CCJV

Contract No. HY/2009/11
Central – Wan Chai Bypass
North Point Reclamation

Report for

Translocation of Corals from ex-PCWA Basin (Site 13)

& North Point (Site 27) to Junk Bay (Recipient Site)

April 2010

Approved By _____

(Project Director)

REMARKS:

The information supplied and contained within this report is, to the best of our knowledge, correct at the time of printing.

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1 INTRODUCTION

1.1 Project Background

1.1.1 Under the Wan Chai Development Phase II and Central-Wan Chai Bypass Project, the proposed reclamation works and the associated dredging activities are expected to post direct and indirect impacts on the marine ecology. Baseline marine ecological survey conducted in 2007 revealed presence of hard and gorgonian corals at the ex-PCWA Basin (Site 13) and North Point (Site 27).

1.1.2 Translocation of the affected colonies from Site 13 and Site 27 to a suitable Recipient Site was recommended to mitigate the impact on the standing corals (EIA Report Register No. AEIAR –125/2008). Baseline sampling work (Chung Shun Boring Eng. Co., Ltd. 2009) confirmed the presence of 20 hard coral colonies at Site 13 and 1 gorgonian sea whip at Site 27, and an Recipient Site was proposed at a semi-sheltered site at Junk Bay.

1.1.3 Cinotech Consultants Limited (CINOTECH) was employed by the Contractor to serve as the Environmental Consultant, including to conduct Pre-translocation Baseline Survey at Site 13, Site 27 and the Recipient Site, as well as the Coral translocation.

1.1.4 This report presents the results of

- Pre-translocation Baseline Survey at Site 13, Site 27
- Recipient Site Survey and tagging of Reference Colonies
- Coral Translocation

2 METHODOLOGY

2.1 Pre-Translocation Survey – Site 13 and Site 27

2.1.1 The pre-translocation survey was undertaken at Site 13 and Site 27 (Fig. 2.1). A total of 20 colonies of hard coral *Oulastrea crispata* at Site 13, and 1 colony of gorgonian sea whip *Echinomericeae sp*. at Site 27 were recorded in the previous baseline survey. The survey aimed to recover and confirm the locations of the previously recorded coral colonies.

2.1.2 A 100m long transect was laid parallel to the shore at the location with coral record (Fig. 2.1). Underwater survey was performed at the two sides of the transect, all hard corals encountered were recorded for the following information,

- Species identity
- Depth
- Size
- Percentage sedimentation
- Bleaching
- Partial mortality
- Associated substratum
- Orientation
- General condition of immediate surrounding of the coral colonies

2.1.3 Photographic records of each colony were collected from an angle that best represent the entire colony.

2.1.4 The recorded colonies were cross checked with the previous record in two ways to ensure all colonies to be translocated were retrieved,

a. Plastic tags with code label have been attached to the colonies in previous baseline survey, the labeled colonies were checked against the record list,

b. In case plastic tags were not found, the physical parameters including the size and shape of the colonies were cross referenced with the record to confirm the individual identities.

2.2 Pre-Translocation Survey – Recipient Site at Junk Bay

2.2.1 Previous baseline survey has proposed a semi-sheltered area at Junk Bay for placement of the translocated colonies from Site 13 and Site 27. Prior to coral translocation, the proposed Recipient Site was surveyed to ensure a healthy coral community of the same species and similar hydrographical conditions (e.g. substratum type and water depth) as the existing donor site.

2.2.2 Along the coast of the proposed Recipient Site, assessment of substrate and ecological attributes was performed using semi-quantitative, Rapid Ecological Assessment (REA) surveys (Fig. 2.1).

2.2.3 REA surveys provide information on the relative cover of coral and other major benthic groups, as well as inventory of sessile benthic taxa used to define community types. REA has been adopted in many regions to examine baseline information on coral reefs, such as the Great Barrier Reef (DeVantier et al. 1998). This method can be applied to a wide range of coral reef and community types and were also used in a coral community study in Hong Kong with some modification (AFCD 2004).

2.2.4 At each site, the REA survey was performed along three 50 m transects laid parallel to the shore. The benthic cover, taxon abundance, and ecological attributes of the transect were recorded in a swathe of 2m wide, 1m either side of the transect.

2.2.5 The locations and routes (starting and end points) of the REA transects were recorded on site using GPS (Garmin GPS 60CS). Photographs of representative taxa were taken during the surveys.

2.2.6 Two types of information were recorded:

(1) Cover of the major benthic groups;
(2) Inventory of sessile benthic taxa.
These were performed according to Tier I and Tier II levels of information.

2.2.7 Tier I: Categorization of ecological (benthic cover) and environmental variables.

- To describe the benthic cover, six substrate and seven ecological attributes (Table 2.1 (a)) were assigned. Each attribute was given a rank, from 0 to 6 (Table 2.1 (b)) based on the overall cover along the survey area.

2.2.8 Tier II: Taxonomic inventories to define types of benthic communities.

- An inventory of benthic taxa was compiled during each swim. Taxa were identified either *in situ* or with the aid of photos to confirm identification afterward.
- **Hard corals** (Order Scleractinia) – to genus and species level where possible;
- **Soft corals** (Subclass Octocorallia) – to genus level where possible;
- **Other benthos** (sponges, zoanthids, bryozoans, macroalgae, etc) – to genus level where possible or phylum with growth form;

2.2.9 Each taxon in the inventory will be given a rank (0 to 5) on the basis of its abundance in the community at the site (Table 2.1 (c)). These broad categories rank the taxa in terms of the relative abundance of individuals, rather than the contribution to benthic cover, at each site, as shown in Table 2.1.

Table 2.1 Categories of (a) benthic attributes, (b) ordinal ranks of percentage cover of substrate, and (c) ordinal ranks of taxa abundance

a) Benthic attributes		b) Percentage Cover		c) Taxon abundance	
Substrate	**Ecological**	**Rank**	**Percentage Cover**	**Rank**	**Abundance**
Bedrock	Hard Corals	0	Not recorded	0	Absent
Boulders (diameter >50cm)	Dead Coral Skeleton	1	1-5%	1	Sparse
Cobbles (diameter < 50cm)	Soft Corals	2	6-10%	2	Uncommon
Rubble (dead corals)	Sea anemone beds	3	11-30%	3	Common
Sand with gravel	Encrusting Algae	4	31-50%	4	Abundant
Mud & Silt	Coralline Algae	5	51-75%	5	Dominant
	Erect Macroalgae	6	76-100%		

2.2.10 For placement of translocated colonies, the Recipient Site should be inhabited with the same coral species, i.e. *Oulastrea crispata* and *Echinomuricea sp*., as the translocated colonies. The area of recipient site was selected based on the space requirement of approximately 20 boulders with attached coral colonies (occupying the largest area of less than 0.25 m each), and hence with sufficient space to receive the newly translocated colonies.

2.3 Tagging of Reference Coral Colonies at the Recipient Site

2.3.1 To distinguish the effect of the translocation exercise on the translocated coral colonies against the natural variation in health status at the Recipient Site, comparison of health status between the translocated colonies and original colonies in the Recipient Site shall be performed. Simultaneous monitoring of the 2 groups of colonies will help evaluating the potential sources of impact to the colonies if deteriorating in health condition is recorded.

Coral Tagging Methodology

2.3.2 At the Recipient Site, original hard coral colonies were identified to species level and tagged for impact monitoring after the coral translocation. Target species of Reference Coral Colonies included *Oulastrea crispata* (10 colonies) and *Echinomuricea* sp. (5 colonies). Colonies were tagged giving priority to the large, undamaged colonies since damage to these colonies would be more evident compared to smaller colonies or corals with existing damage.

2.3.3 The selected colonies were tagged with a numbered stone, painted in bright yellow, was placed next to each tagged colony. For each tagged coral, specific detailed information was collected including species identification, size, growth form and depth. The health status of each tagged coral colony was carefully recorded, including information on existing surface area with partial mortality, bleached area, as well as percentage cover of sedimentation. The condition of each tagged coral colony was recorded by taking a photograph from an angle and distance that best represents the entire colony.

