

Asia Submarine-cable Express (ASE) – Tseung Kwan O

Baseline Coral Monitoring Update Survey Report

December 2013

Environmental Resources Management

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NTT Com Asia Ltd

Asia Submarine-cable Express (ASE) –
Tseung Kwan O
亞洲快線海底光纜系統 - 將軍澳

December 2013

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For and on behalf of
ERM-Hong Kong, Limited
香港環境資源管理顧問有限公司

Approved by 批核: Terence Fong



Signed by 簽署: Terence Fong

Position 職位: Partner

Date 日期: December 2013

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Asia Submarine-cable Express (ASE) - Tseung Kwan O
Environmental Certification Sheet
EP-433/2011


Reference Document/Plan

Document/ Plan -to be-Certified/ Verified:	Baseline Coral Monitoring Update Survey Report
Date of Report:	
Date prepared by ET:	ERM-Hong Kong Ltd
Date received by IEC:	Ecosystem Ltd


Reference EM&A Manual/ EP Requirement

EM&A Manual Requirement:	Section 4
Content:	<i>Coral Communities</i>
4.1 "Baseline Survey will be conducted within one month before any jetting works for the Project marine installation works start. The objective of Baseline Surveys is to identify suitable coral monitoring locations and to collect baseline monitoring data of corals at those locations for comparison with data collected during Post Project Surveys."	
4.2 "A Baseline Monitoring Survey Report should be submitted within two weeks after the completion of baseline monitoring and include the following details: Brief project background information; Monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (and depth), monitoring date, time, frequency and duration; and Comments and conclusions."	
EP Condition:	Condition No. 2.3
Content:	<i>Coral Communities</i>
To protect the coral communities at Cape Collinson and Tai Long Pai, the Permit Holder shall confirm the identified coral communities will be more than 180m away from the cable alignment and in any case the IEC of the EM&A Programme shall certify in writing adequate buffer to the identified coral communities are maintained during the cable laying works. The conditions of the identified coral communities will also be verified by coral inspections immediate prior to and after the cable laying works.	

ET Certification

I hereby certify that the above referenced document/ plan complies with the above referenced condition of EP-433/2011.	
Terence Fong, Environmental Team Leader:	
	Date: <i>Dec 2013</i>

IEC Verification

I hereby verify that the above referenced document/ plan complies with the above referenced condition of EP-433/2011.	
Vincent Lai, Independent Environmental Checker:	
	Date: <i>December 2013</i>

1.1

BACKGROUND

In January, 2013, NTT Com Asia (NTTCA) installed a telecommunication cable (Asia Submarine-cable Express (ASE) cable) approximately 7,200 km in length, connecting Japan and Singapore with branches to the Philippines, Hong Kong SAR (HKSAR) and Malaysia Marine works for the cable installation was completed in January 2013. The landing site is located at a new Beach Manhole (BMH) and the cable was ultimately connected with a Data Centre in Tseung Kwan O (TKO) Industrial Estate. From Tseung Kwan O, the cable extends westward approaching the Tathong Channel. Near to Cape Collinson, the cable is approximately parallel to the Tathong Channel until north of Waglan Island where the cable travels eastward to the boundary of HKSAR waters where it enters the South China Sea. The total length of cable in Hong Kong SAR waters is approximately 33.5 km. A map of the cable route is presented in *Figure 1.1*.

A *Project Profile (PP-452/2011)* which includes an assessment of the potential environmental impacts associated with the installation of the submarine telecommunications cable system was prepared and submitted to the Environmental Protection Department (EPD) under section 5.(1)(b) and 5.(11) of the *Environmental Impact Assessment Ordinance (EIAO)* for the application for Permission to apply directly for Environmental Permit (EP). The Environmental Protection Department, subsequently issued an *Environmental Permit (EP- 433/2011)* for the Project. In accordance with the EP conditions, an environmental monitoring and audit (EM&A) programme is required to be implemented in order to track the environmental performance of the cable installation works of the Project.

Pursuant to *Condition 2.4* of the EP, an environmental monitoring and audit (EM&A) programme, as set out in the *Environmental Monitoring and Audit Manual (EM&A Manual)* ⁽¹⁾ was required for this Project. Baseline data were collected prior to the start of cable installation works in 2012 and monitoring and audit were conducted throughout the cable installation and after its completion in early 2013 as required in the *EM&A Manual*.

Upon inspection in October 2013 the ASE cable was found to be damaged and a section within Zone A (see *Figure 2.1*) requires re-installation. The EM&A programme is therefore required to resume for the cable installation works in Hong Kong Waters (the "Project"). A new coral monitoring baseline survey (Baseline Update) was proposed to be carried out prior to the installation of the faulty section of cable. The Baseline Update survey was attempted in November, 2013.

(1) ERM (2012) EM&A Manual for Asia Submarine-cable Express (ASE) - Tseung Kwan O.

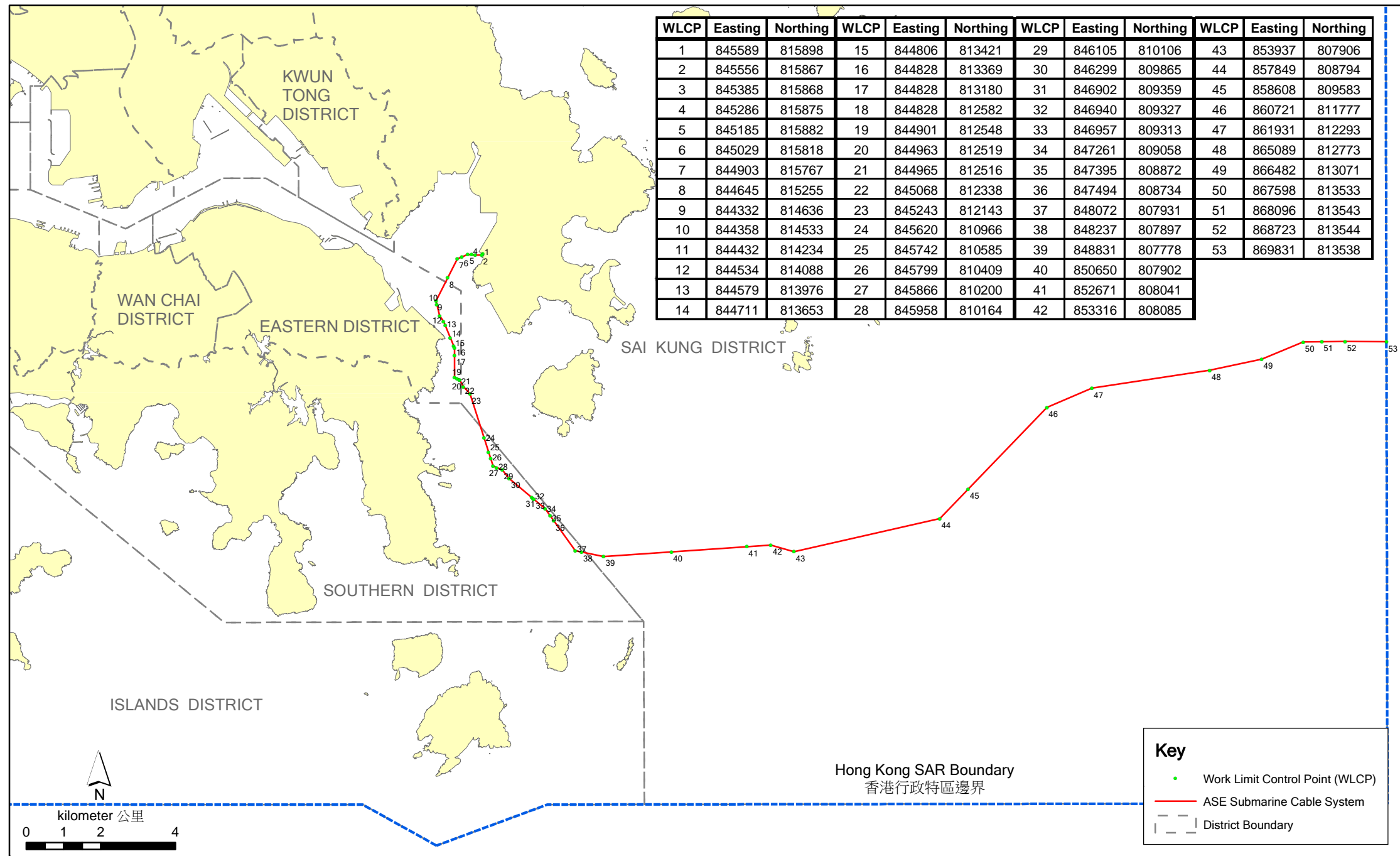


Figure 1.1

Proposed ASE Submarine Cable System (Layout Plan)

File: 0171870_Landing_Overview_20110815.mxd
Date: 17/09/2012

Key

- Work Limit Control Point (WLCP)
- ASE Submarine Cable System
- District Boundary

**Environmental
Resources
Management**



1.2 *PURPOSE OF THIS REPORT*

This Baseline Update Report (“the Report”) has been prepared by ERM-Hong Kong, Limited (ERM) on behalf of NTTCA to present the methodology and findings of the Baseline Update Monitoring Survey conducted in November, 2013.

1.3 *STRUCTURE OF THE REPORT*

The remainder of the report is structured as follows:

Section 2: Baseline Update Survey Methodology

Presents the survey methodology, parameters monitored, monitoring locations and depth in accordance with the *EM&A Manual*.

Section 3: Survey Results

Reviews the condition and health status of corals at the monitoring station surveyed during the Baseline Update Survey and comparison with previous survey information in order to determine if any detectable changes have occurred between monitoring events.

Section 4: Conclusion

Presents a discussion of the results, comparison to previous surveys and conclusions/recommendations.

This section presents the methodology proposed for the November 2013 Baseline Update Survey, which follows that of the original Baseline and Post-Project Coral Monitoring Survey.

2.1 **MONITORING LOCATIONS**

The following monitoring locations, shown in *Figure 2.1*, were surveyed during the 2012 Baseline and 2013 Post-Project Monitoring:

Monitoring Stations:

- Zone A: Cape Collinson; and
- Zone B: Tai Long Pai.

Control Station:

- Zone C: Tung Lung Chau.

During the November 2013 Baseline Update monitoring, however, only Zone A was surveyed due to adverse conditions.

2.2 **METHODOLOGY**

Subtidal dive surveys were undertaken at Zone A, which lies in close proximity to the Project Area and focusses on the section of cable route to be replaced. The survey included the following two components:

- Semi-quantitative Rapid Ecological Assessment (REA) survey; and
- Coral Colony Monitoring.

Each of these surveys is described further in the following sections.

Rapid Ecological Assessment Survey Method

A standardised semi-quantitative REA survey technique was used to investigate the general conditions of the coral communities--including any scleractinian (hard), alcyonacian (soft) and antipatharian (black) corals found--associated with subtidal hard bottom habitat at survey site. The REA technique allows collection of semi-quantitative information on the ecological attributes of the subtidal habitat in a relatively simple way without compromising scientific rigour. This technique is the standard practice for EIA and EM&A marine ecological surveys in Hong Kong and has been modified from the standardised REA survey technique established for the assessment of coral communities on the Great Barrier Reef ⁽¹⁾ for marine environment of Hong Kong ⁽²⁾.

(1) DeVantier, L.M., G.De' Ath, T.J. Done and E. Turak (1998). *Ecological assessment of a complex natural system: A case study from the Great Barrier Reef*. Ecological Applications 8: 480-496.

