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Site Formation for Kai Tak Cruise Terminal Development - Design and Construction

First Post-Translocation Coral Monitoring Report

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LIST OF ABBREVIATIONS

AFCD	Agriculture, Fisheries and Conservation Department
ArchSD	Architectural Services Department
CEDD	Civil Engineering and Development Department
DEP	Director of Environmental Protection
EIA	Environmental Impact Assessment
EM&A	Environmental Monitoring and Audit
EP	Environmental Permit

1 INTRODUCTION

1.1 General

The main purpose of this Report is to document the field activities, results and findings of the First Post-translocation Coral Monitoring Survey conducted on 18 and 25 September, 2009. The health, condition and the size of translocated plus reference *Oulastrea crispata* colonies located within and adjacent to the coral recipient site at Tseung Kwan O were individually assessed. The findings of the first post-translocation monitoring survey are presented with comparison of the baseline post-translocation results. This first post-translocation coral monitoring was completed successfully in accordance with the Final Detailed Coral Translocation Plan [1] and the detailed mitigation measures documented in the approved EIA Report, Environmental Monitoring and Audit (EM&A) Manual (EIA 138/2007) and Environmental Permit and variation (EP-328/2009 and VEP-289/2009).

1.2 Description of the Project

1.2.1 Civil Engineering and Development Department (CEDD) have commissioned Scott Wilson Ltd under Agreement No. CE 56/2008(CE) to undertake design and construction supervision for the site formation works for Kai Tak Cruise Terminal Development at the former Kai Tak Airport in the southeastern region of Kowloon Peninsula (the Project). After closure in 1998, the disused airport site has been occupied by various temporary uses, including a golf driving range and has been subjected to a number of proposals to redevelop the site with change usage.

1.2.2 The Project comprises the following key components.

(a) Site Formation Works

- demolition of the existing seawall;
- construction of Edge Structures and Transition Edge Structures;
- formation and construction of an Apron Area, including the provision of trough & pit systems for installation of Apron Facilities by others;
- formation of the Designated Areas including provision of piled quay deck structures and upgrading of existing seawalls;
- installation of fender and mooring facilities, navigation aids and apron drainage; and,
- dredging of seabed and fairways.

(b) Environmental monitoring and implementation of mitigation measures in association with the above.

1.2.3 In the original Project Brief, Temporary Infrastructure will be required to facilitate the operation of the Phase I Berth in mid 2013. However, based on the current programme and development, Architectural Services Department (ArchSD) will bring forward the construction programme for the Cruise Terminal Building such that the required facilities for

(1) Scott Wilson Ltd and ERM (2009). Detailed Coral Translocation Plan for Site Formation for Kai Tak Cruise Development - Design and Construction.

the operation of the Phase I Berth will be provided by the newly constructed Cruise Terminal Building. As a result of this, the provision of the Temporary Infrastructure will not be required and the design of the site formation works including the edge structures and seawalls will be carried out on this basis.

1.2.4 The development layout plans are presented in *Figure 1.1*.

1.2.5 A number of environmental studies have been carried out at the site as part of the masterplanning and Environmental Impact Assessments required under the Environmental Impact Assessment Ordinance (EIAO). These include:

- The Environmental Appraisal Report for the Cruise Terminal;
- EIA report (*EIA-139/2007*) for the decommissioning of the Former Kai Tak Airport Other than the North Apron – approved on 19 December 2007;
- EIA report (*EIA-138/2007*) for Dredging Works for the Proposed Cruise Terminal at Kai Tak – approved on 19 December 2007; and,
- EIA Report (*EIA-157/2008*) for the Kai Tak Development – approved without conditions on 4 March, 2009.

1.2.6 An Environmental Permit (EP) has been obtained by CEDD for Dredging Works for the Proposed Cruise Terminal (EP-328/2009), which links directly to the EM&A measures set out and agreed in the approved EIA-138/2007.

1.2.7 The marine ecological impacts associated with the Project identify the potential for direct loss of habitat and associated marine life due to the dredging activities and demolition of the existing seawall required for the formation of the new cruise terminal. With respect to the mitigation of potential impacts, a specific requirement of the approved EIA-138/2007 is the need to undertake coral translocation from the impacted area to an identified site in Tseung Kwan O. The requirements for coral translocation have also been set down in the Environmental Permit for Dredging Works and variation (EP-328/2009 and VEP-289/2009).

1.2.8 As required under Agreement No. CE 56/2008(CE) and Environmental Permit No. EP-328/2009, the coral translocation works comprises three phases of works:

i. Preparation of a detailed Coral Translocation Plan, including the results of a pre-translocation surveys for the Kai Tak (donor site) and proposed coral recipient site (Tseung Kwan O);

ii. Execution and documentation of the coral translocation exercise; and

iii. The implementation and documentation of a post-translocation coral monitoring programme over a period of 12 months.

1.3 Objectives for the First Post-translocation Coral Monitoring Survey

1.3.1 The objective of the First Post-translocation Coral Monitoring Survey was to document and assess the health and condition of the coral colonies moved from Kai Tak to Tseung Kwan O three months post-translocation. Data from this first post-translocation monitoring survey were collected for two purposes:

- To assess translocated coral condition three months after the translocation works; and,

- To collect a robust dataset to track the temporal status of the translocated and reference coral colonies (*Oulastrea crispata*) in terms of health dynamics and their relative growth rates. Reference to the baseline survey results (immediately following the coral move) will be made.

1.4 Structure of the Report

1.4.1 Following this introductory section (Section 1), the remainder of this First Post-translocation Coral Monitoring Report is structured as follows:

Section 2: Detailed description of the coral monitoring approach and methodology utilised for this specific survey.

Section 3: Presentation of the findings for the first post-translocation monitoring survey including the health status and size of the translocated and reference coral colonies assessed in September, 2009.

Section 4: A summary and discussion of the key results of the First Post-Translocation Coral Monitoring Survey and the schedule for the next survey assessment.

