*[5]
Aulospongus involutus[6]	*Anthothoe stimpsoni*[1]	*Polycitor africanus*[2,5]
Chondropsis sp[3]	*Cerianthus sp*[3]	*Polyclinum isipingense*[5]
Cliona orientalis[3]	*Heteractis magnifica*[1,2]	*Polysyncratom ?aspiculatum*[5]
Cliona sp gamma form[1]	**Zoanthids**	*Polysyncraton millepore*[5]
Cyclacanthia cloverlyae[4]	*Palythoa natalensis*[1,3]	*Pseudodistoma africanum*[5]
Cyclacanthia mzimayensis[4]	***Sea fans***	*Pseudodistoma delicatum*[5]
Fascaplysinopsis sp[3]	*Acabaria sp*[3]	*Pyura stolonifera*[1,2]
Forcepia sp[3]	*Homophyton verrucosum*[2,3]	*Sigillina* sp[1,2,3]
Geodia sp[3]	**Bryozoa**	*Stolonica multitestis*[5]
Hemiasterella aff *magna*[1]	*Sertella sp*[3]	*Symplegma ?bahraini*[5]
Hemiasterella minor[2]	**Arthropoda**	*Sycozoa* sp[3]
Hemiasterella vasiformis[3]	*Panulirus homarus*[3]	*Tridemnum cerebriforme*[5]
Higginsia natalensis[1]	**Echinoderm**	**Algae**
Ircinia echinata[1,2]	*Diaderma setosum*[3]	*Amphiroa ephedraea*[2,3]
Meniastrella minor[1]	*Fromia* sp[3]	*Callophycus condominius*[3]
Oceanapia aff *ramsayi*[1,2,3]	*Linkia guidingi*[3]	*Champia compressa*[3]
Placospongia sp[3]	*Linkia laevigata*[2,3]	*Codium lucasii*[2,3]
Polymastia sp[3]	*Mithrodia clavigera*[3]	*Dichotomaria diesingiana*[3]
Rhaphoxya sp[1]	**Molluscs**	*Dictyota dichotoma* var *intricata*[3]
Rhobdermia (?) *sp*[3]	*Hyotissa hyotis*[1,3]	*Exallosorus harveyanus*[3]
Spheciospongia excentrica[1,2,3]	*Lopha cristagalli*[1]	*Hypnea sp*[3]
Spheciospongia globularis[1,2,3]	*Phyllida verrucosa*[3]	*Hypnea viridis*[3]
Spheciospongia vagabunda[1,3]	**Tunicata**	*Laurencia brongniartii*[3]
Stronylodesma aliwaliensis[4]	*Aplidium flavolineatum*[5]	*Lobophora variegata*[2,3]
Suberites kelleri[1,2,3]	*Aplidium haesitans*[5]	*Meristotheca papulosa*[3]
Xestospongia sp[1]	*Aplidium mernooensis*[5]	*Osmundaria serrata*[2,3]
Hard corals	*Aplidium monile*[5]	*Padina* sp[1]
Coscinarea columna[1]	*Aplidiopsis tubiferus*[5]	*Peysonnelia capensis*[2,3]
Coscinarea sp[2]	*Atriolum marsupialis*[5] (< *A. marinens*	*Stypopodium multipartitum*[2,3]
Dendrophyllia sp[1,3]	*Botryllus gregalis*[5]	*Turbinaria decurrens*[1]
Favia speciose[1,2]	*Botryllus mortenseni*[5]	*Ulva* cf *rigida*[3]
Favites pentagona[1,2]	*Cystodytes dellechiajei*[5]	*Zonaria subarticulata*[3]
Favites[3] *complanata*[1,2]	*Didemnum granulatum*[5]	*Zonaria subarticulata*[3]
Galaxea fascicularis[1]	*Didemnum leopardi*[5]	
Galaxea fascicularis[2]	*Didemnum molle*[1,2,5]	
Leptoseris explanata[1,2]	*Didemnum ?obscurum*[5]	
Lobophyllia[2] *hemprichii*[1]	*Didemnum psammathodes*[5]	
Mantipora aequiterbucalata[1]	*Didemnum rodriguesi*[5]	
Montipora[2,3] *spongodes*[1]	*Diplosoma virens*[1,2,5]	
Pocillipora verrucosa[1,2,3]	*Ecteinascidia thurstoni*[5]	
Pocillopora damicornis[1,2,3]	*Eudistoma bituminis*[5]	
Porites lutea[1,2]	*Eudistoma caeruleum*[5]	
Stylophora pisitillata[1,2,3]	*Eudistoma hospitale*[5]	
Tubastrea micrantha[1,2,3]	*Eudistoma modestum*[5]	
Soft corals	*Euherdmania divida*[5]	
Dendronephthya sp[1,2,3]	*Lissoclinum bilobatum*[5]	
Eleutherobia aurea[1,2,3]	*Lissoclinum bistratum*[5]	
Leptophyton benayahui[1,3]	*Molgula scutata*[5]	
Sinularia brassica[1,2,3]	*Polyandrocarpa griffithsi*[5]	

1 (Schleyer et al. 2006); 2(Brash 2006); 3 (Olbers et al. 2009); 4 (Samaai et al. 2004); 5 (Monniot and Monniot 2001); 6 (Pauline 2015)

Also, see the summary given in the account of work done Walters Shoal (Pauline 2015) and canyon biota (Sink et al. 2006).