2.4 Coral Translocation

2.4.1 Coral translocation from Site 13 and 27 to the Recipient Site was performed with multiple measures to minimize stress and damage to the colonies.

2.4.2 All tagged movable boulders with the translocated coral colonies at Site 13 and Site 27 were moved entirely as a whole object and lifted from the sea bottom and loaded to the boat with lifting bag. All the coral colonies attached on the boulders were kept submerged at all time with a brief exposure unavoidable when transferred onto the vessel.

2.4.3 The translocated colonies transferred onto the vessel were submerged in seawater tanks (80 cm x 100 cm x 40 cm in dimension and 32 liters in volume each) with continuous aeration onboard. Each seawater tank held no more than 4 boulders to avoid overcrowding. Shading was provided by placing the tanks under shell roof of the vessel to avoid exposure to direct sunlight. Ambient water quality parameters of sea surface temperature and dissolved oxygen were measured once (with 5 replicate sampling) at Site 13 and Site 27 on the day of coral translocation. The seawater quality in the tank was checked every 10 minutes to ensure no fluctuation above 10% ambient occurs to the seawater in which the corals were submerged.

2.4.4 Corals were transported to the recipient site immediately after the removal. Speed of the vessel was kept <5 knots during the moving exercise. During the course of transportation, all the coral colonies were kept submerged at all time. Constant supervision of the boulders and the correct orientation of boulder in the seawater holding tanks were carried out to ensure coral colonies were not damaged on the way to the Recipient Site.

2.4.5 Arrived at the Recipient Site, translocated colonies were placed one by one to the seabed. Colonies were positioned to similar depths with orientations as their previous location at the donor sites as far as possible. Each colony was tagged with a labeled stone, place next to the colonies (see Section 2.3.3).

2.4.6 Record of size, location, health conditions (sedimentation, bleaching and partial mortality) were recorded for each translocated colony after the completion of translocation work. Photographs of each translocated coral were taken as baseline for future monitoring.

Figure 2.1a Locations of the survey transects at Site 13 and Site 27

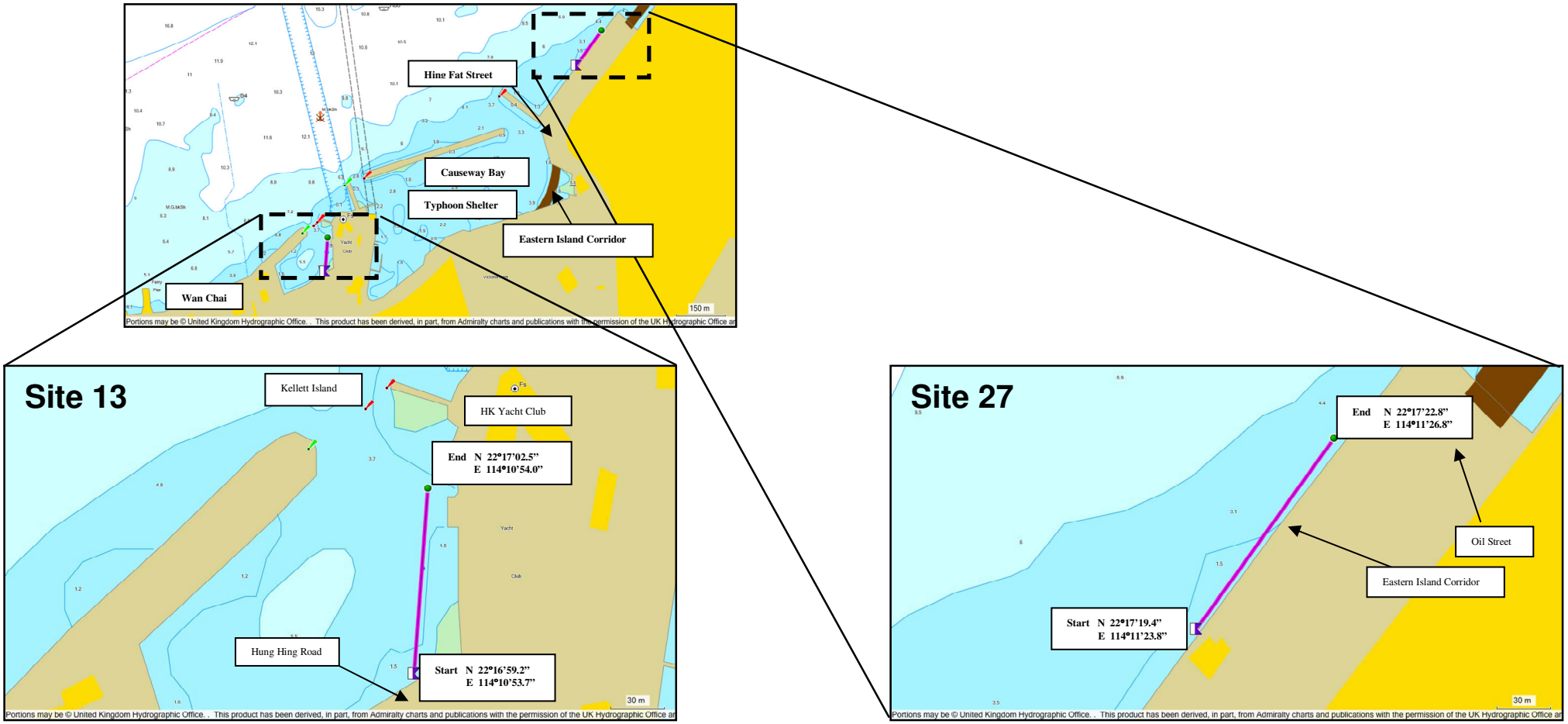
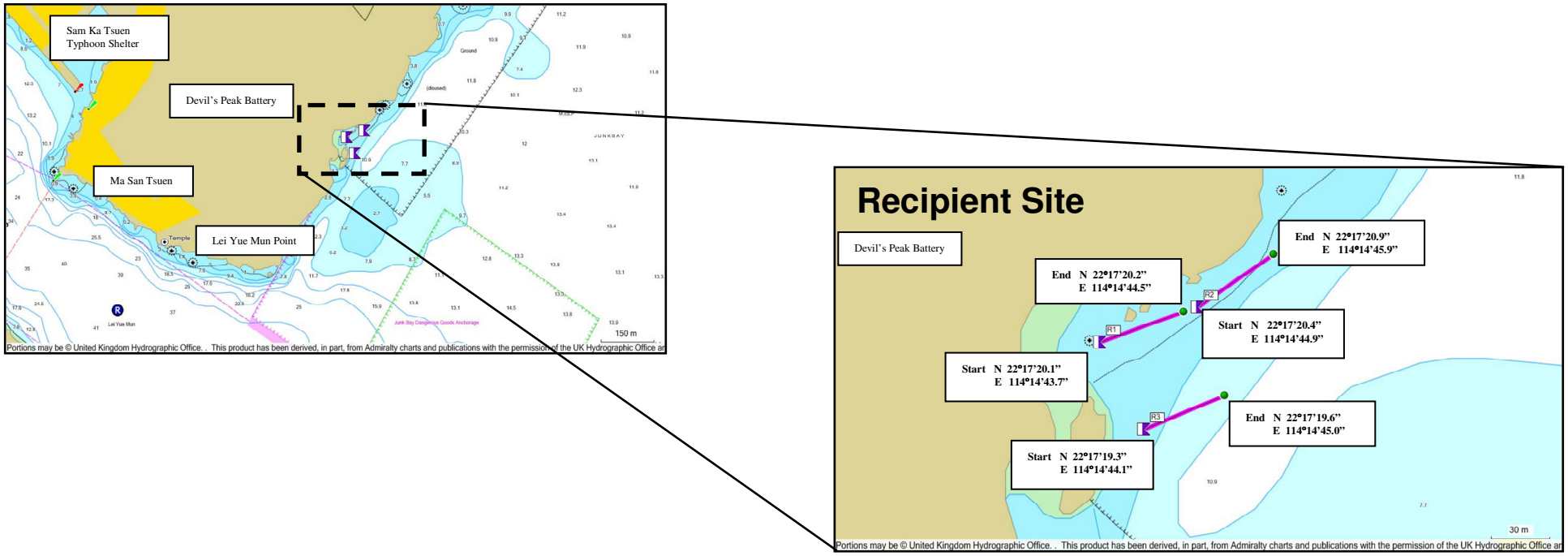


Figure 2.1b Locations of the survey transects at Recipient Site



3 RESULTS

3.1 Pre-Translocation Survey – Site 13 and Site 27

3.1.1 The locations of the survey transects are shown in Figure 2.1a-b, and survey conditions in Table 3.1. Physical conditions and health status of the recorded colonies are presented in Table 3.2. Schematic positions of the colonies are shown in Figure 3.1a-c.