2 FIRST POST-TRANSLOCATION CORAL MONITORING METHODOLOGY

2.1 General

2.1.1 The main objective of the post-translocation coral monitoring programme was to track the health and condition of the translocated corals at the Tseung Kwan O recipient site once every three months over a period of one year [(1)]. The first coral monitoring survey was carried out on 18 and 25 September 2009 following a baseline assessment conducted on 19th June 2009, immediately following the translocation works.

2.1.2 The corals removed from the seawall of the Former Kai Tak Runway and transferred to Tseung Kwan O were placed within the established recipient site located as shown in *Figure 2.1*. A total of 72 boulders containing 157 colonies of *Oulastrea crispata* were placed inside a pre-established underwater rope grid (1 m^2 grid cells) secured with metal bars on two sides. The condition of each translocated coral was assessed during the baseline coral translocation survey and the majority of *O. crispata* colonies were in good condition exhibiting no stress or damage that was attributed to the translocation works. The occurrence and percentage cover of partial mortality per coral colony was generally low for both the translocated and reference *O. crispata* colonies.

2.1.3 The condition and health status of each translocated and reference corals were re-assessed three months later. Representative photographs were taken of each coral colony and used to estimate the size of individual coral colonies for the post-translocation assessment and monitoring. Full details of the field methodology are detailed in the following sub-sections.

2.2 Monitoring of Coral Health Status

2.2.1 All coral colonies for each recovered boulder were assessed visually and notes were recorded on the standard parameters measured. The following standard coral health parameters were recorded *in-situ* for each translocated coral colony (as detailed in the EM&A (EIA-138/2007) and the Final Detailed Coral Translocation Plan):

- The number and size of all hard coral colonies for each translocated boulder/rock.
- The existing surface area (percentage cover) of each coral colony that exhibited partial mortality.
- The existing coral surface area bleached of which two categories were recorded: a. Blanched (i.e. pale) and b. bleached (i.e. whitened) and recorded as a percentage cover estimate of the total coral colony area.
- Each coral colony was also assessed for sediment cover including the percentage cover of the colony affected and the colouration, texture and approximate thickness of sediment on the coral colony and adjacent substrate. Any contiguous patches of sediment cover >10 % were recorded.

2.3 Monitoring of Growth and Change in Cover of *Oulastrea crispata*

2.3.1 The coral monitoring survey programme established the additional collection of data allowing the growth and change in coral cover of individual *Oulastrea crispata* colonies to

(1) Scott Wilson 2009. Final Detailed Coral Translocation Plan. Prepared by ERM for CE 56/2008 (CE) Site Formation for Kai Tak Cruise Terminal Development - Design and Construction.

be tracked over the 12 month period of post-translocation monitoring. Photographs at a standardised height from each coral colony were taken at the time of the baseline coral translocation survey. During this first post-translocation survey, however, underwater visibility was extremely poor (<20 cm) and it was not possible to take the photographs from the standardised height used for the baseline records (ie fixed height of 25 cm above the coral colony) (*Figure 2.2 G*). Instead, a series of close-up photographs of the individual coral colonies were recorded with a scale bar included in all photographs (*Figure 2.2 H*).

2.3.2 The coral images were then digitally analysed post-survey using Coral Point Count (CPCe) software (http://www.nova.edu/ocean/cpce/). The health parameter data collected in the field was verified with the examination of the individual photographs. In addition, the size (maximum diameter and area) of each coral colony was extracted from the coral images after scale calibration for each image had been carried out.

2.4 Reference Corals

2.4.1 To distinguish natural variation in the health status and the general condition of the *Oulastrea crispata* colonies,as opposed to stress possibly induced by the translocation works, a random suite of *O. crispata* colonies within and adjacent to the recipient site were also included in the monitoring programme. A total of 40 randomly selected *O. crispata* colonies referred to as 'reference corals' were monitored using the same methods as for the translocated colonies to assess their health status (ie partial mortality, bleaching and sediment cover) and photographs of each individual colony for verification of the conditions of the coral and size estimation.

2.4.2 Coral health data obtained for the reference colonies will be collected on each post-monitoring survey occasion and used to compare with the coral condition of the translocated coral colonies. It is expected that the general health condition of the translocated and reference *Oulastrea crispata* colonies will be similar.

3 RESULTS AND FINDINGS

3.1 Introduction

3.1.1 The First Post-translocation Coral Monitoring Survey was conducted on 18th and 25th September 2009, several days after typhoon Koppu (which affected Hong Kong on 14th and 15th September). The survey objective was to repeat the translocation monitoring (as conducted for the baseline) to assess the health and condition of the corals moved from Kai Tak in June, 2009.

3.1.2 A total of seven typhoons had affected Hong Kong in the period between the baseline and first post-translocation coral monitoring surveys (19th June and 18th September 2009). The majority, however, did not affect Hong Kong directly and resulted in a typhoon signal no.1 or 3, with the exception of Typhoons Molave and Goni (typhoon signal no. 8) on 23rd July and 4th August, respectively. The most recent Typhoon Koppu, however, resulted in a typhoon signal no. 8 and rough seas and heavy rains were experienced territory-wide over several days. The coral recipient site at Tseung Kwan O was directly exposed to storm surge due to the prevailing south-easterly winds in the early hours of 15th September and land runoff due to the heavy rainfall. (over 100 mm recorded on 15th September in many parts of Hong Kong)(1).

3.1.3 The revisit of the coral recipient site at Tseung Kwan O, in September 2009, revealed notable damage to the underwater grid (that had been established for the placement and relocation of the translocated corals). The two solid, metal holding frames at each end of the grid had been shattered and this had led to the detachment and entanglement of the grid rope lines and attached weights. The laminated markers for the grid cells were also damaged. The grid reference was basically destroyed. Representative photographs showing the damaged recipient site grid are presented in *Figures 2.2 A-B*.