(2) Fabricius, K.E. and D. McCorry. (2006). *Changes in octocoral communities and benthic cover along a water quality gradient in reefs of Hong Kong*. Marine Pollution Bulletin 52: 22-23.

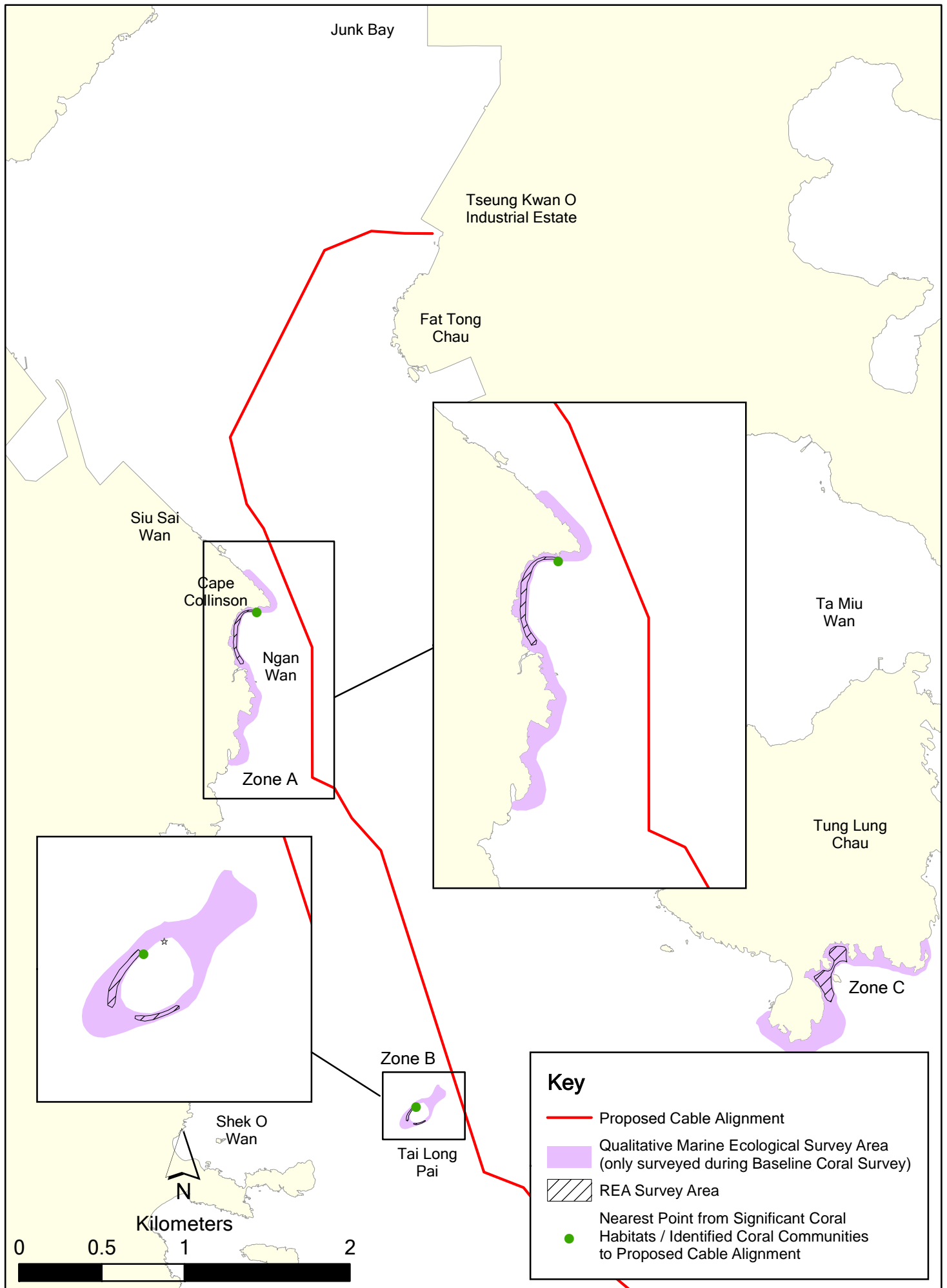


Figure 2.1

Locations of Major Coral Community

An REA survey was conducted by a qualified coral ecologist using SCUBA with the aim of recording the condition of existing substratum, estimating the diversity and relative abundance of coral assemblages (ie hard corals, octocorals and black corals) and identification of coral taxa (hard corals identified to species level while octocorals and black corals recorded to genus level). The survey was undertaken along a transect placed onto the seabed following a specific depth contour. Only Zone A was surveyed; conditions at Zone B and Zone C were observed to be too dangerous to conduct the survey work, and thus these sites were abandoned. While six transects with length of 100 m each were surveyed during previous monitoring events, only a single REA transect was surveyed in Zone A in November 2013 due to adverse conditions at the site. Additionally, while previous monitoring transects have been 100 meters in length, that surveyed in November 2013 was only 75 meters in length, as surge and visibility conditions worsened beyond that point, and further data collection was not possible. The six transects previously surveyed were also divided between depth regions:

- Shallow depth region: -2 to -5 m CD (typically the depth range of hard coral colonies associated with subtidal hard bottom habitat); and
- Deep depth region: -5 to -15 m CD.

However, only one, the shallow region, was surveyed during the Baseline Update. The transect was extended between the 3.5 and 4.0-m contour, as surge became too dangerous for data collection above this depth.

Following the laying of the transect line, a coral specialist swam along the transect and conducted the REA survey. The REA methodology encompassed an assessment of the benthic cover (Tier I) and taxon abundance (Tier II) undertaken in a swathe ~ 1-m wide, 0.5 m either side of each transect, due to visibility limitations. Further explanation of the two assessment tiers implemented during the survey is presented below.

Tier I – Categorisation of Benthic Cover

Upon the completion of observation along each survey transect, five ecological and seven substratum attributes were assigned to one of seven standard ranked (ordinal) categories (*Tables 2.1 and 2.2*).

Table 2.1 *Categories used in the REA Surveys – Benthic Attributes*

Ecological	Substratum
Hard coral	Hard Substratum
Dead standing coral	Continuous pavement
Soft coral	Bedrock
Black coral	Rubble
Macroalgae	Sand
Turf Algae	Silt
	Large boulders (>50 cm)
	Small boulders (<50 cm)
	Rocks (<26 cm)

Table 2.2 *Categories used in the REA Surveys – Ordinal Ranks of Percentage Cover*

Rank	Percentage Cover (%)
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Tier II – Taxonomic Inventories to Define Types of Benthic Communities

An inventory of benthic taxa was also compiled for each transect. Taxa were identified *in situ* to the following levels:

- Scleractinian (hard) corals to species wherever possible;
- Soft corals, gorgonians, black corals, anemones and conspicuous macroalgae recorded according to morphological features and to genus level where possible; and
- Other benthos (e.g. sponges, ascidians, bryozoans, etc) recorded to genus level wherever possible but more typically to phylum plus growth form.

Each taxon in the inventory was ranked in terms of abundance in the community (i.e. specific to the area surveyed, not within the context of Hong Kong or greater region) (Table 2.3). These broad categories rank taxa in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are subjective assessments of abundance, rather than quantitative counts of each taxon.

Table 2.3 *Ordinal Ranks of Taxon Abundance*

Rank	Abundance
0	Absent
1	Rare ^(a)
2	Uncommon
3	Common
4	Abundant
5	Dominant

Note: (a) The classification of “rare” abundance refers to low abundance (small quantity) on the transect, rather than in terms of distribution in Hong Kong waters.

A set of environmental site descriptors were recorded for each REA transect as follows:

(A) The degree of exposure to prevailing wave energy was ranked from 1 – 4, where:

1 = sheltered (highly protected by topographic features from prevailing waves);

2 = semi-sheltered (moderately protected);

3 = semi-exposed (only partly protected); and

4 = exposed (experiences the full force of prevailing wave energy).

(B) Sediment deposition on the reef substratum (particle sizes ranging from very fine to moderately coarse) rated on a four point scale, from 0 -3, where:

0 = no sediment;

1 = minor (thin layer) sediment deposition;

2 = moderate sediment deposition (thick layer), but substrate can be cleaned by fanning off the sediment; and

3 = major sediment deposition (thick, deep layer), and substrate cannot be cleaned by fanning.

A suite of representative photographs was taken for each REA transect. All field data were checked upon completion of each REA transect and a dive survey log was completed at the end of the fieldwork day. Photographs were compiled for each REA transect which was then reviewed to verify the REA data. Verified REA data were presented in terms of:

- Site (transect) information (Tier I and II data), depth and environmental descriptors;
- Species abundance data for each transect; and
- Species lists, species richness and mean values for ecological and substratum types were compiled.

Coral Colony Monitoring

Coral Colony Monitoring was undertaken using the same method as during the original Baseline Survey and the first Post-Project Monitoring Survey to identify any evidence of sediment stress to corals before and after cable installation works of the Project. At each coral monitoring station, a total of fifteen (15) hard coral colonies and fifteen (15) octocoral/black coral colonies (or all colonies present if less than 15) were selected for monitoring. Priority was given to selecting colonies of horizontal plate-like and massive growth forms which present large stable surfaces for the interception and retention of settling solids. Each of the selected corals was identified to species or genus levels and photographed. The following data were collected:

- Maximum diameter of the identified hard coral and soft coral colonies;
- Maximum height and width of the identified gorgonians and black corals;
- Percentage of sediment cover on the identified colonies and the colouration, texture and approximate thickness of sediment on the coral colonies and adjacent substrate;
- Percentage of bleached area on the identified colonies of which two categories were recorded: a. blanched (ie pale) and b. bleached (ie whitened);
- Percentage of colony area showing partiality mortality; and
- Physical damage to colonies, tissue distension, mucous production and any other factors indicating to corals were noted in the field.

Although coral tagging is a common practice for repeated monitoring of individual colony, this technique was not employed in this monitoring programme due to difficulties in re-locating the exact transect placement and the tagged corals given the generally low visibility in the area and low light conditions in deep water. Instead, colonies of similar growth forms and size were selected.

3.1

INTRODUCTION

This section presents findings of the Baseline Coral Monitoring Survey Update conducted in November 2013.

The Baseline Update Survey was attempted in Zones A, B and C on November 7, and again November 15, 2013. Weather conditions on November 7 were mainly sunny, with moderate to fresh (Force 4-5) east winds. Moderate swell, surface chop and strong below-surface surge were experienced. Underwater visibility was extremely poor (<0.3 m) along the northeast face of Cape Collinson in Zone A, and a strong north current was present; this area was abandoned and a partial REA transect was run along the south side of Cape Collinson at the 3.5 to 4.0-m depth contour. Visibility was slightly better here (~1 m) at the start of the transect. The line was run approximately along the 4-m contour as the surge became too strong to work any shallower than that depth. The transect was stopped short at 75 m, as the visibility significantly decreased and the surge force increased along the line. The rocks were also covered in sea urchins and barnacles, adding to the hazard in surge and low visibility. The divers considered it too dangerous to extend the transect beyond this point. Conditions continued to deteriorate throughout the dive, and the dive was abandoned after the completion of the 75-m transect. Conditions were assessed at Zones B and C, and found to be worse than those at Zone A; hence the survey was not conducted at those sites.