Table 3.1 Location and Survey Conditions of Pre-translocation Survey at Site 13 and Site 27

Location	Transect GPS Coordinates		Depth (m)	Visibility (m)	Weather	Tide	Current (knot)
Site 13	Start	N 22°16'59.2" E 114°10'53.7"	2.5 - 4	1 – 2	Calm Cloudy	Flood	0 - 0.5
	End	N 22°17'02.5" E 114°10'54.0"					
Site 27	Start	N 22°17'19.4" E 114°11'23.8"	2.5 - 6	1 – 2	Calm Cloudy	Flood	0 - 0.5
	End	N 22°17'22.8" E 114°11'26.8"					

3.1.2 Site 13 was mainly composed of cobble substrate with scattered sandy bottom. A total of 20 hard coral colonies was recorded (Appendix I). All colonies belonged to the same species, *Oulastrea crispata*, with size of the colonies ranged from 6 to 45 cm^2. The corals showed generally normal status, with low level of sedimentation, and no bleaching or mortality was observed. All the recorded colonies were associated with small boulders of diameters from 17 to 38 cm, and therefore regarded feasible for translocation.

3.1.3 Plastic tags were found attached to 14 boulders with the associated coral colonies. Thus the 14 colonies could be cross-referenced with the previous recorded in the baseline survey. Upon checking with the size of the colonies and associated boulders, the remaining 6 colonies were also matched with the previous record.

3.1.4 At Site 27, the substratum was composed of vertical seawall, cobbles and anthropogenic waste. One colony of gorgonian sea whip *Echinomuricea* sp. was recorded. The sea whip was tagged with plastic tag and matched with previous record.

3.1.5 Therefore, all the 20 colonies at Site 13 and 1 colony at Site 27 were recovered for coral translocation.

Table 3.2 Physical Conditions and Health Status of the Translocated Coral Colonies in Pre-Translocation Survey, Before and After Translocation.

Site 13				Pre-Translocation Survey (6 Feb 2010)						Before			After Translocation (20 Feb 2010)			
Code	**Species**	**Previous tag attached?**	**Previous tag code**	**Depth (m)**	**Size (cm^2)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Asso. Bould. Dia. (cm)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Depth (m)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**
T01	*O. crispata*	Yes	HC01	2.7	8	1	0	0	38	1	0	0	2.5	1	0	0
T02	*O. crispata*	Yes	HC02	2.7	25	1	0	0	38	3	0	0	2.5	2	0	0
T03	*O. crispata*	No	HC03	2.6	6	1	0	0	35	2	0	0	2.7	2	0	0
T04	*O. crispata*	No	HC04	2.6	9	0	0	0	35	5	0	0	2.6	2	0	0
T05	*O. crispata*	No	HC05	2.6	10	0	0	0	35	3	0	0	2.9	3	0	0
T06	*O. crispata*	Yes	HC06	2.9	22	0	0	0	20	1	0	0	2.5	1	0	0
T07	*O. crispata*	Yes	HC07	3.1	12	1	0	0	25	2	0	0	2.7	2	0	0
T08	*O. crispata*	No	HC08	2.8	38	0	0	0	41	1	0	0	2.5	1	0	0
T09	*O. crispata*	Yes	HC09	3.1	16	0	0	0	27	3	0	0	2.7	1	0	0
T10	*O. crispata*	Yes	HC10	2.9	6	1	0	0	21	1	0	0	2.9	1	0	0
T11	*O. crispata*	Yes	HC11	2.7	45	2	0	0	30	1	0	0	2.9	1	0	0
T12	*O. crispata*	Yes	HC12	2.9	15	3	0	0	17	3	0	0	2.6	3	0	0
T13	*O. crispata*	Yes	HC13	2.7	25	1	0	0	33	3	0	0	2.9	3	0	0
T14	*O. crispata*	Yes	HC14	2.7	18	2	0	0	35	0	0	0	2.9	0	0	0
T15	*O. crispata*	Yes	HC15	2.1	12	1	0	0	19	0	0	0	2.8	0	0	0
T16	*O. crispata*	Yes	HC16	2.1	9	1	0	0	22	1	0	0	3.1	1	0	0
T17	*O. crispata*	No	HC17	2.2	26	0	0	0	27	1	0	0	2.8	1	0	0
T18	*O. crispata*	Yes	HC18	2.2	18	1	0	0	20	3	0	0	2.7	3	0	0
T19	*O. crispata*	Yes	HC19	2.2	6	0	0	0	22	2	0	0	2.6	2	0	0
T20	*O. crispata*	No	HC20	2.1	8	0	0	0	18	2	0	0	2.6	2	0	0
Site 27				**Pre-Translocation Survey (6 Feb 2010)**						**Before**			**After Translocation (20 Feb 2010)**			
Code	**Species**	**Previous tag attached?**	**Previous tag code**	**Depth (m)**	**Height (cm)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Asso. Bould. Dia. (cm)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Depth (m)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**
T21	*Echinomuricea* sp.	Yes	GOR01	2.7	40	0	0	0	NA	0	0	0	8.5	0	0	0

Sed. = Percentage Sedimentation; Ble. = Percentage Bleaching; Mort. = Percentage Partial Mortality; Asso. Bould. Dia. = Associated Boulder Diameter.

Figure 3.1a Schematic position of Translocated and Reference Coral Colonies at Site 13