3.1.4 With the loss of the grid reference the relocation of the translocated boulders/rocks with corals had to be conducted using a search and recovery method. Using GPS surface reference locations, depth references and compass bearings a team of two divers conducted a systematic underwater search pattern of an area that incorporated the original grid and vicinity. Each boulder with corals when recovered had to be re-orientated and re-positioned within the recipient site. The majority of the boulders had been moved and several overturned. Several coral colonies suffered tissue abrasion and were positioned on the underside of the boulder. Given the need to stabilise all the Kai Tak boulders/rocks and aid the relocation of these boulders for the subsequent post-translocation monitoring the majority were placed in small aggregations and care was taken to ensure these where within the recipient site area (*Figure 2.2 F*). The location of all 72 boulders/rocks with corals in the underwater grid is presented in *Figure 3.1* for immediately following the translocation (July 2009) and in September, 2009. The figure shows the exact position of the boulders/rocks at the time of the baseline assessment and the approximate position for the first post-monitoring survey assessment.

3.1.5 To address the permanent tagging of the Kai Tak boulders/rocks with corals the cable tie tagging system was replaced with new permanent tags consisting of a tough, orange plastic square (approximately 1 cm^2) with a unique number (engraved in black) for each boulder/rock. The highly visible plastic tags were permanently fixed to the boulder/rocks using an underwater glue (Mr Sticky©). Prior to gluing the tag the boulder/rock surface (for the tag area, only) was cleaned with a wire brush to remove turf algae and fouling organisms.

(1) http://www.weather.hk/informtc/koppu/report.htm# Accessed on 7th October 2009

All the tags were secured at a location on the boulder/rock away from the coral colonies so as not to interfere with their potential growth and/or additional recruitment. The tagging activity was conducted with minimal disturbance to the translocated corals. Representative photographs showing the gluing technique *in-situ* are presented in *Figures 2.1 C-E.*

3.1.6 On 18th September 2009, prevailing weather was sunny and hot with calm sea conditions. Underwater visibility was extremely low (less than 30 cm). A slight swell was experienced and the wind started picking up in the afternoon around low tide (low water 0.8 m at 1455 hrs)(1). With the start of the flood tide (late afternoon) a strong current developed and as a result all dive works were stopped at 1730 hours. Not all the Kai Tak boulders/rocks with corals were recovered on this survey day and so an extra day of survey assessment work was conducted on 25th September, 2009. On the second survey day the weather was sunny and fine. The sea conditions were slightly improved with little current and wave surge. Underwater visibility had improved slightly around 0.3-0.5 m but the low visibility on both days did pose challenges in locating boulders/rocks and recording clear coral images. Please note that the visibility prevented the recording of standardised coral photographs (as for the baseline) and all coral photographs were taken close-up with inclusion of a scale bar for size calibration of the coral colonies post-survey.

3.2 Coral Results

General

3.2.1 All 72 translocated boulders/ rocks were recovered and 157 translocated coral colonies (plus three newly discovered coral colonies on boulders with tag numbers 27, 42 and 48) individually assessed (*Table 1*). A total of 40 reference *Oulastrea crispata* colonies were randomly selected and assessed, 20 of which where located within the recipient site and 20 colonies along the area of the reference transect. All coral colonies were photographed (as described in *Section 2.3.*1) and are presented in *Annex A.*

Translocated Coral Health and Condition

3.2.2 The health and condition of the 160 coral colonies was assessed (live versus dead coral colonies) and detailed records made for the live coral colonies (on % partial mortality, bleaching and sediment cover). The results are presented in *Table 2* and revealed that 122 colonies (76 %) of the translocated *Oulastrea crispata* coral colonies were alive and 38 (24 %) had died. For the living corals, a third (~35 %, 43 colonies) were in good condition exhibiting no visual signs of damage or stress (for an example photograph of a healthy colony refer to *Figure 2.3 A*). The remaining 79 (65 %) *O. crispata* coral colonies exhibited varying levels of partial mortality (ranging from 5 to >50 %). Thirty-seven colonies were recorded with > 50 % partial mortality, 20 colonies showed <50 % partial mortality and a total of 22 colonies were affected by sediment (sediment cover ranged from 5-50 %, refer to *Table 4*). The majority of coral colonies (63.5 %) exhibited sediment cover of >15 %. Several incidences of biofouling of the exposed coral skeleton (corallines and turf algae, tube worms and barnacles) were observed for a number of the colonies which had suffered partial mortality. Example photographs of the dead coral surfaces overgrown by algae and fouling organisms are presented in *Figure 3.2* as follows: algae (turf and coralline algae) (*Figure 3.2 B*), barnacles (*Figure 3.2 C)* and tube worms (*Figure 3.2 D-F*). The majority of translocated boulders had been disturbed and this had resulted in coral damage such as tissue abrasion. Furthermore, elevated sediment deposition within the site was visible on all seabed substrate (bedrock, boulders and rocks, refer to the photographs presented in *Annex A*).

(1) http://www.weather.gov.hk/tide/eWAGtext2009.htm. Accessed on 16th September, 2009

Representative photographs of four of the translocated coral colonies recorded in July 2009 (immediately following the move) and then three months later (September, 2009) are presented in *Figure 3.3*.

3.2.3 The disturbance to the site and damage exhibited by the coral colonies suggested that the site suffered direct physical impacts of increased wave surge and run-off resulting from typhoon Koppu and possibly earlier disturbance at the time of typhoon Molave. It was concluded from the observations of the general site conditions, damage to the recipient grid and levels of total and partial mortality of the translocated coral colonies that increased wave surge and run-off (as a result of the associated heavy rainfall) resulted in the physical movement of the boulders. This in turn led to the damage of some coral colonies due to: 1. Crushing/abrasion resulting from some boulders/rocks being overturned and 2. The increased sediment deposition directly on the corals and on all substrate surfaces at the recipient site.

3.2.4 In summary, of the 160 coral colonies assessed on the boulders/rocks, moved from Kai Tak in June 2009, a total of 122 (76 %) corals were alive but 38 (24 %) had died. Of the living coral colonies 35 % did not exhibit any partial mortality, bleaching or sedimentation. Sixty-five percent of the living corals, however, exhibited some level of partial mortality or sedimentation, as described in *Section 3.2.2* and detailed in *Table 4*.