As monitoring was not completed on November 7, the team attempted to survey again at Zone A on November 15. Weather was similar on the 15th, this time with winds (Force 4) from the north to northeast. Surge and chop conditions appeared more favorable; however, similar surge and poor visibility conditions were again experienced underwater and the survey was abandoned without the collection of any data due to concerns for diver safety. Again, the conditions at Zones B and C were assessed as worse than at Zone A, and thus no surveys were conducted at those sites. A detailed description and discussion of the monitoring results from Zone A, collected November 7, are presented below.

3.2

REA SURVEY RESULTS

Seabed composition along the monitored transect within Zone A is presented in *Table 3.1*. Each taxon in the inventory was ranked in terms of relative abundance in the community and results recorded during the Baseline and Post Project Coral Monitoring Surveys are shown in *Table 3.2* and *3.3*, respectively. Findings of the REA surveys are discussed below.

Zone A - Cape Collinson

During the November 7 Baseline Update survey, the degree of exposure within Zone A, along the northeast face of Cape Collinson was (3) - semi-

exposed, while the south side was (4) – exposed, thus creating strong surge conditions nearshore. Sediment deposition on the substrate (referring to hard substrates only) was rated as (2) – minor, and seemed influenced by the rough sea conditions and resultant elevated suspended sediment.

Tier I Results

The seabed along the transect sampled in Zone A was mainly composed of large boulders in the shallow depth region (2-5 m CD), with some patches of sand (Table 3.1). The poor visibility did not allow for observations of seabed between boulders, but previous surveys indicate exposed bedrock is also present here. Some hard and soft coral colonies were present but accounted for less than five percent cover. Moderate cover by crustose coralline algae was also observed.

Table 3.1 *Results of REA Tier I Survey, Baseline Update (November 7, 2013)*

Benthic Attribute	Rank	Percent Cover
Large boulders	6	76-100
Sand	2	6-10
Hard coral	1	1-5
Soft coral	1	1-5
Crustose coralline algae	3	11-30

The estimated percentage covers of the major benthic attributes were similar between the Baseline and first Post-Project Coral Monitoring Surveys, which also recorded less than five percent hard and soft coral cover.

Tier II Results

Both hard coral and octocoral coverage was less than five percent along the REA transect, which is similar to that observed during the Baseline and first Post-Project Monitoring. Compositions of coral assemblages were also noted to be similar to the previous surveys, with six hard coral and three octocoral species recorded. *Goniopora stutchburyi* and *Porites lutea* were the dominant hard coral species recorded, while *Dendronepthea* sp. was the dominant soft coral species found (Table 3.2).

Table 3.2 Results of REA Tier II Survey, Baseline Update (November 7, 2013)

Taxon	Ordinal Rank	Abundance
Scleractinian (hard) Corals		
<i>Cyphastrea serailia</i>	1	Rare
<i>Favia</i> sp.	1	Rare
<i>Goniopora stutchburyi</i>	2	Uncommon
<i>Oulastrea crispata</i>	1	Rare
<i>Plesiastrea versipora</i>	1	Rare
<i>Porites lutea</i>	2	Uncommon
Alcyonacean (soft) Coral		
<i>Dendronephthya</i> sp.	2	Uncommon
<i>Euplexaura</i> sp.	2	Uncommon
<i>Paraplexaura</i> sp.	2	Uncommon
Other Fauna		
<i>Anemones</i>	1	Rare
<i>Anthocidaris crassipina</i>	5	Dominant
<i>Barnacles</i>	4	Abundant
<i>Bryozoans</i>	2	Uncommon
<i>Colochirus quadrangularis</i>	1	Rare
<i>Holothuria leucospilata</i>	1	Rare
<i>Perna viridis</i>	2	Uncommon
<i>Saccostrea cucullata</i>	4	Abundant
<i>Tunicates</i>	1	Rare

The partial REA transect conducted November 7, 2013 was placed approximately in the same location as A-S2 from the previous surveys. Though the number of hard coral species observed was greater in November than in February, 2013, or during the original Baseline monitoring, and soft coral species were fewer, it must also be considered that a smaller area was surveyed during the November 7, 2013 monitoring (a 75-m x 1m belt transect as opposed to a 100-m by 4-m belt transect in the shallow region). Additionally, the placement of transects is not exact, as water clarity and conditions at the sites do not allow for placement of permanent transect or coral colony markers that can be relocated for replication, and transects may not cover the exact space or the same coral colonies each survey. Results of the Tier II Surveys conducted during the original Baseline monitoring and Post-Project Monitoring are provided in *Tables 3.3 and 3.4*.

Table 3.3 Results of Tier II Survey, 2012 Baseline Monitoring

Taxon/ Family	Species	S1	S2	S3
Scleractinian (hard) Corals				
Siderastreidae	<i>Psammocora superficialis</i>	1	1	
Dendrophyllidae	<i>Tubastrea/ Dendrophyllia</i> sp.		1	
Faviidae	<i>Cyphastrea chalcidicum</i>	1		
	<i>Oulastrea crispata</i>	3	1	2
	<i>Plesiastrea versipora</i>			1
Poritidae	<i>Goniopora stutchburyi</i>	2		1
Alcyonacean (soft) Coral				
Nephtheidae	<i>Dendronephthya</i> sp.		2	4
	<i>Scleronephythya</i> sp.			1
Plexauridae	<i>Echinomuricea</i> sp.	2	3	3
	<i>Euplexaura</i> sp.		2	2
	<i>Menella</i> sp.		2	
	<i>Paraplexaura</i> sp.	1	1	2
Ellisiidae	<i>Ellisella</i> sp.	1	1	1
	<i>Viminella</i> sp.	1		1

Table 3.4 Results of Tier II Survey, Post-Project Monitoring (February 2013)

Taxon/ Family	Species	S1	S2	S3
Scleractinian (hard) Corals				
Siderastreaeidae	<i>Psammocora superficialis</i>	1	1	
Dendrophyllidae	<i>Tubastrea/Dendrophyllia sp.</i>		1	
Faviidae	<i>Cyphastrea chalcidicum</i>	1		
	<i>Oulastrea crispata</i>	3	1	2
	<i>Plesiastrea versipora</i>			1
Poritidae	<i>Goniopora stutchburyi</i>	2		1
Alcyonacean (soft) Coral				
Nephtheidae	<i>Dendronephthya sp.</i>		2	4
	<i>Scleronephythya sp.</i>			1
Plexauridae	<i>Echinomuricea sp.</i>	2	3	3
	<i>Euplexaura sp.</i>		2	2
	<i>Menella sp.</i>		2	
	<i>Paraplexaura sp.</i>	1	1	2
Ellisiidae	<i>Dichotella sp.</i>			
	<i>Ellisella sp.</i>	1	1	1
	<i>Viminella sp.</i>	1		1

3.3 RESULTS OF CORAL COLONY MONITORING

Coral Colony Monitoring was also undertaken along the REA transect. Coral colonies with similar growth forms and size to those monitored during the original Baseline Coral Survey and Post-Project Coral Monitoring Survey were selected and measured during the November 7, 2013 survey. Data collected for each hard and soft coral colony are summarized in *Table 3.5*.

Photographic records of the assessed coral colonies are provided in *Annex A*.

The average maximum diameter for hard coral colonies assessed during the Baseline Update survey was 15.9±8.3cm, compared with an average of 12.9±11.8cm for the original Baseline Survey and 11.3±6.1cm for the Post-Project Monitoring Survey (*Tables 3.6 and 3.7*). Average gorgonian height recorded during the November 2013 survey was 45.6±16.9cm compared to 18.9±6.5cm for the Baseline survey and 21.9±7.4cm for the Baseline survey.

The majority of hard coral colonies assessed were recorded as having one percent sediment coverage of less than 1 mm thickness. This is comparable to sediment coverage during both the original Baseline and the Post-Project Coral Monitoring Surveys, which ranged between 1 and 5 percent (*Tables 3.6 and 3.7*). Octocorals were generally free of sediments. Selected coral colonies in the survey area did not exhibit any sign of bleaching, partial mortality or any physical damage during any of the surveys.

CONCLUSION

In accordance with the *EM&A Manual*, a Post-Project Coral Monitoring Survey was undertaken on 18 and 19 February 2013 at three designated monitoring zones (including two Impact Monitoring stations at Cape Collinson and Tai Long Pai, and one Control station at Tung Lung Chau) within one month of completion of the marine works. A Coral Monitoring Baseline Update Survey was attempted in November 2013. An REA survey and coral colony monitoring were conducted in Zone A on November 7, 2013 using the same methodology used during the original Baseline and Post-Project Coral Monitoring Surveys.



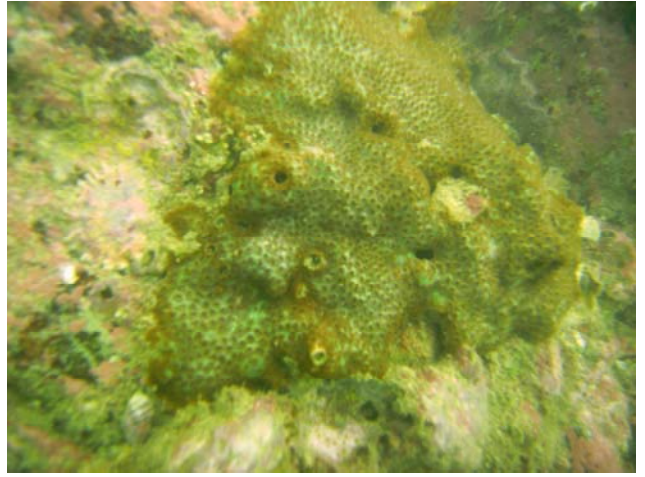

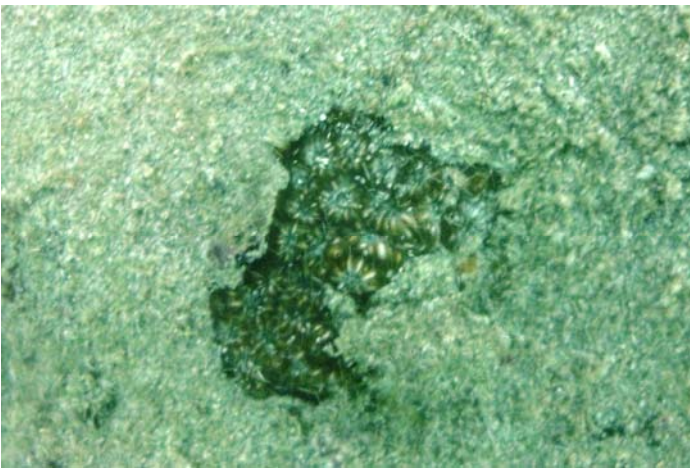
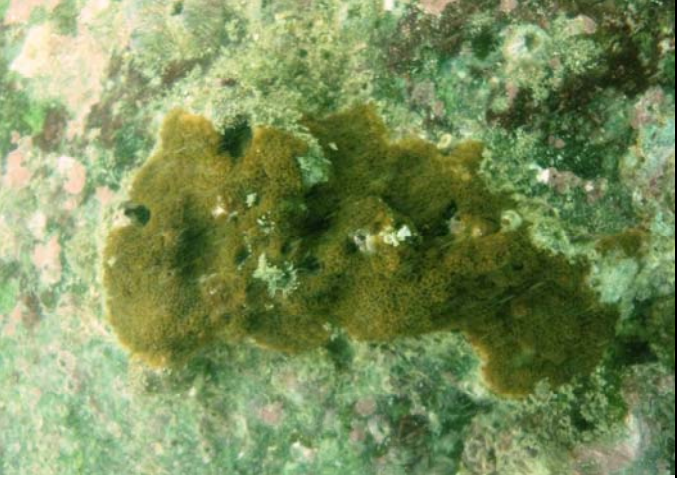
Due to adverse weather conditions experienced during the November 2013 monitoring, the survey was incomplete, with only a partial REA transect conducted in the shallow region of Zone A (Cape Collinson). Conditions at Zones B and C were deemed to hazardous to allow safe collection of data by divers. However, the limited data collected was comparable to that collected previously, with similar cover and composition of major abiotic and biotic attributes. In addition, results of coral colony monitoring indicated the condition of coral colonies assessed during the November 2013 survey were similar to those assessed during last monitoring survey (February 2013). Sediment cover was low, and selected coral colonies did not exhibit any sign of bleaching, partial mortality or physical damage.