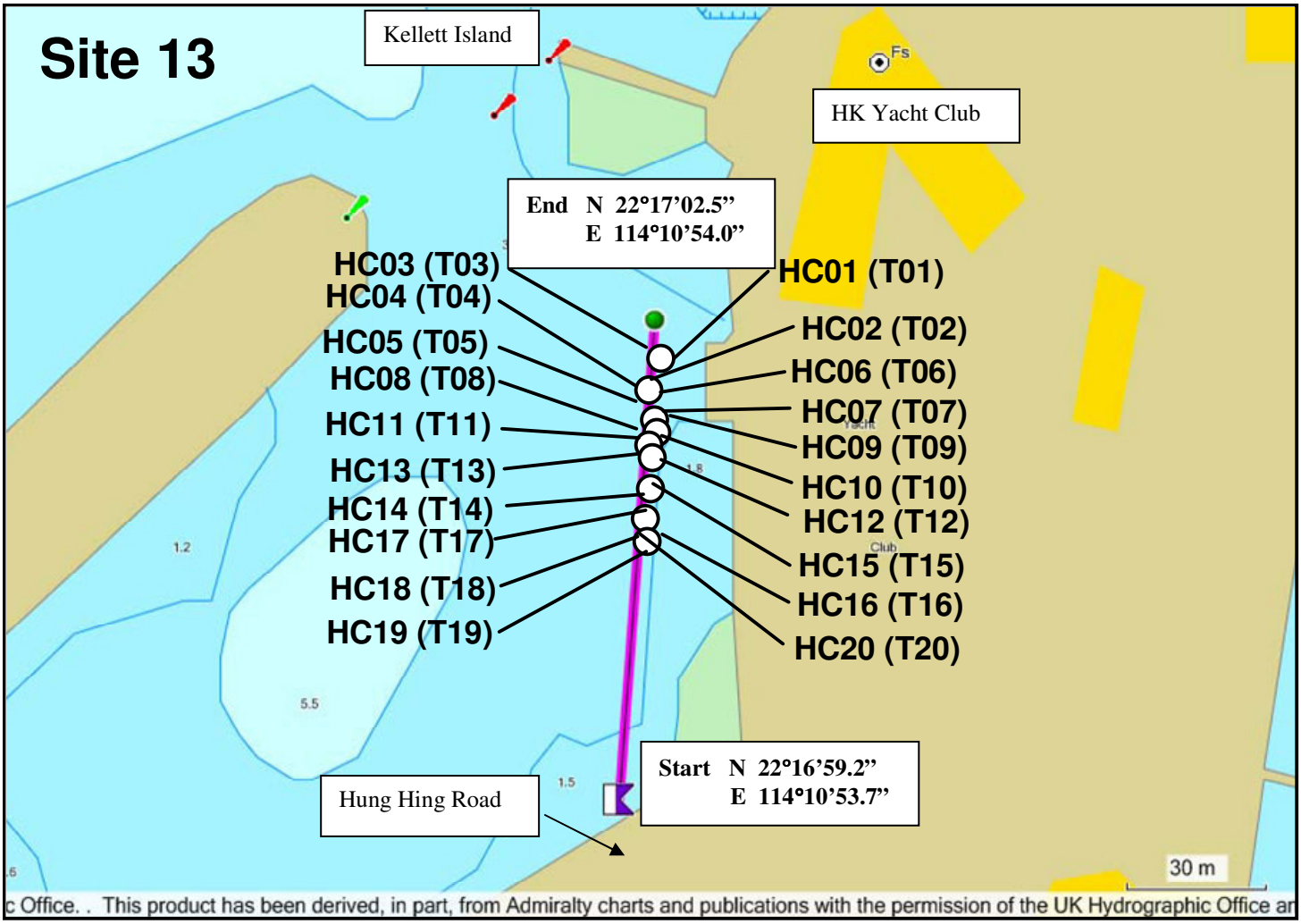


Figure 3.1b Schematic position of Translocated and Reference Coral Colonies at Site 27

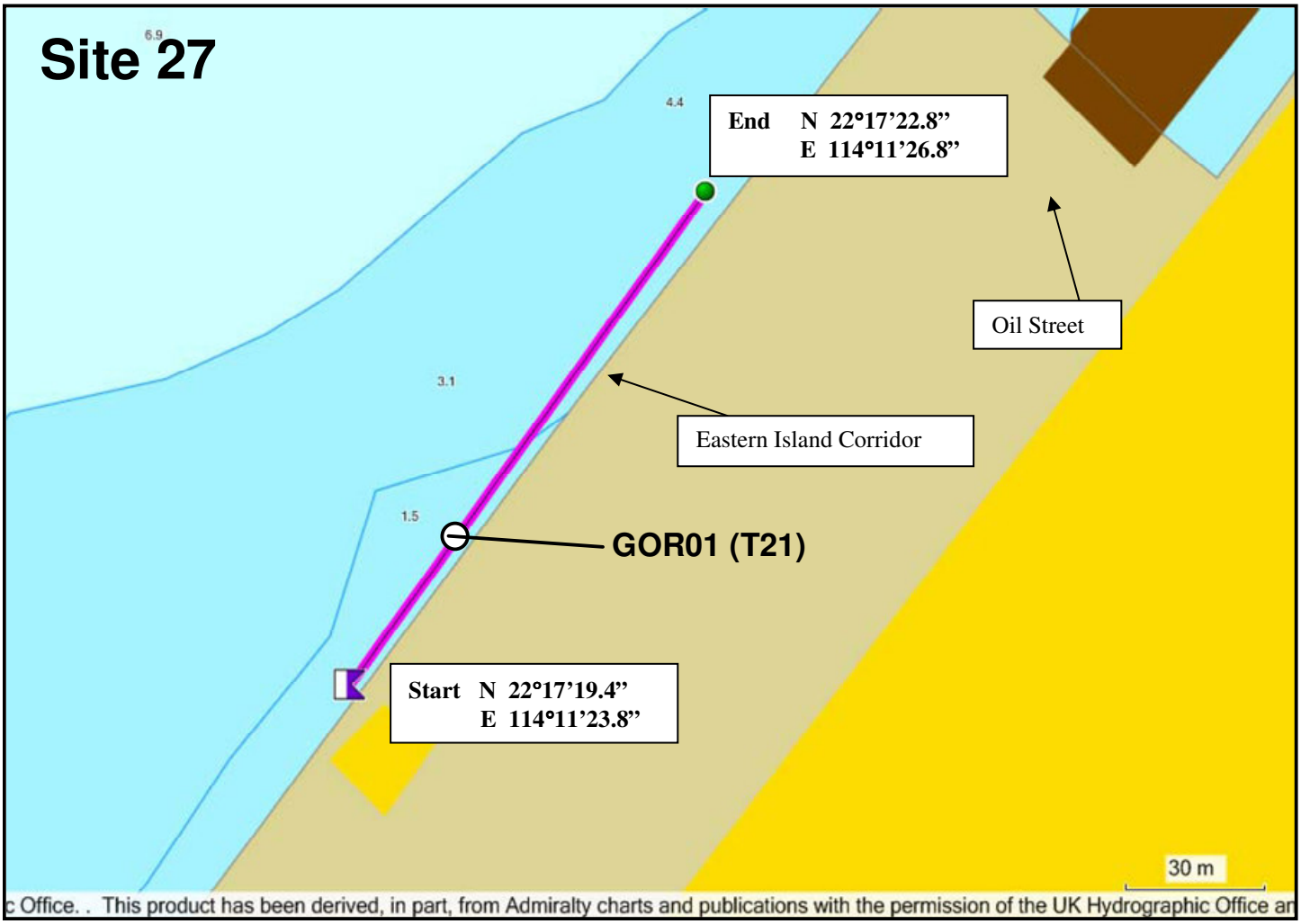
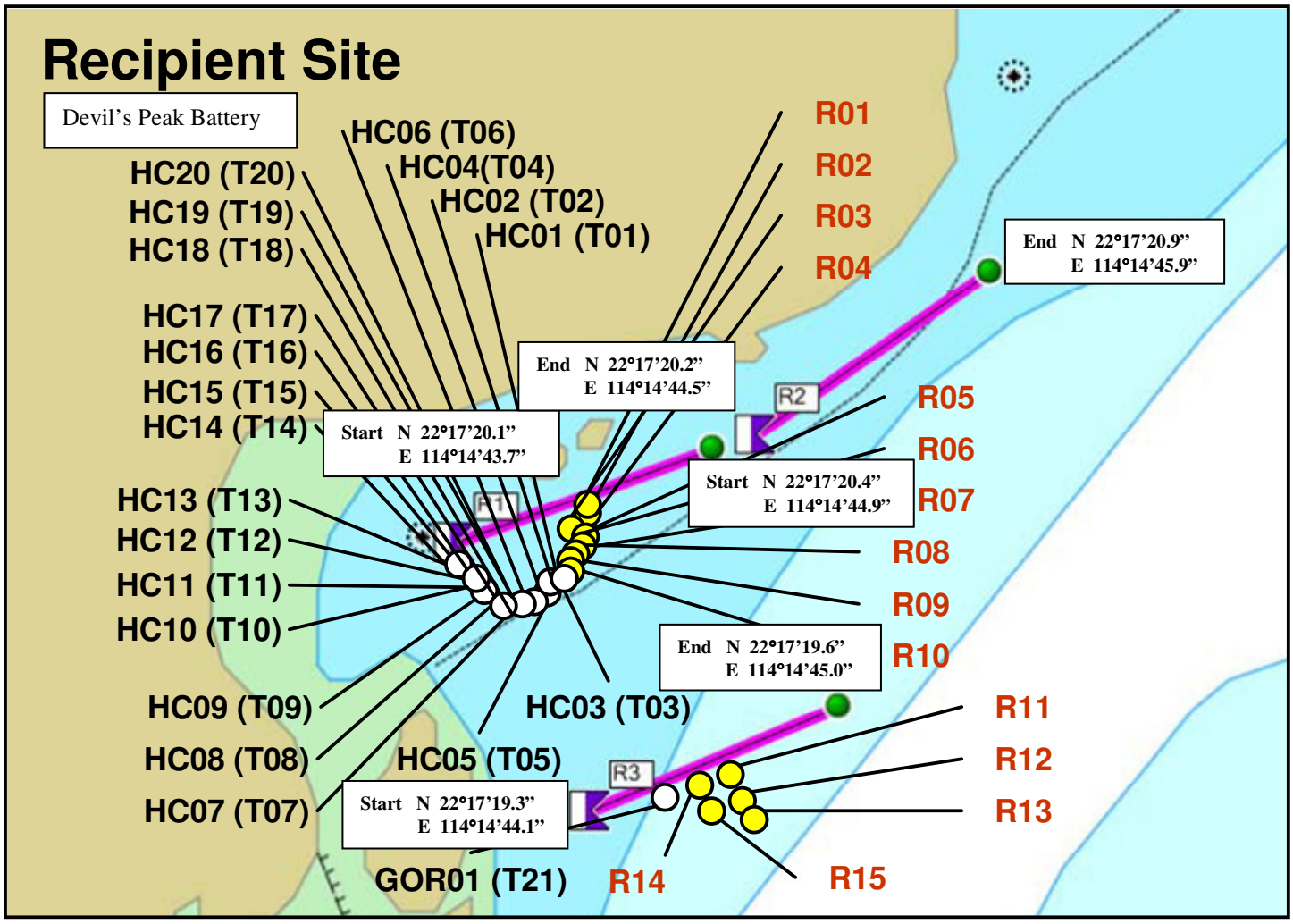