Reference Coral Health and Condition

3.2.5 The health and condition of a suite of randomly selected reference corals were assessed during the survey within the recipient site and along the adjacent reference transect. A total of 40 reference corals were examined. The majority of the reference corals were affected by sedimentation or exhibited partial mortality. Ninety percent of the coral colonies (*Oulastrea crispata*) assessed within the recipient site exhibited partial mortality or sedimentation and 60 % of the *O. crispata* colonies examined along the reference transect (adjacent to the recipient site) also showed levels of partial mortality or sedimentation. It was also noted that 40 % of the reference corals assessed exhibited a level of sediment cover. Sediment deposition of individual colonies ranged from 5 to 50 % and for 55 % of colonies the sedimentation cover was estimated to be 30 % or a higher portion of the coral colony (*Tables 3* and *5*). Representative photographs of the reference corals are presented in *Figure 3.4*. It is noted that the majority of reference *Oulastrea crispata* colonies were attached to bedrock and not individual boulders or rocks so damage from the movement boulders was not encountered by the reference corals.

General Observations on the Status of Hard Corals and the Environmental Conditions of the Recipient Site at Tseung Kwan O

3.2.6 The status of the translocated corals at the recipient site of Tseung Kwan O indicated that disturbance to the site had occurred as a result of Typhoon Koppu. In addition to the damage recorded for the translocated coral colonies a number of visual observations of coral damage to other species of hard corals recorded within the recipient site and adjacent area were made. The hard corals *Turbinaria peltata*, *Favites pentagona*, *Goniopora* sp. and *Psammocora* sp. showed signs of partial bleaching, ie, colonies with retracted polyps and pale colouration, partial mortality and areas of sediment (*Figure 3.5 A-F*). One colony of *Turbinaria peltata* (located within the recipient site) had become detached and had recently died as a result of the disturbance (the toppled dead skeleton is shown in *Figure 3.5* G). A further example of coral damage as a result of sediment deposition is show in *Figure 3.6*. A colony of *Turbinaria peltata* colony recorded within the recipient site was photographed in June (baseline assessment) and again in September, 2009 (three months later). The photograph recorded in September shows an increase in partial mortality and deposition of sediment on

the dead portion of the colony. Furthermore, the surrounding substrate is also covered in sediment.

3.2.7 Noticeable sediment deposition was observed on bedrock and boulder surfaces within the recipient site and adjacent area. *Figure 3.7* shows comparative photographs of the same area of hard substrate taken at the time of the baseline assessment in June and for the post-translocation assessment in September, 2009. Sediment deposition is apparent on the majority of hard substrate surfaces at the time of the September survey. Furthermore, visual observations and the recorded photographs (*Figure 3.7*) showed elevated sedimentation was most notable for the recipient site areas deeper than ~5 m.

Number and Size of Oulastrea crispata *Colonies*

3.2.8 The estimated size of individual translocated coral colonies are presented in *Table 4*. The mean diameter of *Oulastrea crispata* ranged in size from 0.6 to 12.7 cm and the estimated total area of individual coral colonies ranged from 0.3 to 65.2 cm^2, a size spectrum representing possible recruits to adult colonies. The average size (area estimate) of the translocated coral colonies was 7.0 cm^2. The size of individual colonies will be recorded in all future monitoring surveys to track growth rates and changes in live coral cover of the *O. crispata* colonies.

3.2.9 The size of the reference *Oulastrea crispata* coral colonies are presented in *Table 5*. The average size of the reference colonies within the recipient site and along the reference transect ranged from 0.9 to 5.0 cm in diameter with average size (estimated area) of 3.5 cm^2 (ranging from 0.8 to 14.1 cm^2).

4 SUMMARY AND DISCUSSION

4.1.1 All 72 translocated boulders/rocks were relocated and all 157 translocated *Oulastrea crispata* colonies plus three newly discovered coral colonies were individually assessed during the First Post-translocation Coral Monitoring Survey conducted over two days (18th and 25th September, 2009). One hundred and twenty-two coral colonies were recorded alive but 38 of the 160 translocated *O. crispata* coral colonies exhibited total mortality. The majority of live *O. crispata* colonies were shown to have partial mortality or sedimentation but 35 % of the live corals were in good condition. The majority of living colonies did exhibit partial mortality which ranged from 5 to >50 % or sedimentation (generally 15 % or greater). Some portions of dead coral skeletons were observed to be overgrown with turf and coralline algae and biofouling organisms such as tube worms and barnacles.

4.1.2 A total of 40 reference corals were assessed and the health and condition of reference corals located within the recipient site and along the reference transect showed a similar trend in recorded partial mortality and sediment cover. No total mortality was recorded which is most likely due to the majority of reference colonies attached to bedrock and not boulders or rocks that were moved around during times of high wave surge. The majority of reference *O. crispata* (> 70 %) was recorded with partial mortality or sediment covering a portion the coral colony (generally 30 % or greater).

4.1.3 The general environmental conditions of the recipient site showed physical disturbance of the natural substrate, the established underwater grid and the boulders/rocks with corals moved from Kai Tak. Furthermore, elevated sediment deposition on hard surface substrates was apparent and most noticeable at depths below ~5 m. A number of hard coral species recorded within the recipient site also showed signs of damage from physical disturbance (toppling) and sedimentation. The observed disturbance to the site and the damage to corals (both those translocated and reference corals) was attributed to Typhoon Koppu. This Typhoon affected the territory on the night of the 14th and early morning hours of 15th September, 2009. At 12.35 on 15th September a No. 8 Southeast Gale or Storm Signal was hoisted and gale force winds persisted until dawn. The maximum wind gust recorded for Tseung Kwan O was 92 km/hour (NNE direction at 2025 hours on 14th September). Heavy squally showers affected Hong Kong on the 15th September with more than 100 mm of rainfall recorded (1). The recipient site experienced high wave surge and run-off which resulted in the physical disturbance and sedimentation which affected the majority of corals within the area.