The results of the Baseline Update survey do not indicate any significant differences from data collected during the Post-Project Coral Monitoring Survey conducted in February 2013. As this Baseline Update survey was incomplete, and the results do not differ substantially from the last monitoring, it is recommended that the Post-Project Coral Monitoring Survey results be used as baseline conditions for the cable repair works. The full dataset for the Post-Project Coral Monitoring Survey conducted in February 2013 are found in *Annex B*.

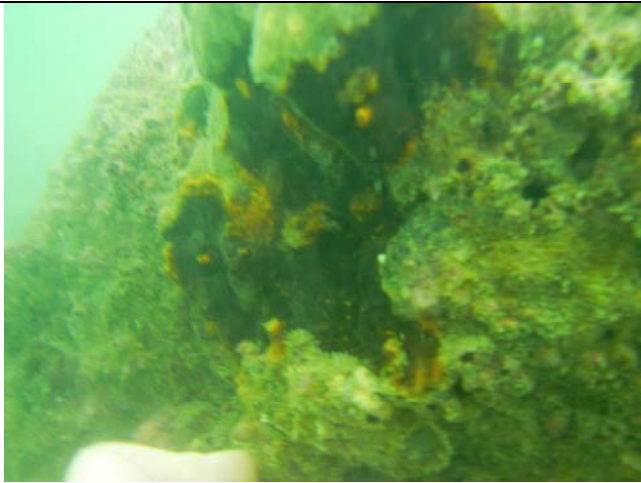
Annex A

Photographic Records from Baseline Update Monitoring

Annex A1 Photographic Records of Fauna Observed at Zone A – Cape Collinson during the REA Survey for the November 2013 Baseline Update Survey

<p><i>Porites lutea</i> surrounded by crustose coralline algae</p>	<p><i>Favia</i> sp.</p>	<p><i>Plesiastrea versipora</i></p>
		
<p><i>Goniopora stutchburyi</i></p>	<p><i>Oulastrea crispata</i></p>	<p><i>Cyphastrea serailia</i></p>
		

Encrusting Bryozoan



Crustose coralline algae and sea urchin (Anthocidaris crassipina)



Green mussel (Perna viridis)



Barnacles



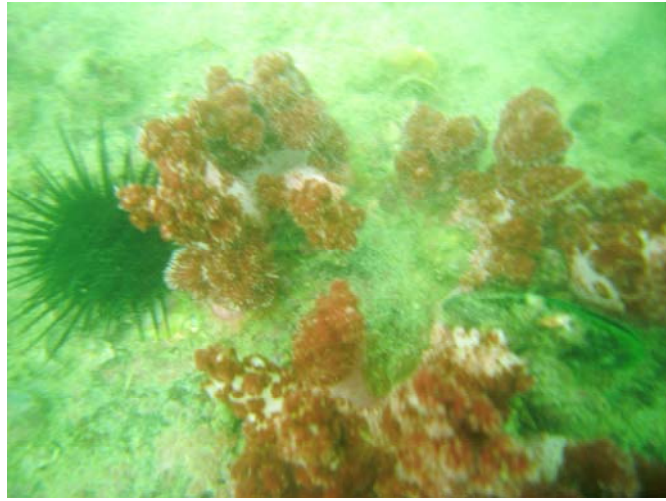
Encrustation of oysters and crustose coralline algae



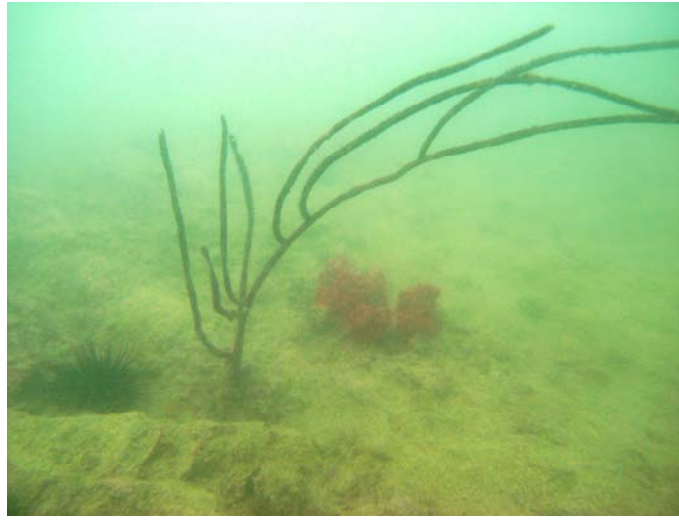
Paraplexaura sp.



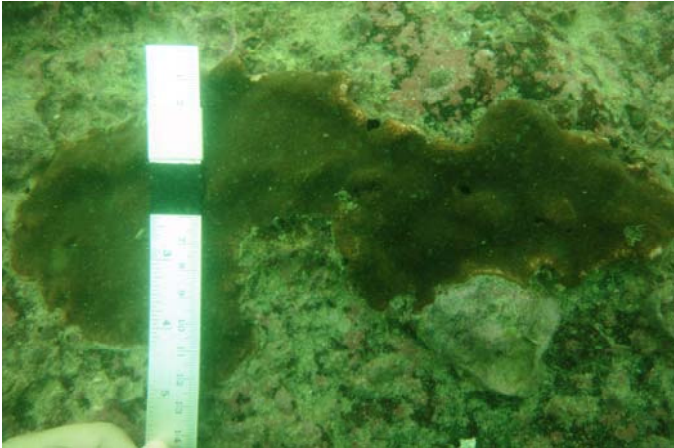
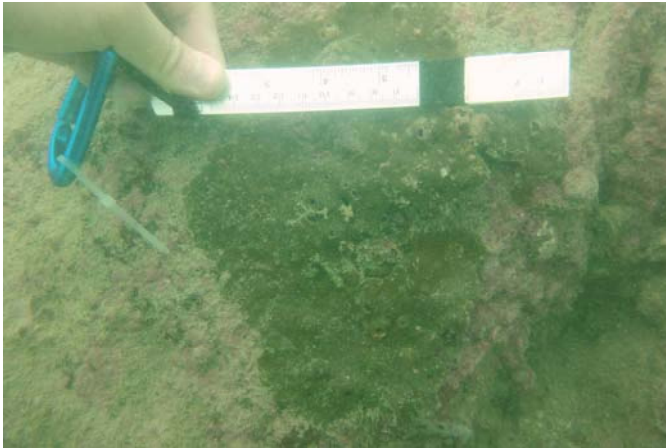

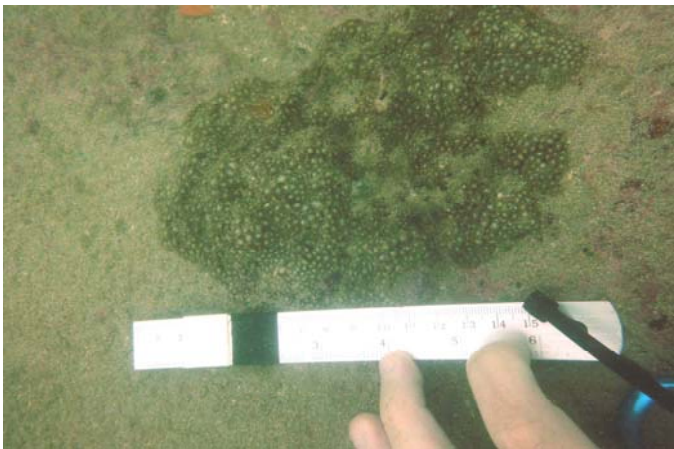
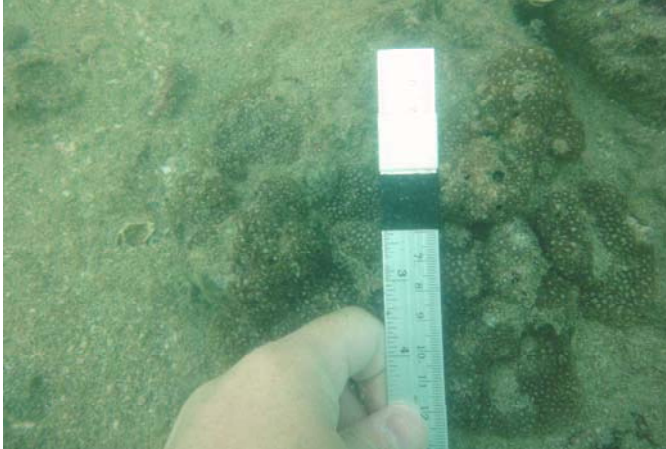

Dendronephthya sp.

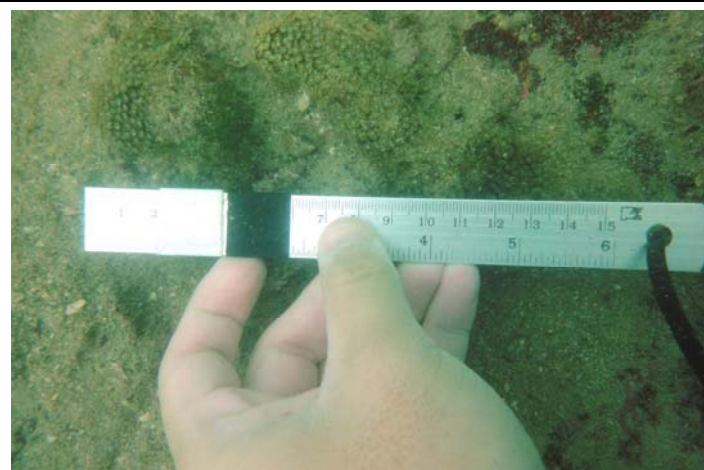


Euplexaura sp.