Figure 3.1c Schematic position of Translocated and Reference Coral Colonies at Recipient Site



Pre-Translocation Survey – Recipient Site

3.1.6 The locations of the transect for REA survey at the Recipient Site is shown in Figure 2.1a-b, and survey conditions in Table 3.3. Records of ecological and substrate attributes, as well as the taxonomic inventories are presented in Table 3.4. Photos of physical characteristics of the survey sites and substrate characteristics are shown in Appendix II

Table 3.3 Location of REA Transects and Survey Conditions of Pre-translocation Survey at the Recipient Site

Transect	Transect GPS Coordinates		Depth (m)	Visibility (m)	Weather	Tide	Current (knot)
R1	Start	N 22°17'20.1" E 114°14'43.7"	2.5 - 4	1 – 2.5	Calm Cloudy	Flood	0 - 0.5
	End	N 22°17'20.2" E 114°14'44.5"					
R2	Start	N 22°17'20.4" E 114°14'44.9"	3 - 5	1 – 2.5	Calm Cloudy	Flood	0 - 0.5
	End	N 22°17'20.9" E 114°14'45.9"					
R3	Start	N 22°17'19.3" E 114°14'44.1"	6 - 11	1 – 2	Calm Cloudy	Flood	0 - 0.5
	End	N 22°17'19.6" E 114°14'45.0"					

3.1.7 The Recipient Site is a south east facing shore composing of bedrocks, boulders and cobbles at shallow zone (2 to 5 m) and mainly big boulder at the deeper zone (6 to 12 m).

3.1.8 Among the 3 REA transects, transect R1 is located at the more sheltered cobble substratum (Table 3.2). The hard substratum in R1 was mainly inhabited by encrusting algae and barnacles. Scattered hard corals were observed on boulder surfaces, in which *Oulastrea crispata* was more common. Transect R2 was mainly composed of bedrock and boulder substrate. Common inhabitants include barnacles, sponges and bryozoans. Five species of hard corals were observed on both bedrock and boulder surface. The more common species included *Goniopora stutchburyi* and *Plesiastrea versipora*. Transect R3 was laid along the deeper zone (6 to 11 m) at the Recipient Site. The hard surface was mainly bared or covered with sparse sponge and bryozoan. Gorgonian sea whips, *Echinomericea* sp., were recorded on the boulder surface at 8 to 9 m. No hard coral was observed.

3.1.9 In the Recipient Site, the abundance and diversity of hard corals were higher than the Coral Donor Sites, albeit still low. The shallow zone share similar substratum type to Site 13; and original colonies of *Oulastrea crispata* were present, which were suitable to serve as Reference Coral Colonies for the Translocated Colonies. At the deeper zone, the boulder shore also share similar substratum and same species of sea whip as Site 27. Although located at the greater depth when compared with Site 27, the physical condition and the

existence of the same species of gorgonian sea whip suggested the suitability of the area for the placement of the translocated sea whip.

Table 3.4 REA Survey - Ecological and Substrate Attributes, and Taxonomic Inventories at the Recipient Site

	Working Site		
Substrate attributes (0 – 6)	**R1**	**R2**	**R3**
Bedrock	2	5	1
Boulder (diameter >50cm)	2	3	5
Cobble (diameter<50cm)	5	1	0
Rubble (dead corals)	0	0	0
Sand with gravel	2	1	2
Silt & Mud	0	0	0
Ecological attributes (0 – 6)	**R1**	**R2**	**R3**
Hard corals	2	2	0
Dead coral skeleton	0	0	0
Soft corals (Gorgonian Octocoral)	0	0	2
Sea anemones	0	0	0
Macroalgae	2	2	0
Encrusting algae	3	1	0
Coralline algae	2	1	0
Other benthos			
Sponges	1	2	1
Bryozoans	1	2	1
Tunicates	1	1	1
Hydroids	1	1	0
Rock Oysters	0	0	0
Mussels	1	1	1
Barnacles	2	2	0
Tube worms	0	1	0
Sea Urchins	3	3	1
Taxonomic inventories (0 – 5)			
Hard Coral	**R1**	**R2**	**R3**
Goniopora stutchburyi	1	2	0
Oulastrea crispata	2	1	0
Plesiastrea versipora	1	2	0
Psammocora superficialis	0	1	0
Turbinaria peltata	0	1	0
Soft Coral (Gorgonian Octocoral)	**R1**	**R2**	**R3**
Echinomuricea sp.	0	0	2
No. Hard Coral Species	3	5	0
No. Soft Coral Species	0	0	1

3.2 Tagging of Reference Coral Colonies at the Recipient Site

3.2.1 In the Recipient Site, 10 colonies of hard coral *Oulastrea crispata* (R01 to R10) and 5 colonies of gorgonian sea whip *Echinomuricea* sp. (R11 to R15) were tagged as the Reference Colonies for monitoring of the coral transplantation. Status of the reference coral colonies in terms of sedimentation, bleaching and partial mortality is presented in Table 3.5.

Table 3.5 Physical Conditions and Health Status of the Reference Coral Colonies in the Recipient Site.

Site 13		**Pre-Translocation Tagging (7 Feb 2010)**					**Baseline data – Translocation Date (20 Feb 2010)**		
Code	**Species**	**Depth (m)**	**Size (cm^2)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**
R01	*O. crispata*	2.8	25	3	0	0	2	0	0
R02	*O. crispata*	2.8	20	0	0	0	1	0	0
R03	*O. crispata*	3.3	10	0	0	0	2	0	0
R04	*O. crispata*	3.3	60	0	0	0	1	0	0
R05	*O. crispata*	3.3	10	0	0	0	0	0	0
R06	*O. crispata*	3.3	15	0	0	0	1	0	0
R07	*O. crispata*	3.3	50	0	0	0	2	0	0
R08	*O. crispata*	3.1	70	0	0	0	0	0	0
R09	*O. crispata*	2.9	20	0	0	0	0	0	0
R10	*O. crispata*	2.9	15	1	0	0	2	0	0
Code	**Species**	**Depth (m)**	**Height (cm)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**	**Sed. (%)**	**Ble. (%)**	**Mort. (%)**
R11	*Echinomuricea* sp.	8.4	25	0	0	0	0	0	0
R12	*Echinomuricea* sp.	8.5	25	0	0	0	0	0	0
R13	*Echinomuricea* sp.	8.5	15	0	0	0	0	0	0
R14	*Echinomuricea* sp.	8.4	25	0	0	0	0	0	0
R15	*Echinomuricea* sp.	8.5	20	0	0	0	0	0	0

Sed. = Percentage Sedimentation; Ble. = Percentage Bleaching; Mort. = Percentage Partial Mortality; Asso. Subs. = Associated Substratum.

3.3 Coral Translocation

3.3.1 Coral translocation was conducted on 20 February 2010. Twenty colonies from Site 13 and 1 colony from Site 27 were moved to the Recipient Site (Appendix III).