4.1.4 The suitability of the recipient site was considered acceptable based on the consideration and acceptability of the site meeting key criteria (as per international best practice and as listed in the Detailed Coral Translocation Plan, Section 4.1.2) and the dive survey investigation of the site as part of the pre-translocation phase of works. Recipient Site selection was a key element in the planning process and while it is not recommended to designate a site without a site investigation it was found that with only slight modifications to the boundaries that the recipient site was suitable based on:

- Records of the natural occurrence of *Oulastrea crispata* colonies in proximity to the designated recipient site.
- Suitable bathymetry and water depth of the site (after modification).
- Suitable substrate type and general environmental conditions.

(1) http://www.weather.gov.hk/tide/eWAGtext2009.htm. Accessed on 16th September, 2009

- The sheltered conditions of the site as indicated by the naturally occurring coral community. These were general observations and not based on the vulnerability to prevailing winds during a typhoon.

4.1.5 It is noted that the slight modification of the recipient site location recommended by the pre-translocation survey (VEP-289/2009) was carried out to ensure that translocated corals were placed in the same location as the naturally occurring *Oulastrea crispata* colonies. It is surmised that if the corals had been placed within the original recipient site location where sediment deposition appeared higher that the survival of the translocated corals may have been much reduced. Further insights gained from the translocation monitoring to date include: 1. Future coral translocation programmes may need to consider permanent stabilisation of boulders/rocks and 2. The suitability of the recipient coral sites with reference to vulnerability to storm damage should also be considered.

4.1.6 The translocated corals were shown to have suffered damage due to physical disturbance and sedimentation as a result of Typhoon Koppu. No records were made of the coral condition immediately following Typhoon Molave and it is possible that the recipient site may have been impacted at that time though all evidence suggests that the recent typhoon had caused the major damage and disturbance. It was also noted that there was a proliferation of fouling organisms on the shallow seabed hard substrate (tube worms and barnacles) and their overgrowth on coral skeleton (partial mortality suffered by the translocation colonies) was observed. It is theorised that nutrient pulses into the nearshore environment associated with the typhoon rains may lead to periodic population increases of particular sessile invertebrates. The proliferation of fouling organisms may prevent the recovery of live coral cover over the exposed dead skeleton, however, the sediment deposition is more of a concern.

4.1.7 Scleractinian corals are susceptible to increased rates of sediment deposition as sediment will cover live tissue and polyps leading to partial and total mortality. Species sensitivities to sedimentation are largely determined by the particle trapping properties of the colony and ability of individual polyps to reject settled sediment particles [(1)]. Horizontal and plate-like colonies present large surfaces that intercept and gather sediment, eg, the *Turbinaria peltata* colony photographed within the recipient site. Hard corals are dependent on symbiotic photosynthesising zooxanthellae for their survival and are, therefore, highly sensitive to increases in suspended sediment and the corresponding reduction in light penetration. The tolerance limits of *Oulastrea crispata* to Total Suspended Solids and sediment deposition are not well documented but observations of the species abundance and its ubiquitous distribution within Hong Kong waters indicate a general resilience. Rainfall associated with typhoons does cause increased land run-off and elevated sediment deposition which can result in the partial and total mortality of *Oulastrea crispata* colonies, as recorded at the time of this post-translocation monitoring survey.

4.1.8 The baseline post-translocation coral assessment indicated 97 % success rate for the translocation of the Kai Tak corals immediately following their transfer to Tseung Kwan O. Three months later the post-translocation coral monitoring survey recorded a 76 % survival rate for the *Oulastrea crispata* colonies. A review of the coral transplantation literature indicated that success rates are typically 80-90 % immediately following the transplantation, however, longer term survival rates are often much reduced due to the impacts of storm damage (wave action and sedimentation) [(2)]. Results to date, showed that translocation was

(1) Hawker, D.W. and Connell, D.W. 1992. Standards and Criteria in Pollution Control in Coral Reef Areas. In Chapter 7 of Pollution of Tropical Aquatic Systems. Connell, D.W.and Hwaker, D.W. (ed.) CRC Press.

(2) Jokiel, P.L., Kolinski, S.P., Naughton, J. and J.E. Maragos 2006. Review of Coral Reef Restoration and Mitigation in Hawaii and the US-Affliated Pacific Island. In: Precht, W.F. (ed.), Coral Reef Restoration Handbook. CRC Press.

successful and the majority of the *Oulastrea crispata* colonies also survived the summer typhoons.

4.1.9 Further monitoring and site maintenance will be continued on a quarterly basis. Reference corals (of the same species) will be assessed for their status and condition at each of the remaining three post-translocation coral monitoring surveys. A minimum of 20 coral colonies within and adjacent to the recipient site will be assessed at the same time as the corals translocated from Kai Tak. An extension of the post-translocation coral monitoring may be a consideration if required to justify that the observations of coral mortality were due to the typhoon. Further monitoring would permit a better understanding of the rates of mortality for this coral, the impact of natural perturbations affecting this particular coral species and the rates of recovery.

4.1.10 The remnants of the grid reference will be removed as it could be a source of potential damage to the remaining corals. Given that the boulders/rocks with corals have been aggregated to aid relocation and as this provides a level of stabilisation it is suggested that the grid is not re-established.

4.1.11 The data collected from the first post-translocation coral monitoring will serve as the second of the temporal monitoring dataset collected during the 12 month post-translocation monitoring programme. The condition of the translocated corals will be further assessed in future surveys which will be conducted every three months (ie quarterly) and monitoring will take place in December, 2009 and March and June, 2010.

Tables

Table 1: Summary Table of the Number of *Oulastrea crispata* Colonies recorded on Translocated Boulders/ Rocks during the Pre-translocation Survey (Apr 09), Coral Translocation Works (Jun 09) and 1st Post-Translocation Survey (Sep 09).