Annex A2 Photographic Records of Hard Coral Colonies Assessed at Zone A – Cape Collinson during the Coral Colony Monitoring for the November 2013 Baseline Update Survey

Colony No. 1 – <i>Porites lutea</i>	Colony No. 2– <i>Porites lutea</i>	Colony No. 3 - <i>Porites lutea</i>
		
Colony No. 4 – <i>Goniopora stutchburyi</i>	Colony No. 5 – <i>Goniopora stutchburyi</i>	Colony No. 6 – <i>Goniopora stutchburyi</i>
		
Colony No. 7 – <i>Goniopora stutchburyi</i>	Colony No. 8 – <i>Oulastrea crispata</i>	Colony No. 9 – <i>Goniopora stutchburyi</i>



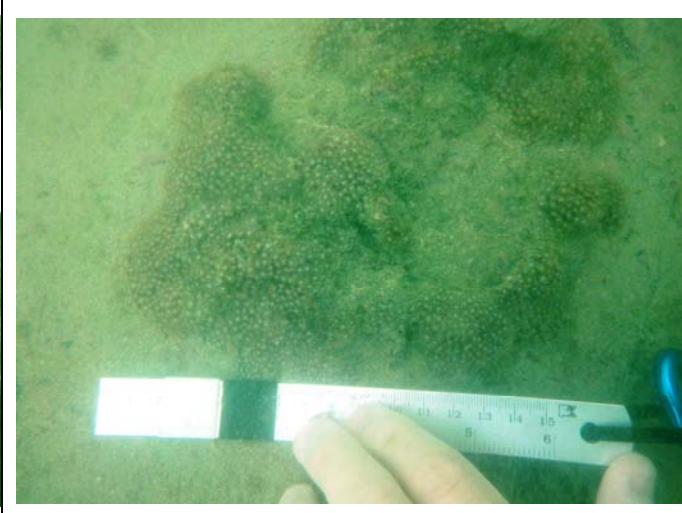
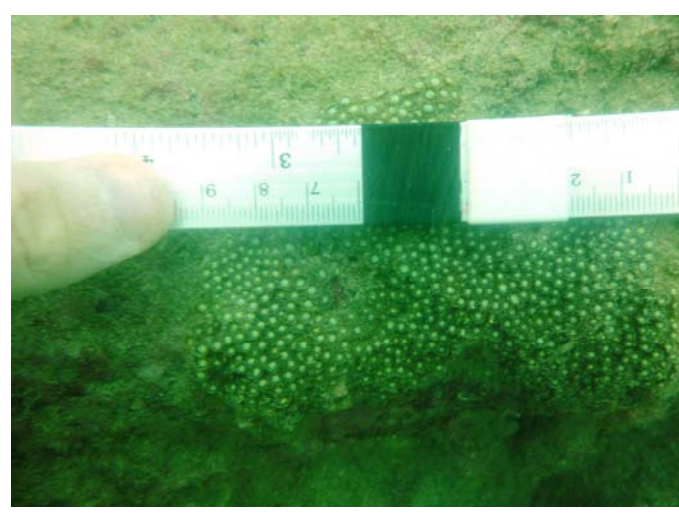
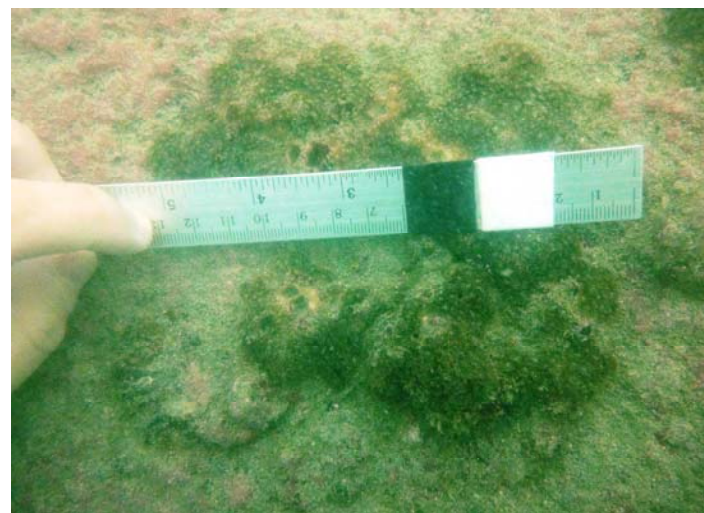
Colony No. 10 - *Goniopora stutchburyi*



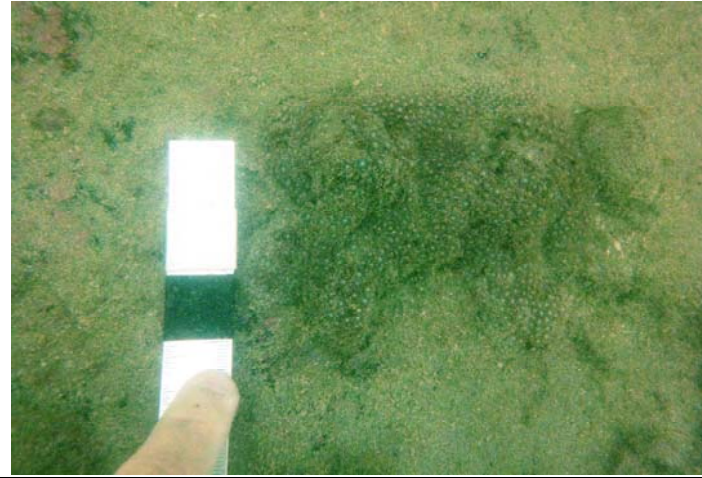
Colony No. 11 - *Goniopora stutchburyi*



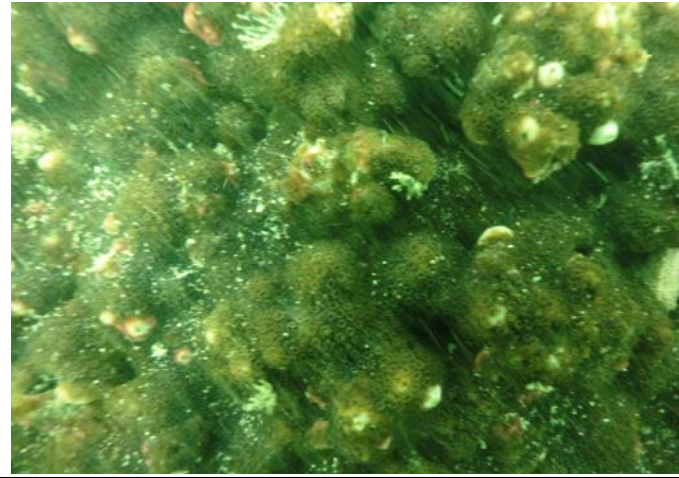
Colony No. 12 - *Goniopora stutchburyi*



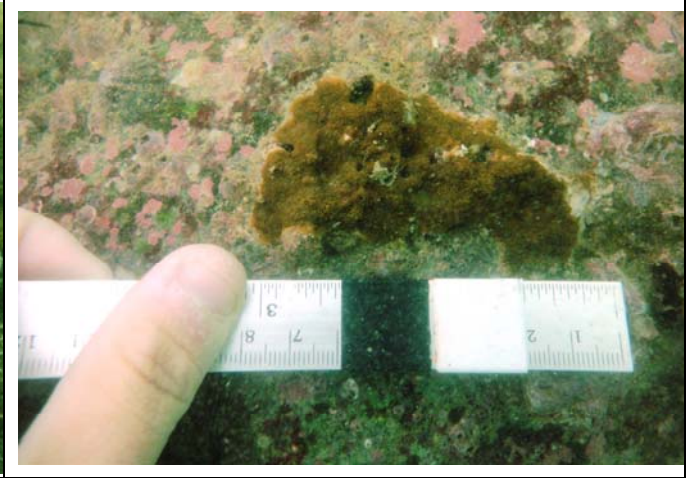
Colony No. 13 - *Goniopora stutchburyi*



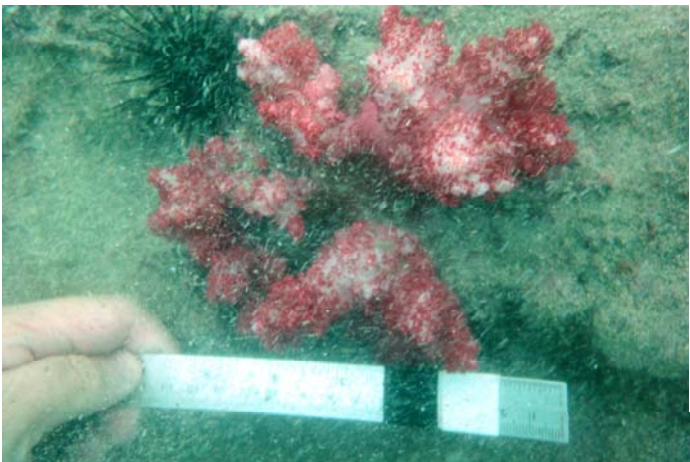

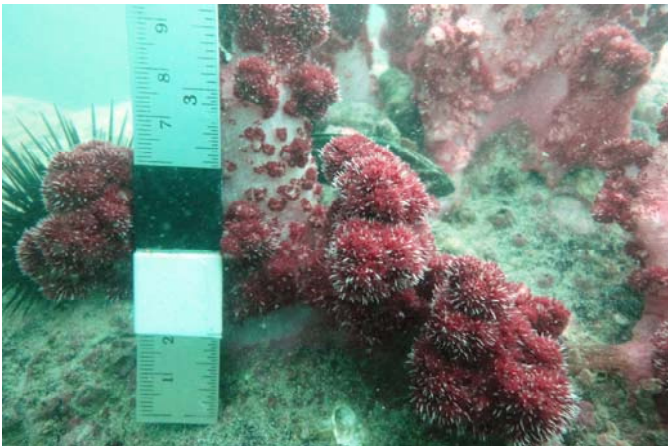
Colony No. 14 - *Cyphastrea serailia*

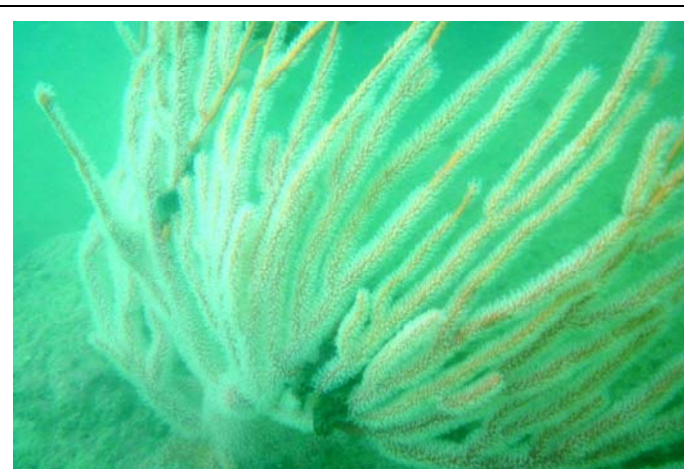
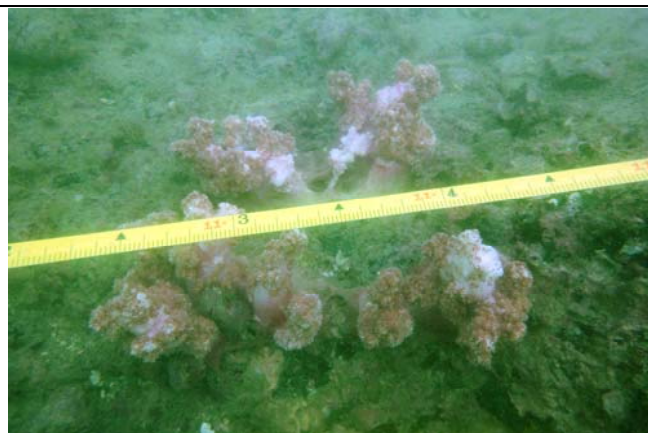
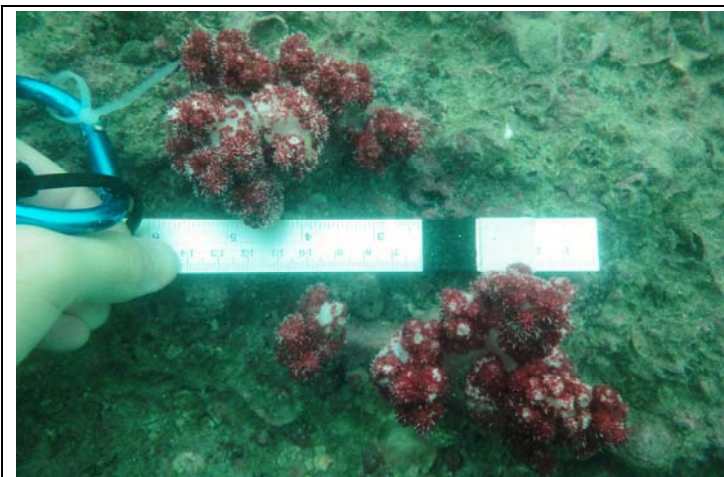