3.3.2 Over the course of translocation, all colonies were kept immersed underwater. Temperature and dissolved oxygen were recorded and maintained at stable level during the moving exercise (Appendix IV). The translocated colonies at the Recipient Site were descended and placed on cobble bottom, secured by additional rocks, and tagged with numbered stone. Health status of the Translocated Colonies (T01 to T21) and the 15 Reference Colonies (R01 to R15) were recorded as the Baseline data for the subsequent Monitoring Survey (Table 3.2 & 3.5). Approximate locations of the translocated and reference coral colonies are shown in Figure 3.1a-c. Pictures of each Translocated and Reference Coral Colony are presented in Appendix V.

3.3.3 All the Translocated Colonies showed no apparent change in sedimentation, bleaching and partial mortality when compared with the pre-translocation phase.

4 DISCUSSION

4.1.1 The translocation exercise of coral colonies from Site 13 (20 hard coral colonies) and Site 27 (1 gorgonian sea whip) to Recipient Site (Junk Bay) involved 5 major processes and associated surveys,

1. Pre-translocation Survey at the two Donor Site to identify the status of the colonies to be translocated,
2. Recipient Site survey to identify appropriate site for placement of the translocated colonies,
3. Identification and tagging of reference coral colonies originated in the Recipient Site
4. Moving of the coral colonies to the Recipient Site
5. Post-translocation monitoring of the Translocated and Reference Coral Colonies to evaluate the effectiveness of translocation

4.1.2 This report describes the results for the first 4 processes, in which translocation of colonies has been successfully conducted from Site 13 and 27 to the Recipient Site. The translocated colonies showed a generally normal status immediately after the moving exercise, as indicated by the little change in level of sedimentation, bleaching and mortality.

4.1.3 In order to evaluate the effectiveness of the translocation, regular post-translocation monitoring should be conducted to assess the status of the translocated colonies, using the original coral colonies in the Recipient Site as reference.

4.1.4 As required under the EM&A Manual for the Project, monitoring should be performed at the 3rd, 6th, 9th and 12th month after the translocations. Any change in health status in both translocated and reference coral colonies should be monitored and compared.

5 REFERENCES

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APPENDIX

Appendix I Photo Record of Coral Colonies to be Translocated at Site 13 and Site 27

Site 13: T01 (HC01) & T02 (HC02)

Site 13: T03 (HC03)

Site 13: T04 (HC04)

Site 13: T05 (HC05)

Site 13: T06 (HC06)

Site 13: T07 (HC07

Site 13: T08 (HC08)

Site 13: T09 (HC09)

Site 13: T10 (HC10)

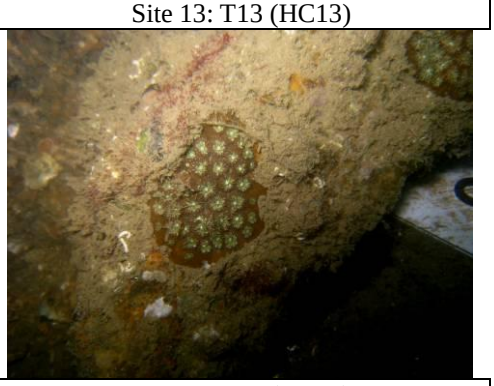
Site 13: T11 (HC11)

Appendix I (con't) Photo Record of Coral Colonies to be Translocated at Site 13 and Site 27

Site 13: T12 (HC12)

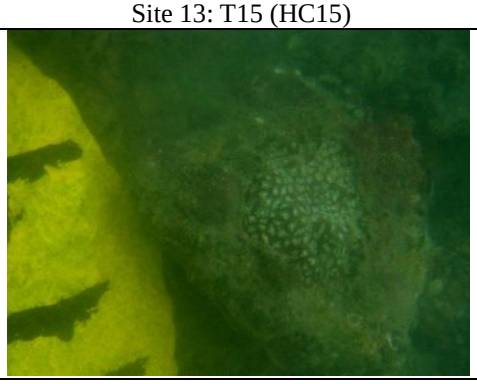
Site 13: T13 (HC13)

Site 13: T14 (HC14)



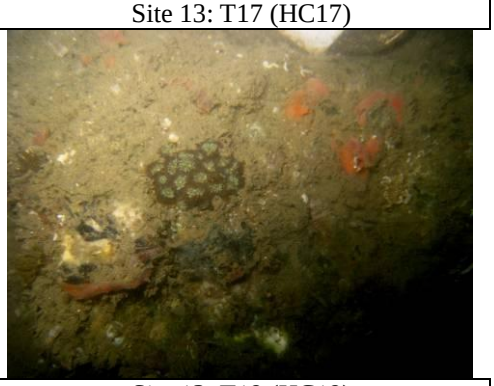
Site 13: T15 (HC15)

Site 13: T16 (HC16)



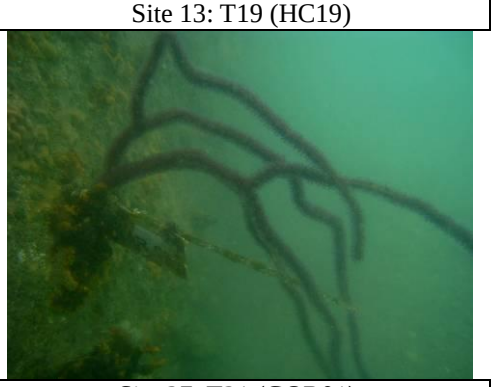
Site 13: T17 (HC17)

Site 13: T18 (HC18)



Site 13: T19 (HC19)

Site 13: T20 (HC20)



Site 27: T21 (GOR01):

Appendix II Recipient Site Survey – Representative Physical and Ecological Characters

Boulder encrusted with oyster & barnacle

Sea urchin *Diadema satosum*

Sea cucumber *Holothuria* sp.

Bryozoan

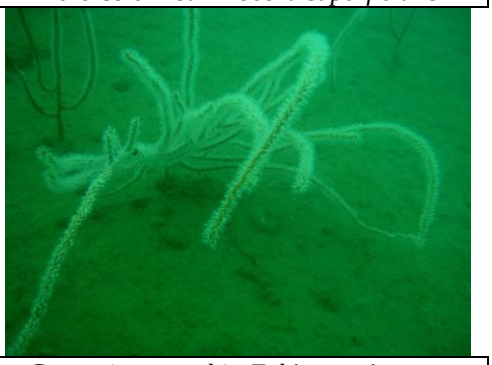
Hard coral *Plesiastrea versipora*

Hard coral *Turbinaria peltata*

Hard coral *Goniopora stutchburyi*

Hard coral *Psammocora superficialis*

Gorgonian sea whip *Echinomuricea* sp.



Gorgonian sea whip *Echinomuricea* sp.

Appendix III Photo Record of Coral Translocation Exercise

Survey vessel

Holding tanks on transportation vessel

Hodling tanks with Translocated colonies

DO meter

Placement of colonies at Recipient Site

Tagging and monitoring at Recipient Site

Appendix IV Temperature and Dissolved Oxygen recorded at Site 13, Site 27, Recipient Site and Holding tanks for the Translocated Corals during the Translocation Exercise.