Tag no.	No. of Coral(s) Recorded in Pre-Translocation Survey - Apr 09	No. of Coral(s) Recorded during Coral Translocation (Baseline Survey - Jun 09)	No. of Coral(s) Recorded during Coral Translocation (1st Monitoring - Sep 09)
1	2	1	1
2	1	1	1
3	1	3	3
4	1	1	1
5	1	2	2
6	1	2	2
7	1	1	1
8	2	2	2
9	2	2	2
10	1	1	1
11	1	5	5
12	1	1	1
13	1	1	1
14	2	3	3
15	3	3	3
16	1	1	1
17	3	3	3
18	1	1	1
19	1	1	1
20	1	1	1
21	1	1	1
22	2	2	2
23	2	4	4
24	2	3	3
25	2	2	2
26	2	2	2
27	1	4	5
28	1	1	1
29	1	1	1
30	1	3	3
31	3	5	5
32	2	1	1
33	1	1	1
34	1	1	1
35	1	1	1
36	2	2	2

Tag no.	No. of Coral(s) Recorded in Pre-Translocation Survey - Apr 09	No. of Coral(s) Recorded during Coral Translocation (Baseline Survey - Jun 09)	No. of Coral(s) Recorded during Coral Translocation (1st Monitoring - Sep 09)
37	2	2	2
38	1	3	3
39	1	1	1
40	3	3	3
41	2	2	2
42	2	2	3
43	2	2	2
44	2	2	2
45	4	4	4
46	2	2	2
47	1	1	1
48	3	3	4
49	1	1	1
50	1	1	1
51	1	1	1
52	2	5	5
53	1	2	2
54	4	7	7
55	1	1	1
56	2	2	2
57	1	1	1
58	1	2	2
59	2	2	2
60	1	1	1
61	2	2	2
62	2	2	2
63	2	3	3
64	2	2	2
65	1	1	1
66	4	5	5
67	5	5	5
68	1	1	1
69	2	2	2
70	3	3	3
23B	-	4	4
40B	-	4	4
Total	120	157	160

Table 2: A summary table of the overall health and condition of the translocated corals assessed in September, 2009 (three months after they were moved from Kai Tak).

Corals assessed (number of colonies)		Dead Coral	Live Coral	Live Coral (detailed condition assessment recorded as number of coral colonies)			
				Healthy Coral showing no sign of stress	Coral with partial mortality (< 50 % cover)	Coral with partial mortality (>= 50% cover)	Affected by sediment
Colony number	160	38	122	43	20	37	22
Percentage (%)	100	24	76	35	16	30	18

Table 3: A summary table of the overall health and condition of the reference corals assessed in September, 2009.

Corals assessed (number of colonies)		Healthy Coral showing no sign of stress	Coral with partial mortality (< 50 % cover)	Coral with partial mortality (>= 50% cover)	Affected by sediment
Inside Recipient Site	20	3	4	4	9
Percentage (%)	100	15	20	20	45
Reference Transect	20	8	2	3	7
Percentage (%)	100	40	20	15	35

Table 4: **Summary Table of the *Oulastrea crispata* Colony Details for each tagged Boulder/Rock for the Post-Translocation Works (Baseline Survey – Jun 09) and the First Post-Translocation Coral Monitoring Assessment (Sep 09).**

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
1	1	7.5	5.7	-	-	-	-	1.6	80	-	-	-	-
2	2	1	1.3	-	-	-	-	1.7	80	-	-	-	-
3	3	2.5	3.3	-	-	-	-	0	100	-	-	-	-
3	4	-	1.2	-	-	-	-	1.1	30	-	-	-	-
3	5	-	2.2	-	-	-	-	1.8	*	-	-	-	-
4	6	4	5.3	-	-	-	-	3.4	20	30	-	-	-
5	7	5.5	6.2	-	5	-	-	2.7	90	-	-	-	-
5	8	-	5.4	-	-	-	-	0	100	-	-	-	-
6	9	-	2.2	-	-	-	-	0	100	-	-	-	-
6	10	2.5	4.1	-	-	-	-	3.4	50	-	-	-	-
7	11	6.5	8.6	-	5	-	-	2.1	*	-	-	-	-
8	12	2.5	7.8	-	-	-	-	7.2	5	-	-	-	-
8	13	1.5	2.1	-	-	-	-	2.5	-	-	-	-	-
9	14	7	9.4	-	-	-	-	6	*	35	-	-	-
9	15	4.5	4.1	-	-	-	-	5.1	10	-	-	-	-
10	16	2.5	4.6	-	-	-	-	3.9	20	-	-	-	-
11	17	-	1.4	-	-	-	-	1.5	-	-	-	-	-
11	18	3	3	-	-	-	-	2	20	-	-	-	-
11	19	-	0.6	-	-	-	-	1.5	-	-	-	-	-
11	20	-	0.5	-	-	-	-	0.8	-	-	-	-	-
11	21	-	0.8	-	-	-	-	1.5	-	-	-	-	-

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
12	22	4	5.5	-	5	-	-	5.6	20	-	-	-	-
13	23	4.5	6.1	<5 (sediment removal)	-	-	-	2.4	90	-	-	-	-
14	24	3.5	4.8	-	-	-	-	3.3	*	-	-	-	-
14	25	-	5.5	-	-	-	-	4	5*	-	-	-	-
14	26	4	4.8	-	-	-	-	3.9	*	10	-	-	-
15	27	3.5	4.6	-	-	-	-	4.5	5	-	-	-	-
15	28	1.5	2.6	-	-	-	-	2	-	-	-	-	-
15	29	3	4.2	-	-	-	-	2.8	*	-	-	-	-
16	30	5	6.6	-	-	-	-	0	100	-	-	-	Overturned
17	31	4	5.8	5 (old)	-	-	-	2.6	50*	-	-	-	-
17	32	2	3.6	-	-	-	-	2.2	50	-	-	-	-
17	33	1	2.3	-	-	-	-	0	100	-	-	-	-
18	34	2.5	4.7	-	-	-	-	4	20	-	-	-	-
19	35	2.5	4.5	-	-	-	-	3.4	*	-	-	-	-
20	36	2	3.8	-	-	-	-	2.6	*	-	-	-	-
21	37	3	4.2	-	-	-	-	2.9	*	20	-	-	-
22	38	2	4.2	-	-	-	-	3.5	*	-	-	-	-
22	39	1	3.4	-	-	-	-	2.5	*	-	-	-	-
23	40	1.5	2.6	-	-	-	-	2.7	-	-	-	-	-
23	41	-	2.4	-	-	-	-	2.1	-	10	-	-	-
23	42	-	1.2	-	-	-	-	0.9	-	-	-	-	-
23	43	2.5	4	-	-	-	-	4.6	-	-	-	-	-
24	44	4.5	6.7	-	-	-	-	5.4	*	-	-	-	-
24	45	1.5	2.4	-	-	-	-	1.5	*	-	-	-	-