Colony No. 15 - *Cyphastrea serailia*



Annex A3 Photographic Records of Soft Coral Colonies Assessed at Zone A - Cape Collinson during the Coral Colony Monitoring for the November 2013 Baseline Update Survey

Colony No. 1 - <i>Dendronephthya</i>	Colony No. 2 - <i>Euplexaura</i>	Colony No. 3 - <i>Dendronephthya</i>
		
Colony No. 4 - <i>Dendronephthya</i>	Colony No. 5 - <i>Dendronephthya</i>	Colony No. 6 - <i>Paraplexaura</i>



Colony No. 7 - *Paraplexaura*



Annex B

Data including Photographic Records from Post-Project Monitoring

Table 1

Description of the Seabed Composition Recorded along Each REA Survey Transect during the Post-Project Coral Monitoring Survey ⁽¹⁾

Transect	Depth (-m CD)	Description
Zone A - Cape Collinson (Monitoring Site)		
Transect 1		
Shallow	~5	The seabed was composed of rubbles and small boulders. The hard coral cover was low (< 5%) with 4 hard coral species <i>Oulastrea crispata</i> , <i>Goniopora stutchburyi</i> , <i>Psammocora superficialis</i> and <i>Cyphastrea chalcidicum</i> recorded. The octocoral cover was low (< 5%) with four species (<i>Paraplexaura</i> sp., <i>Echinomuricea</i> sp., <i>Viminella</i> sp. and <i>Ellisella</i> sp.) recorded.
Deep	~9	The seabed was mainly composed of sand (~50%). No hard coral colonies were found. The octocoral cover was low (between 6-10%) with gorgonians growing on sand. Seven species of octocorals (<i>Echinomuricea</i> sp., <i>Paraplexaura</i> sp., <i>Menella</i> sp., <i>Euplexaura</i> sp., <i>Muricella</i> sp., <i>Sinularia</i> sp. and <i>Dendronephthya</i> sp.) were recorded.
Transect 2		
Shallow	~5	The seabed was mainly composed of bedrocks (~60%). The hard coral cover was low (< 5%) with 2 hard coral species <i>Oulastrea crispata</i> and <i>Psammocora superficialis</i> recorded. The octocoral cover was low (< 5%) with 6 species (<i>Dendronephthya</i> sp., <i>Ellisella</i> sp., <i>Echinomuricea</i> sp., <i>Euplexaura</i> sp., <i>Paraplexaura</i> sp. and <i>Menella</i> sp.) recorded.
Deep	~8-9	The seabed was mainly composed of bedrocks (~50%). No hard coral colonies were found. The octocoral cover was low (between 6-10%) with 6 species (<i>Dendronephthya</i> sp., <i>Dichotella</i> sp., <i>Paraplexaura</i> sp., <i>Echinomuricea</i> sp. and <i>Euplexaura</i> sp. and <i>Viminella</i> sp.) recorded. Two species of black corals, <i>Antipathes curvata</i> and <i>Cirrhopathes</i> sp., were recorded.
Transect 3		
Shallow	~5	The seabed was mainly composed of bedrocks (~60%). The hard coral cover was low (< 5%) with 3 hard coral species <i>Oulastrea crispata</i> , <i>Goniopora stutchburyi</i> and <i>Plesiastrea versipora</i> recorded. The octocoral cover was low (< 5%) with 7 species (<i>Dendronephthya</i> sp., <i>Scleronephthya gracillicum</i> , <i>Ellisella</i> sp., <i>Echinomuricea</i> sp., <i>Viminella</i> sp., <i>Paraplexaura</i> sp., <i>Euplexaura</i> sp. and <i>Menella</i> sp.) recorded.
Deep	~9	The seabed was mainly composed of bedrocks (~60%). No hard coral species was found. The octocoral cover was between 6-10% with 6 species (<i>Paraplexaura</i> sp., <i>Echinomuricea</i> sp., <i>Euplexaura</i> sp., <i>Anthogorgia</i> sp., <i>Dendronephthya</i> sp. and <i>Scleronephthya gracillicum</i>) recorded.
Zone B - Tai Long Pai (Monitoring Site)		
Transect 1		
Shallow	~2-5	The seabed was mainly composed of bedrocks (> 80%). No hermatypic hard coral species was recorded while 1 species of ahermatypic hard coral (<i>Tubastrea/Dendrophyllia</i> sp.) was recorded. The octocoral cover was about 5% with 4 species (<i>Dendronephthya</i> sp., <i>Menella</i> sp., <i>Euplexaura</i> sp., <i>Paraplexaura</i> sp.) recorded.
Deep	~5-15	The seabed was mainly composed of bedrocks (> 80%). No hard coral species was recorded. The octocoral cover was between 11-30% with 8 species (<i>Dendronephthya</i> sp., <i>Menella</i> sp., <i>Euplexaura</i> sp., <i>Paraplexaura</i> sp., <i>Anthogorgia</i> sp., <i>Acanthogorgia</i> sp., <i>Verrucella</i> sp. and <i>Echinomuricea</i> sp.) recorded. Black coral colonies, <i>Antipathes curvata</i> and <i>Cirrhopathes</i> sp. were observed.

(1) Since conditions of major biotic and abiotic attributes are similar between the Baseline and Post Project Coral Monitoring Surveys, the descriptions of seabed composition provided in this table are based on data recorded from both surveys.

Transect	Depth (-m CD)	Description
Transect 2		
Shallow	~2-5	The seabed was mainly composed of bedrocks (> 80%). The hard coral cover was extremely low (< 5%) with 3 species <i>Goniopora stutchburyi</i> , <i>Cyphastrea chalcidicum</i> and <i>Psammocora superficialis</i> recorded. Colonies of ahermatypic hard coral <i>Tubastrea/Dendrophyllia</i> sp. were found. The octocoral cover was about 5% with 3 species (<i>Euplexaura</i> sp., <i>Paraplexaura</i> sp. and <i>Echinomuricea</i> sp.) recorded.
Deep	~5-15	The seabed was mainly composed of bedrocks (> 80%). No hard coral species were recorded. The octocoral cover was between 11-30% with 7 species (<i>Dendronephthya</i> sp., <i>Menella</i> sp., <i>Euplexaura</i> sp., <i>Paraplexaura</i> sp., <i>Anthogorgia</i> sp., <i>Verrucella</i> sp. and <i>Echinomuricea</i> sp.) recorded. Black coral colonies, <i>Antipathes curvata</i> and <i>Cirripathes</i> sp. were observed.
Zone C - Tung Lung Chau (Control Site)		
Transect 1		
Shallow	~5	The seabed was mainly composed of bedrocks (~80%). The hard coral cover was low (< 5%) with 7 hermatypic hard coral species <i>Goniopora stutchburyi</i> , <i>Psammocora superficialis</i> , <i>Cyphastrea chalcidicum</i> , <i>Plesiastrea versipora</i> , <i>Porites lobata</i> , <i>Montipora mollis</i> and <i>Montipora venosa</i> recorded. One species of ahermatypic hard coral <i>Tubastrea/Dendrophyllia</i> sp. was recorded. The octocoral cover was very low (< 5%) with <i>Dendronephthya</i> sp. and <i>Scleronephthya gracillicum</i> recorded.
Deep	~10	The seabed was mainly composed of bedrocks (~60%). The hard coral cover was low (<5%). The octocoral cover was low (< 10%) with <i>Euplexaura</i> sp., <i>Paraplexaura</i> sp., <i>Dendronephthya</i> sp. and <i>Scleronephthya gracillicum</i> recorded.
Transect 2		
Shallow	~5	The seabed was mainly composed of bedrocks (~40%). The hard coral cover was low (< 5%) with 7 species <i>Montipora peltiformis</i> , <i>Porites lobata</i> , <i>Cyphastrea chalcidicum</i> , <i>Favites chinensis</i> , <i>Goniopora stutchburyi</i> , <i>Montipora venosa</i> and <i>Plesiastrea versipora</i> recorded. One species of ahermatypic hard coral <i>Tubastrea/Dendrophyllia</i> sp. was recorded. The octocoral cover was very low (< 5%) with only a few small colonies of <i>Dendronephthya</i> sp. recorded.
Deep	~8	The seabed was mainly composed of bedrocks (~80%). The hard coral cover was low (< 5%) with 3 species <i>Plesiastrea versipora</i> , <i>Porites lobata</i> and <i>Psammocora superficialis</i> recorded. The octocoral cover was low (< 10%) with <i>Acanthogorgia</i> sp., <i>Echinomuricea</i> sp., <i>Euplexaura</i> sp., <i>Menella</i> sp., <i>Dendronephthya</i> sp. and <i>Scleronephthya gracillicum</i> recorded.
Transect 3		
Shallow	5	The seabed was mainly composed of bedrocks and small boulders. The hard coral cover was low (< 5%) with 5 species <i>Montipora venosa</i> , <i>Porites lobata</i> , <i>Goniopora stutchburyi</i> , <i>Plesiastrea versipora</i> and <i>Cyphastrea chalcidicum</i> recorded. One species of ahermatypic hard coral <i>Tubastrea/Dendrophyllia</i> sp. was recorded. The octocoral cover was very low (< 5%) with <i>Echinomuricea</i> sp. recorded.
Deep	~9	The seabed was mainly composed of bedrocks (50%). The hard coral cover was low (< 5%) with 4 species <i>Montipora peltiformis</i> , <i>Goniopora stutchburyi</i> , <i>Cyphastrea chalcidicum</i> and <i>Psammocora superficialis</i> recorded. The octocoral cover was low (< 10%) with <i>Paraminabea</i> sp., <i>Euplexaura</i> sp., <i>Echinogorgia</i> sp., <i>Dendronephthya</i> sp. and <i>Scleronephthya gracillicum</i> recorded. Two species of black corals, <i>Antipathes curvata</i> and <i>Cirripathes</i> sp., were recorded.

Table 2

Ordinal Rank of Percentage Cover of Seabed Attributes along the REA Survey Transects during the Post-Project Coral Monitoring

Zone	A						B						C					
Depth ^(a)	S1	S2	S3	D1	D2	D3	S1	S2	D1	D2	S1	S2	S3	D1	D2	D3		
Seabed attributes ^(b)																		
Bedrock	0	5	4	1	5	5	6	6	6	6	6	4	4	5	6	4		
Boulders - large	3	2	3	2	3	3	1	2	3	3	0	3	3	2	2	2		
Boulders - small	3	2	3	3	3	2	1	1	2	2	0	3	3	2	0	3		
Rock	1	1	1	1	1	1	0	0	0	0	1	2	1	1	0	1		
Rubble	3	2	1	2	1	1	1	1	1	1	1	2	1	2	0	2		
Sand	2	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1		
Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Ecological attributes ^(b)																		
Hard coral	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Dead standing coral	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Octocoral	1	1	1	2	2	2	1	1	3	3	1	1	1	2	2	2		
Black coral	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0		
Turf algae	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0		
Macroalgae	1	1	1	1	1	1	1	1	2	2	0	0	0	1	1	1		
Coralline algae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		

Notes:

(a) s = shallow water; m = mid water; d=deep water







(b) 1=<5% Cover, 2= 6-10% Cover, 3 = 11-30% Cover, 4 = 31-50% Cover, 5 = 51-75% Cover, 6 = 76-100% Cover. Also refer to *Table 2.2*.