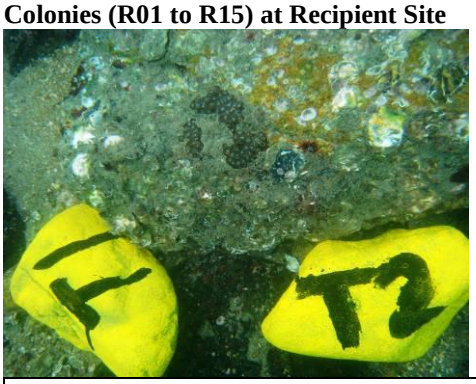
Site 13					
Reading	**1**	**2**	**3**	**4**	**5**
Temp (°C)	16.3	16.5	16.5	16.5	16.5
DO (ppm)	6.7	6.82	7.03	7.14	6.79

Site 27					
Reading	**1**	**2**	**3**	**4**	**5**
Temp (°C)	16.4	16.4	16.3	16.4	16.5
DO (ppm)	8.64	9.06	9.20	8.39	8.41

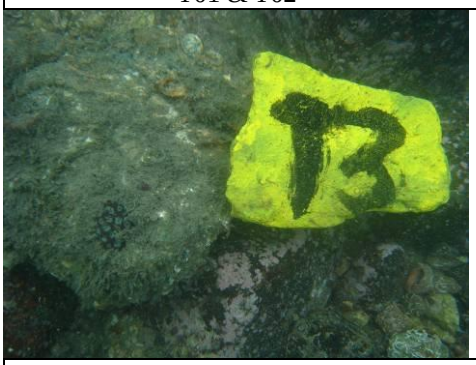
Recipient Site					
Reading	**1**	**2**	**3**	**4**	**5**
Temp (°C)	16.6	16.5	16.5	16.5	16.5
DO (ppm)	9.74	9.28	9.26	9.28	9.53

Holding Tank	**1**		**2**		**3**		**4**		**5**		**6**		**7**		**8**	
Colony	T01 T02		T10 T11 T13		T03 T04		T05 T14		T06 T12 T18 T19		T7 T8 T17 T20		T09 T15 T16		T21	
Time	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)	Temp (°C)	DO (ppm)
1050	16.4	7.1														
1100	16.4	7.61	16.4	7.33	16.3	7.33										
1110	16.4	8.08	16.4	7.81	16.2	8.01	16.2	8.02	16.4	7.45						
1120	16.4	8.64	16.3	9.02	16.3	9.10	16.3	8.61	16.4	8.16	16.4	7.94	16.5	8.0		
1130	16.3	8.87	16.4	9.15	16.4	9.37	16.4	9.20	16.4	9.04	16.5	7.62	16.4	8.91		
1140	16.2	9.20	16.2	9.52	16.1	8.87	16.4	9.36	16.4	9.70	16.5	7.89	16.2	9.43		
1150	16.1	9.50	16.0	9.51	16.2	9.20	16.3	9.78	16.3	9.80	16.4	8.30	16.1	9.56		
1200	16.1	9.63	15.9	9.50	16.1	9.41	16.2	9.86	16.2	9.79	16.3	8.50	16.1	9.61		
1210	16.1	9.72	16.1	9.63	16.2	9.63	16.1	9.94	16.2	9.86	16.3	8.72	16.2	9.70	16.1	8.90
1220	16.2	9.80	16.1	9.72	16.1	9.72	16.2	9.97	16.3	9.96	16.2	8.84	16.3	9.74	16.2	8.99
1230	16.2	9.75	16.0	9.85	16.2	9.80	16.1	10.03	16.2	9.99	16.3	9.04	16.5	9.83	16.2	9.16
1240	16.3	9.89	16.0	9.70	16.1	9.75	16.2	9.99	16.2	9.88	16.3	9.13	16.4	9.72	16.2	9.46
1250	16.3	9.62	16.1	9.89	16.1	9.75	16.1	9.99	16.2	9.81	16.5	9.17	16.4	9.78	16.2	9.55
1300	16.3	9.70	16.1	9.71	16.1	9.65	16.2	9.83	16.3	9.91	16.5	9.44	16.5	9.75	16.2	9.59
1310	16.2	9.75	16.2	9.70	16.2	9.70	16.3	9.88	16.4	9.92	16.3	9.51	16.4	9.89	16.1	9.66
1320			16.2	9.66	16.2	9.69	16.1	9.81	16.3	9.93	16.3	9.46	16.4	9.62	16.1	9.56
1330							16.2	9.80	16.2	9.93	16.3	9.44	16.3	9.70	16.1	9.65
1340											16.2	9.48	16.2	9.75	16.2	9.71
1350															16.2	9.75

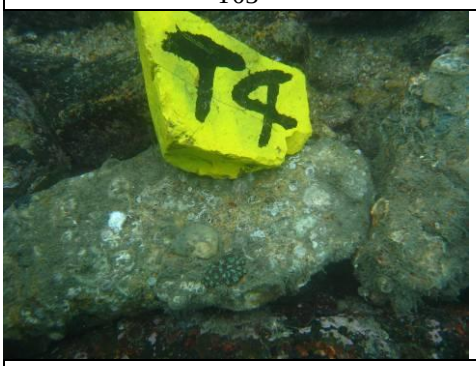
Appendix V Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site

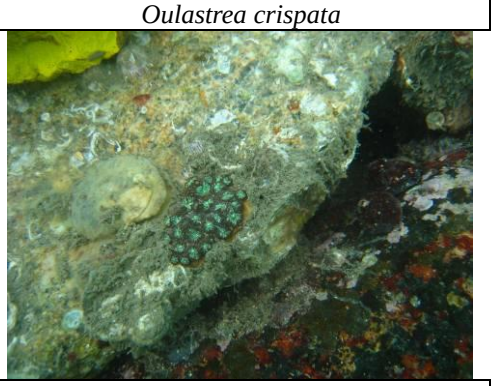


T01 & T02	*Oulastrea crispata*



T03	*Oulastrea crispata*



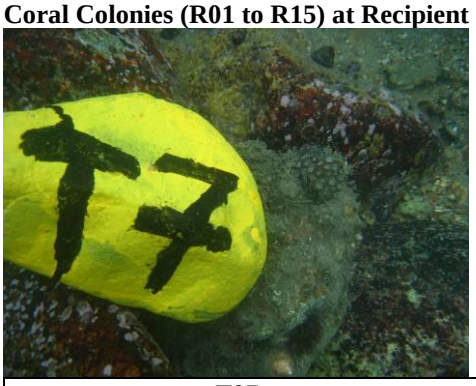


T04	*Oulastrea crispata*

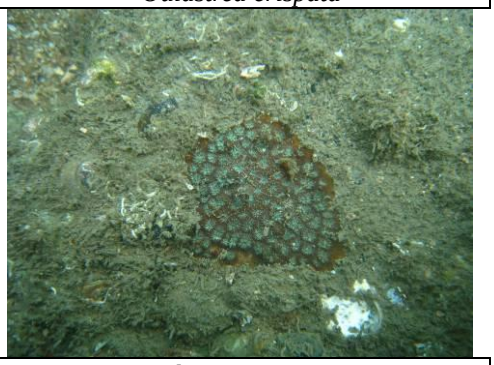
T05	*Oulastrea crispata*

T06	*Oulastrea crispata*

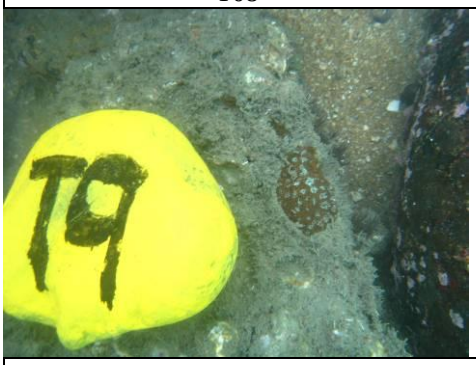
Appendix V (con't) Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site