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
24	46	-	1.3	-	-	-	-	0	100	-	-	-	-
25	47	6	6.5	-	-	-	-	0	100	-	-	-	Overturned
25	48	2	3	-	-	-	-	0	100	-	-	-	Overturned
26	49	4	8.8	-	-	-	-	8.2	-	-	-	-	-
26	50	1.5	3.1	-	-	-	-	0	100	-	-	-	-
27	51	5.5	4.9	-	-	-	-	5.4	-	20	-	-	-
27	52	-	4.8	-	-	-	-	3.8	*	-	-	-	-
27	53	-	2.6	-	-	-	-	2.3	10	-	-	-	-
27	54	-	3.2	-	-	-	-	3.7	-	-	-	-	-
27	55	-	-			-	-	2.9	10	-	-	-	-
28	56	7	10.8	-	5	-	-	0	100	-	-	-	-
29	57	2.5	3.9	-	-	-	-	3	40	-	-	-	-
30	58	9.5	10.2	-	-	-	-	6.3	20*	-	-	-	-
30	59	-	0.7	-	-	-	-	0.7	10	-	-	-	-
30	60	-	0.9	-	-	-	-	1.3	5	-	-	-	-
31	61	6	7.8	-	-	-	-	5.5	40	-	-	-	-
31	62	5	7.2	-	-	-	-	5.2	70	-	-	-	-
31	63	3.5	5	-	-	-	-	2.7	90	-	-	-	-
31	64	-	1.5	-	-	-	-	1.3	-	-	-	-	-
31	65	-	1	-	-	-	-	1.3	-	-	-	-	-
32	66	2.5	2.1	-	-	-	-	2.3	-	-	-	-	-
33	67	3	5.2	-	-	-	-	1.2	90	-	-	-	-
34	68	5	6.6	-	5	-	-	4.8	20	20	-	-	-
35	69	3	5	-	-	-	-	2.7	60	-	-	-	-
36	70	2.5	2.9	-	-	-	-	0	100	-	-	-	Overturned

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
36	71	1	2.6	-	-	-	-	1.9	20	-	-	-	Overgrown by bivalves
37	72	1.5	0.6	-	-	-	-	0	100	-	-	-	-
37	73	3	4.6	-	-	-	-	2	90	-	-	-	-
38	74	2.5	3.4	-	-	-	-	1.5	*	-	-	-	-
38	75	-	0.9	-	-	-	-	1.4	-	-	-	-	-
38	76	-	0.7	-	-	-	-	1.2	-	-	-	-	-
39	77	3	5.3	-	-	-	-	2.1	*	-	-	-	-
40	78	1.5	4.2	-	-	-	-	4.9	30	40	-	-	-
40	79	4	4.7	-	-	-	-	3.7	-	10	-	-	-
40	80	1	1.7	-	-	-	-	0	100	-	-	-	-
41	81	4	5.9	5 (sediment removal)	-	-	-	2.7	55*	-	-	-	-
41	82	1.5	2.5	-	-	-	-	1.9	80	-	-	-	-
42	83	2.5	3.8	-	-	-	-	3.2	-	-	-	-	-
42	84	5.5	7.5	40 (old)	-	-	-	3	*	-	-	-	-
42	85	-	-	-	-	-	-	1.9	-	-	-	-	-
43	86	3	4.6	20 (old)	-	-	-	0	100	-	-	-	Overturned
43	87	2	2.9	-	-	-	-	0	100	-	-	-	Overturned
44	88	6	7.7	-	5%	-	-	7.8	-	-	-	-	-
44	89	7.5	7.8	-	-	-	-	0	100	-	-	-	-
45	90	2	3.2	-	-	-	-	0	100	-	-	-	-
45	91	1	2.3	-	-	-	-	2.3	5	-	-	-	-
45	92	3.5	5.5	-	-	-	-	3	*	-	-	-	-
45	93	3.5	4.4	-	-	-	-	4.5	-	-	-	-	-

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
46	94	5	6.6	30 (old)	-	-	-	4.5	60	-	-	-	-
46	95	3	4.7	-	-	-	-	0	100	-	-	-	-
47	96	10	13.4	-	-	-	-	8.2	55	10	-	-	-
48	97	4	6.1	-	3	-	-	3.1	*	10	-	-	-
48	98	1.5	2.5	-	-	-	-	2	-	-	-	-	-
48	99	2.5	3.6	-	-	-	-	3.7	-	20	-	-	-
48	100	-	-	-	-	-	-	3.1	-	-	-	-	-
49	101	4	6	-	-	-	-	4.3	20	5	-	-	-
50	102	4	4.3	20 (old)	-	-	-	2.8	-	10	-	-	-
51	103	3	4.1	-	-	-	-	2.3	10	-	-	-	-
52	104	13	13.4	-	5	-	-	12.7	10	-	-	-	-
52	105	3	4.7	-	-	-	-	0	100	-	-	-	-
52	106	-	1.7	-	-	-	-	0	100	-	-	-	-
52	107	-	2.9	-	-	-	-	0	100	-	-	-	-
52	108	-	4.4	-	-	-	-	3.7	40	10	-	-	-
53	109	6	8.7	-	3	-	-	6.2	40	30	-	-	-
53	110	-	1.8	-	-	-	-	0	100	-	-	-	-
54	111	4	5.9	10 (old)	-	-	-	4.5	70	-	-	-	Overturned
54	112	3	3.8	-	-	-	-	2.4	40	-	-	-	Overturned
54	113	1.5	0.9	-	-	-	-	0	100	-	-	-	Overturned
54	114	1.5	0.9	-	-	-	-	0	100	-	-	-	Overturned
54	115	-	0.6	-	-	-	-	0	100	-	-	-	Overturned
54	116	-	0.7	-	-	-	-	0	100	-	-	-	Overturned
54	117	-	0.6	-	-	-	-	0	100	-	-	-	Overturned
55	118	3.5	4.2	-	-	-	-	2.9	80	-	-	-	-
56	119	6.5	9.7	-	5%	-	-	2.1	90	-	-	-	-