Table 3 Ordinal Rank of Taxon Abundance along the REA Survey Transects during the Post-Project Coral Monitoring Survey

Type	Taxon/ Family	Species	A	A	A	A	A	A	B	B	B	B	C	C	C	C	C	C		
		Depth ^(a)	S1	S2	S3	D1	D2	D3	S1	S2	D1	D2	S1	S2	S3	D1	D2	D3		
Hard Coral	Acroporidae	<i>Montipora peltiformis</i>												2				2		
		<i>Montipora mollis</i>												3						
		<i>Montipora venosa</i>												3	3	3				
	Siderastreidae	<i>Psammocora superficialis</i>		1	1						1			2				2	2	
	Dendrophyllidae	<i>Turbinaria peltata</i>																		
					1					3	3			2	2	2				
	Faviidae	<i>Cyphastrea chalcidicum</i>		1							1			2	2	2			1	
																1				
				3	1	2	1													
							1								2	2	2			
	Poritidae	<i>Goniopora stutchburyi</i>		2		1					2			2	2	2		2	1	
														2	1	2		2		
Octocoral	Acanthogorgiidae	<i>Acanthogorgia</i> sp.										1					1			
		<i>Anthogorgia</i> sp.						2				1								
		<i>Muricella</i> sp.																		
	Alcyoniidae	<i>Paraminabea</i> sp.					1		1										2	
			<i>Sinularia</i> sp.																	
	Nephtheidae	<i>Dendronephthya</i> sp.			2	4	1	1	4	3		3	3	2	2		3	3	2	
			<i>Scleronephythya</i> sp.				1			3					2			2	2	2
	Plexauridae	<i>Astrogorgia</i> sp.																		
			<i>Echinogorgia</i> sp.						2											1
			<i>Echinomuricea</i> sp.	2	3	3	4	3	3			2	2	2			2		2	
			<i>Euplexaura</i> sp.			2	2	2		2	2	2	2					2	1	1
			<i>Menella</i> sp.			2	2				2	2	2						1	
<i>Paraplexaura</i> sp.			1	1	2	1	1	2	2	2	2	1					1			
Ellisiidae	<i>Dichotella</i> sp.						1													
		<i>Ellisella</i> sp.	1	1	1															
		<i>Viminella</i> sp.	1		1		1													
		<i>Verrucella</i> sp.										1								
Black Coral	Antipathidae	<i>Antipathes</i> sp.					1				1	1						1		
		<i>Cirrhopathes</i> sp.					1					1	1					1		

Notes:* Abundance rating (refer to Table 2.3): 1 = rare; 2 = uncommon; 3 = common; 4 = abundant.

Annex B1 Photographic Records of Hard Coral Colonies Assessed at Zone A - Cape Collinson during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



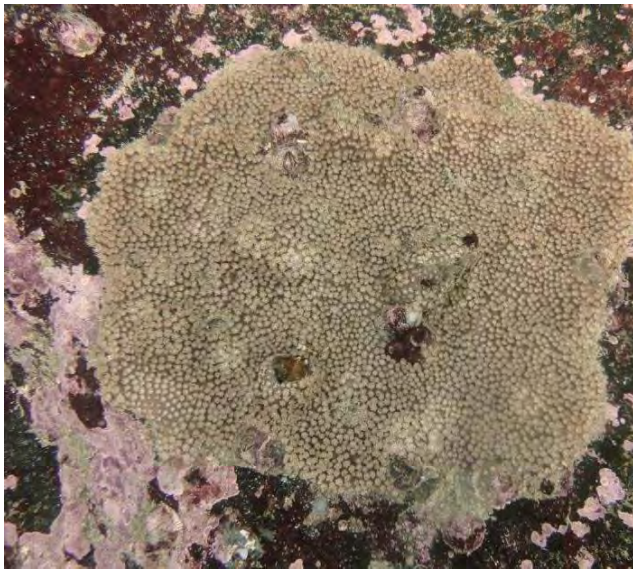
Colony No. 8



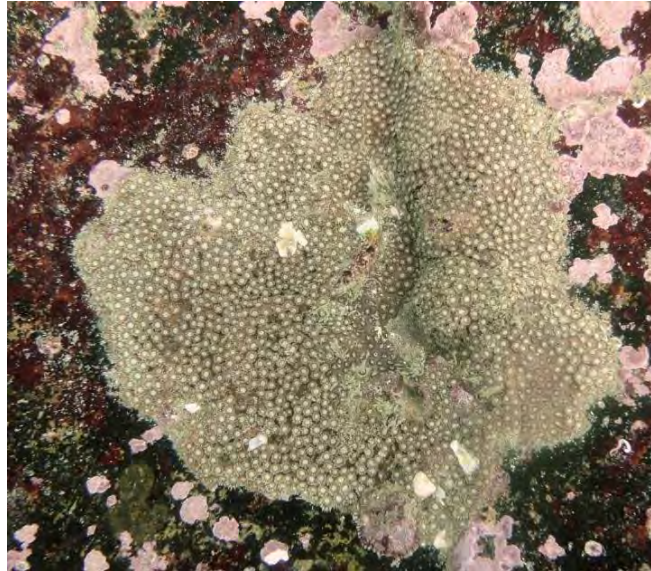
Colony No. 9



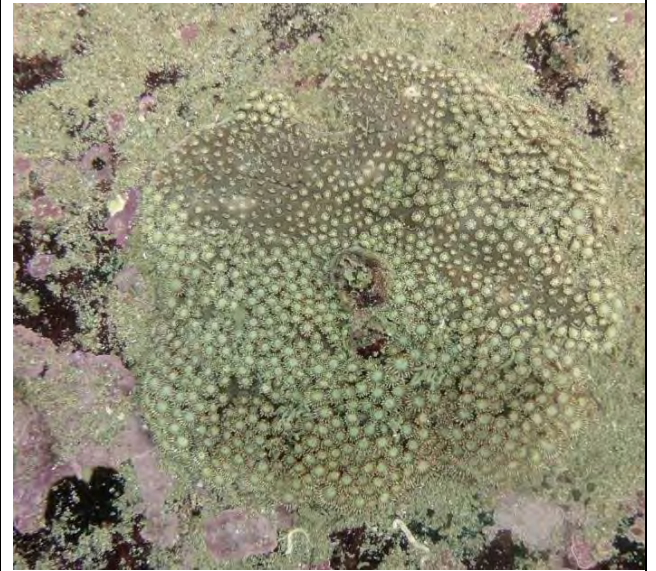
Colony No. 10



Colony No. 11



Colony No. 12



Colony No. 13









Colony No. 14



Colony No. 15



Annex B2 Photographic Records of Soft Coral Colonies Assessed at Zone A - Cape Collinson during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



Colony No. 8



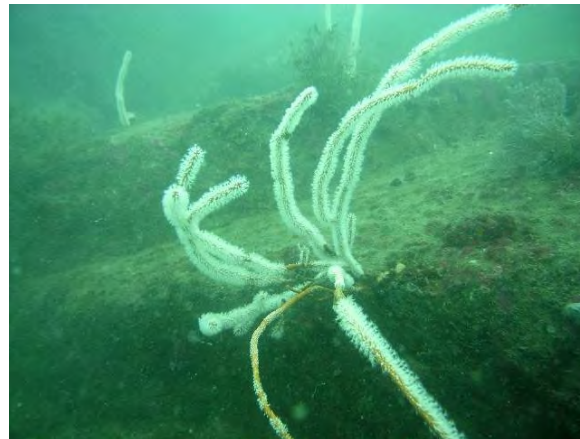
Colony No. 9



Colony No. 10



Colony No. 11



Colony No. 12



Colony No. 13





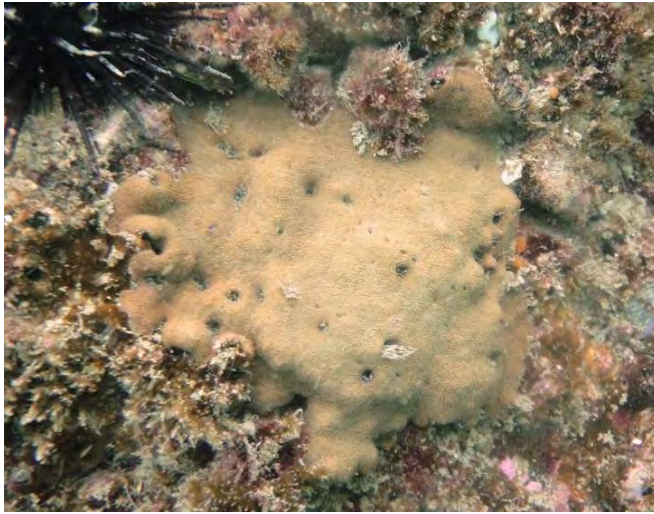



Colony No. 14



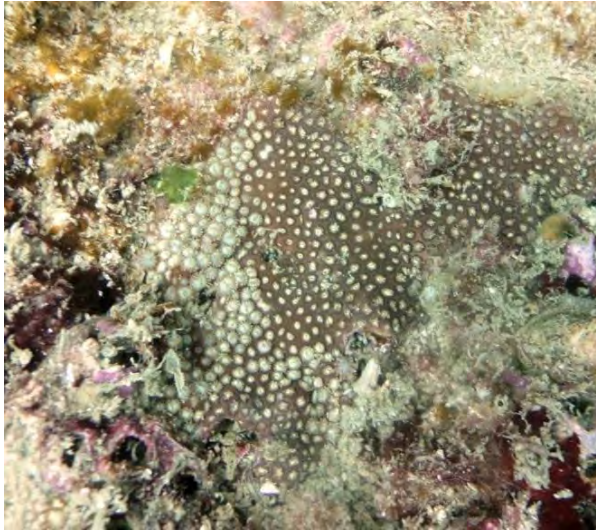
Colony No. 15



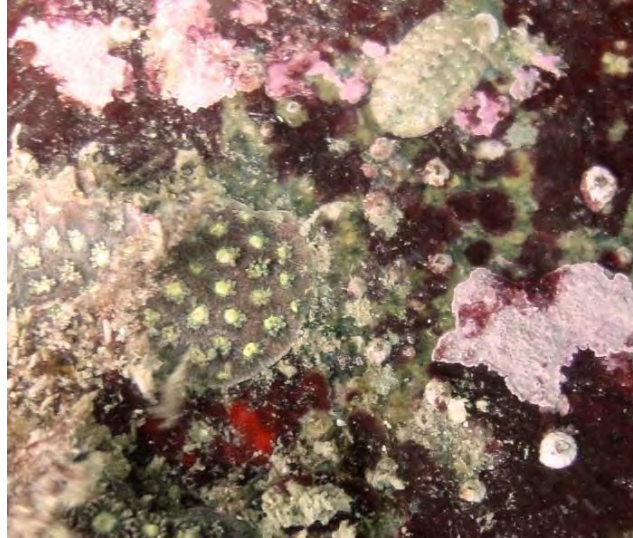
Annex B3 Photographic Records of Hard Coral Colonies Assessed at Zone B - Tai Long Pai, during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