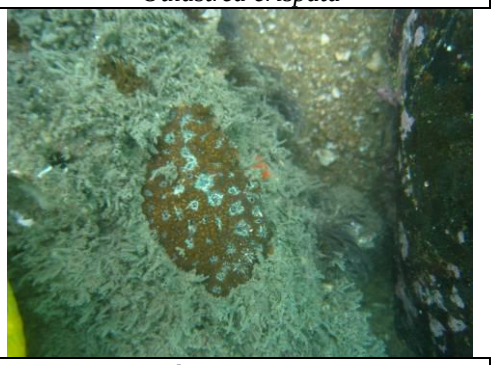


T07	*Oulastrea crispata*

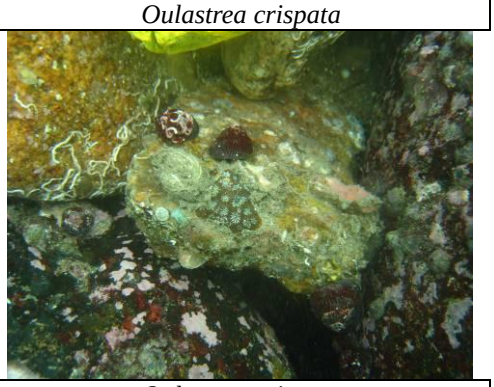


T08	*Oulastrea crispata*





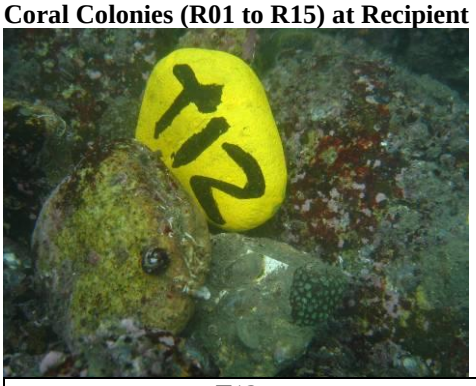
T09	*Oulastrea crispata*



T10	*Oulastrea crispata*

T11	*Oulastrea crispata*

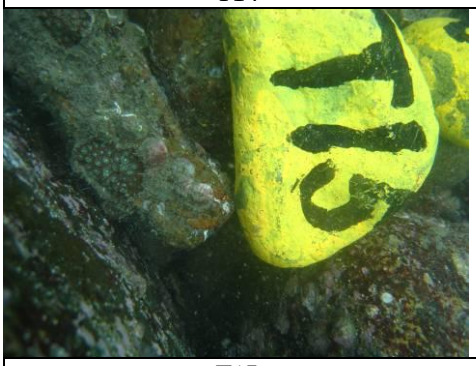
Appendix V (con't) Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site

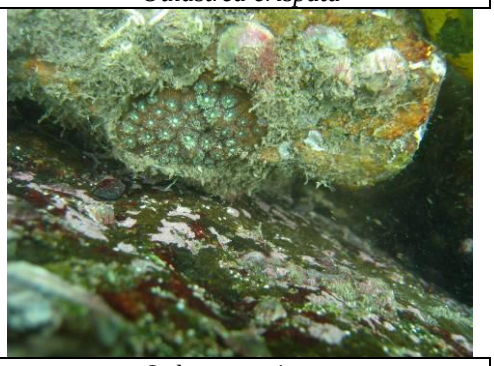


T12	*Oulastrea crispata*

T13	*Oulastrea crispata*

T14	*Oulastrea crispata*

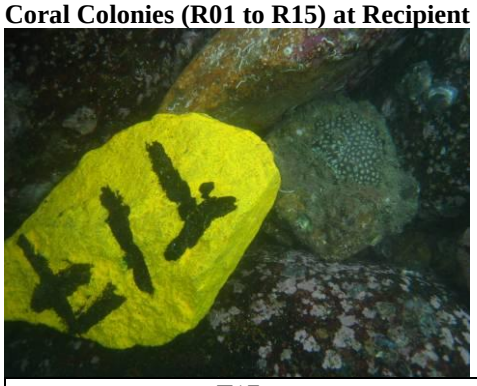




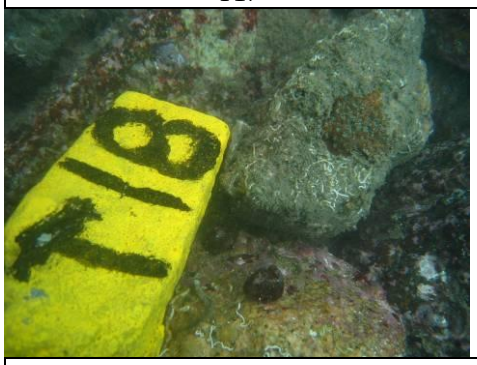
T15	*Oulastrea crispata*

T16	*Oulastrea crispata*

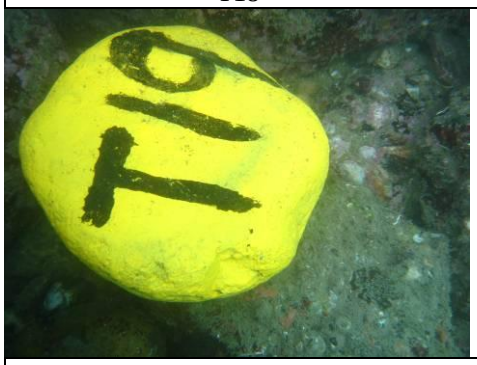
Appendix V (con't) Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site

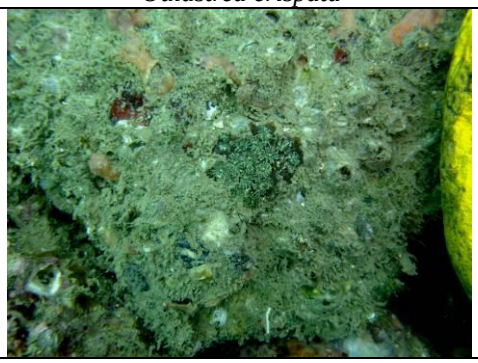


T17 *Oulastrea crispata*

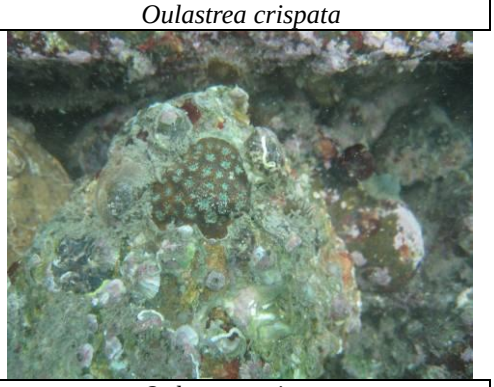


T18 *Oulastrea crispata*





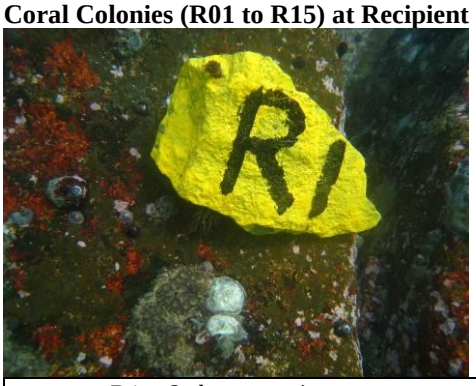
T19 *Oulastrea crispata*



T20 *Oulastrea crispata*

T21 *Echinomuricea* sp.

Appendix V (con't) Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site



R1 - *Oulastrea crispata*

R2 - *Oulastrea crispata*

R3 - *Oulastrea crispata*

R4 - *Oulastrea crispata*

R5 - *Oulastrea crispata*

R6 - *Oulastrea crispata*

R7 - *Oulastrea crispata*

R8 - *Oulastrea crispata*

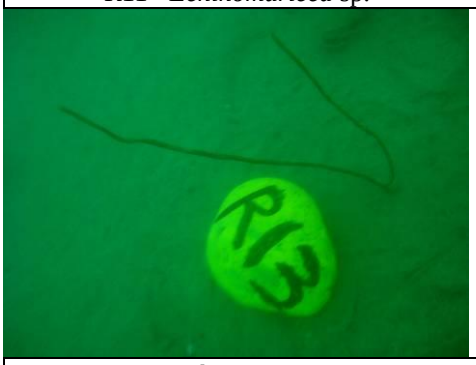
R9 - *Oulastrea crispata*

R10 - *Oulastrea crispata*

Appendix V (con't) Photo Record of Translocated (T01 to T21) and Reference Coral Colonies (R01 to R15) at Recipient Site

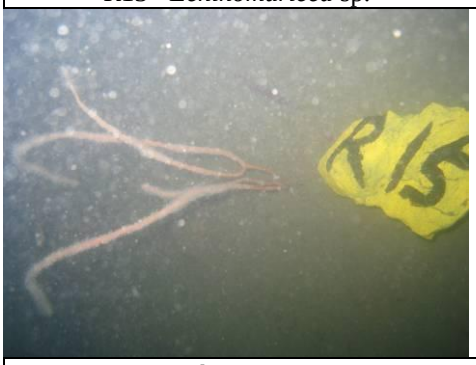
R11 - *Echinomuricea* sp.

R12 - *Echinomuricea* sp.



R13 - *Echinomuricea* sp.

R14 - *Echinomuricea* sp.



R15 - *Echinomuricea* sp.