Colony No. 8



Colony No. 9



Colony No. 10



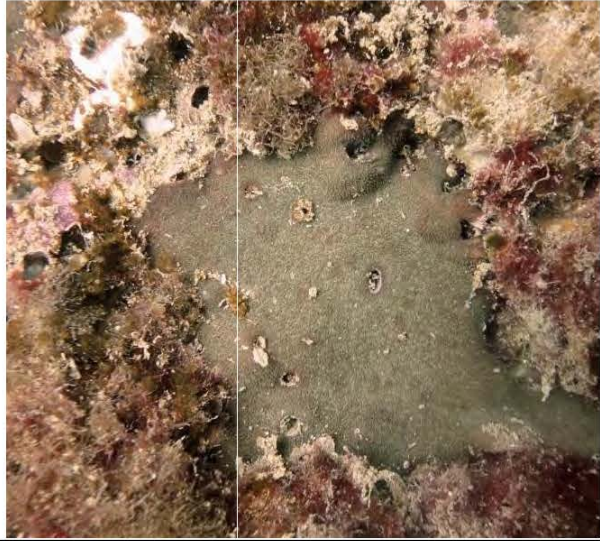
Colony No. 11



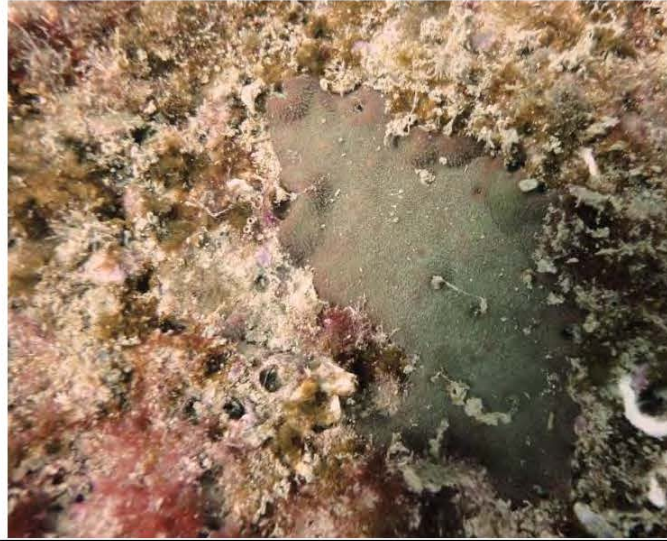
Colony No. 12



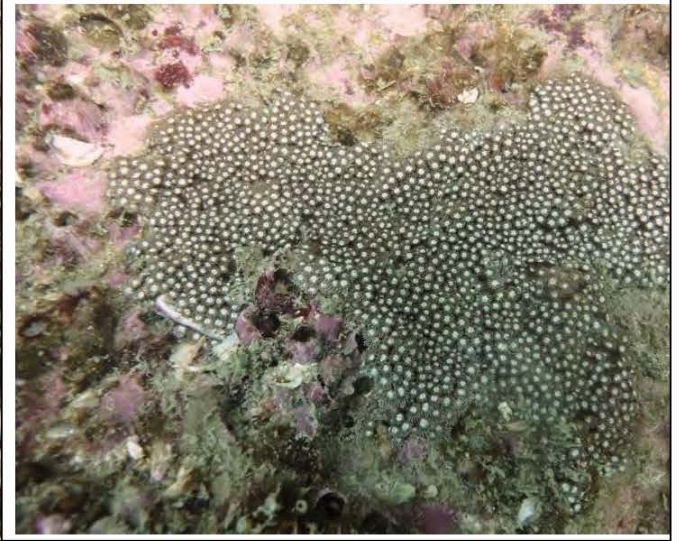
Colony No. 13



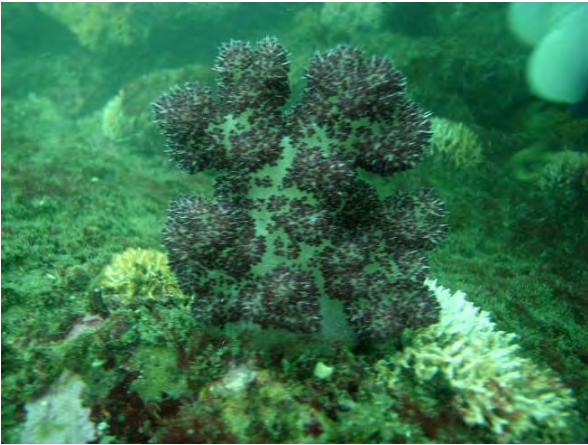


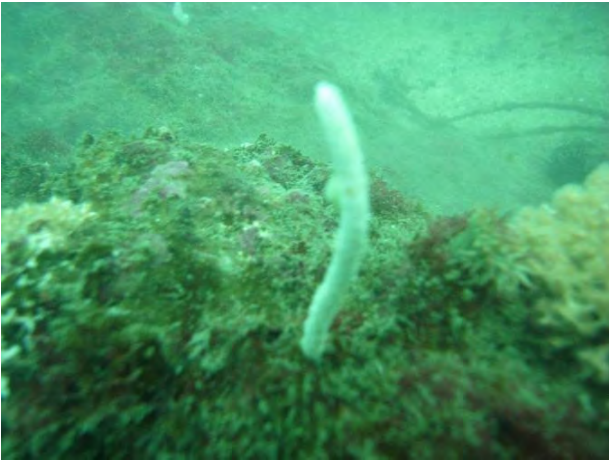


Colony No. 14



Colony No. 15



Annex B4 Photographic Records of Soft Coral Colonies Assessed at Zone B - Tai Long Pai, during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



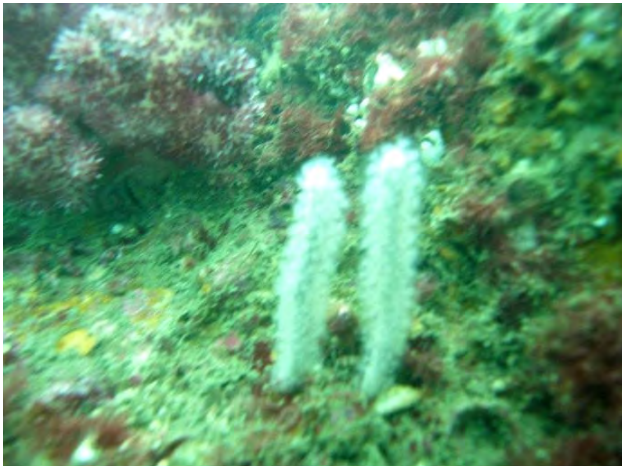
Colony No. 8



Colony No. 9



Colony No. 10



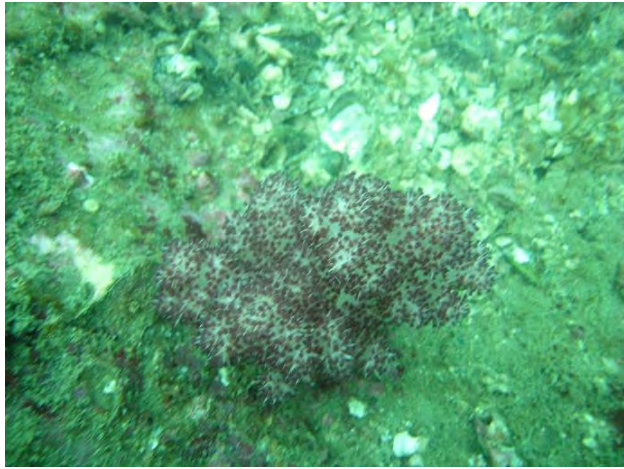
Colony No. 11



Colony No. 12



Colony No. 13









Colony No. 14



Colony No. 15



Annex B5 Photographic Records of Hard Coral Colonies Assessed at Zone C - Tung Lung Chau (Control Site), during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



Colony No. 8



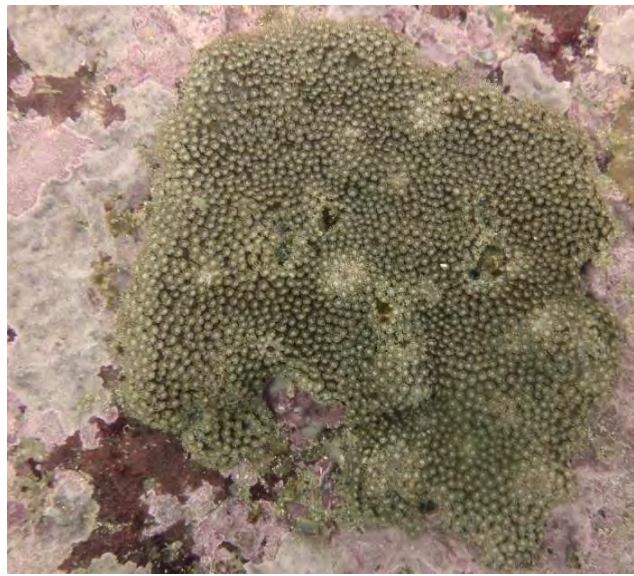
Colony No. 9



Colony No. 10



Colony No. 11



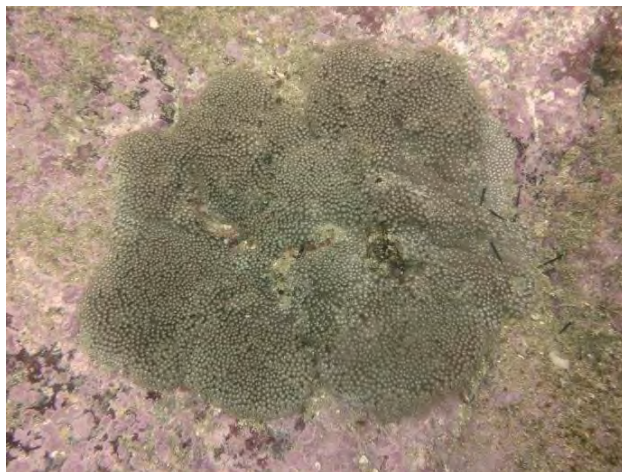
Colony No. 12



Colony No. 13









Colony No. 14



Colony No. 15



Annex B6 Photographic Records of Soft Coral Colonies Assessed at Zone C - Tung Lung Chau (Control Site), during the Coral Colony Monitoring for the Post-Project Coral Monitoring Survey

Colony No. 1	Colony No. 2	Colony No. 3
		
Colony No. 4	Colony No. 5	Colony No. 6
		

Colony No. 7



Colony No. 8



Colony No. 9



Colony No. 10



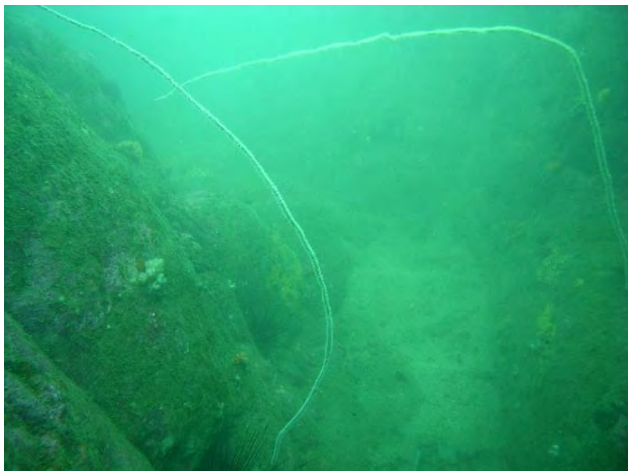
Colony No. 11



Colony No. 12



Colony No. 13



Colony No. 14



Colony No. 15



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