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
56	120	6	8.3	-	-	-	-	0.8	-	20	-	-	-
57	121	3	3.5	5 (sediment removal)	-	-	-	3.7	-	-	-	-	-
58	122	12.5	13.6	-	-	-	-	9.1	35	15	-	-	-
58	123	-	0.7	-	-	-	-	1.1	-	-	-	-	-
59	124	5	6	-	-	-	-	5.2	5	10	-	-	-
59	125	3	4.7	-	-	-	-	2.8	*	10	-	-	-
60	126	2.5	3.9	-	-	-	-	2.8	*	15	-	-	-
61	127	5	6.9	5 (sediment removal)	-	-	-	5.2	*	-	-	-	-
61	128	3	4.5	-	-	-	-	1.3	*	-	-	-	-
62	129	7.5	9.6	-	5	-	-	2.2	*	-	-	-	-
62	130	5	5.8	-	-	-	-	0	100	-	-	-	-
63	131	6	8.1	5 (old)	-	-	-	6.1	60	-	-	-	-
63	132	-	0.6	-	-	-	-	0	100	-	-	-	-
63	133	2	3.5	-	-	-	-	2.4	10	-	-	-	-
64	134	3	4	-	-	-	-	3.1	80	-	-	-	-
64	135	2.5	1.6	-	-	-	-	0	-	-	-	-	-
65	136	6.5	9.2	-	5	-	-	3	90	-	-	-	-
66	137	4.5	8.3	5 (sediment removal)	-	-	-	0	100	-	-	-	Overturned
66	138	1.5	2	-	-	-	-	2.4	95	-	-	-	Overturned
66	139	1	1.8	-	-	-	-	0	100	-	-	-	Overturned
66	140	-	1.4	-	-	-	-	1.2	50	-	-	-	Overturned

Tag no.	Running Count Number of *Oulastrea* Colonies	Coral Diameter measured at Pre-Translocation (cm)	Coral Diameter measured at Post-Translocation (Baseline Survey - Jun 09) (cm)	Health Status				Coral Diameter measured at 1st Post-Translocation - Sep 09 (cm)	Health Status				
				Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)		Partial Mortality (% Affected)	Sediment Cover (% Affected)	Blanched (% Affected)	Bleached (% Affected)	Remarks
66	141	2	2.4	-	-	-	-	0	100	-	-	-	Overturned
67	142	3.5	5.3	-	3	-	-	4.6	20	30	-	-	-
67	143	1	2	-	-	-	-	0	100	-	-	-	-
67	144	1	0.9	-	-	-	-	0	100	-	-	-	-
67	145	3.5	2.9	-	-	-	-	1.9	40	-	-	-	-
67	146	4	6.1	-	-	-	-	3.6	80	-	-	-	-
68	147	8	11.7	-	-	-	-	8.6	90	-	-	-	-
69	148	2	3.3	-	-	-	-	1.9	60	-	-	-	-
69	149	3.5	4.9	-	-	-	-	3.6	30	10	-	-	-
70	150	4	6.1	-	-	-	-	5.2	20	-	-	-	-
70	151	2	2.9	-	-	-	-	2.6	10	-	-	-	-
70	152	3	4.1	-	-	-	-	3.2	*	-	-	-	-
23B	153	-	5.9	-	-	-	-	2.9	20	-	-	-	-
23B	154	-	1.6	-	-	-	-	1.3	30	-	-	-	-
23B	155	-	1.8	-	-	-	-	0	100	-	-	-	-
23B	156	-	9.4	-	-	-	-	5	70	-	-	-	-
40B	157	-	4.1	-	-	-	-	0	100	-	-	-	Overturned
40B	158	-	1.6	-	-	-	-	0	100	-	-	-	Overturned
40B	159	-	3.2	-	-	-	-	1.6	90	-	-	-	Overturned
40B	160	-	1.4	-	-	-	-	0	100	-	-	-	Overturned

Notes:

1) 100 % Partial Mortality = whole coral colony died (total mortality).

2) * denotes a possible underestimate of % Partial Mortality. Percentage partial mortality of the coral colony was possibly underestimated as a portion of the coral skeleton was covered in sediment and/or overgrown by fouling organisms..

3) The sizes a number of coral colonies (identified by their running count number: 2, 111 128 & 129) showed discrepancies with the baseline size data. The colony size estimates for these corals will be further investigated in the 2nd Post-Translocation Coral Monitoring in December 2009.

Table 5: Summary Table of the results of the Reference *Oulastrea crispata* Assessment in September, 2009

Running Count of *Oulastrea* Colonies	Coral Diameter (cm)	Coral Size (cm^2)	Health Status			
			Partial Mortality (% Affected)	Sediment (% affected)	Blanched (% Affected)	Bleached (% Affected)
Inside Recipient Site						
1	1.5	1.5	-	-	-	-
2	2.9	4.9	-	30	-	-
3	2	2.6	50	-	-	-
4	1.5	2	-	10	-	-
5	3.2	6	30	-	-	-
6	2.9	4.9	-	30	-	-
7	1.3	1.6	-	10	-	-
8	4.6	9.2	60	-	-	-
9	2	2.5	-	-	-	-
10	1.5	1.7	-	-	-	-
11	1.5	1.4	-	5	-	-
12	2.7	2.8	30	-	-	-
13	3.6	8.9	20	-	-	-
14	4.1	13.9	50	-	-	-
15	5	14.1	-	40	-	-
16	2.2	2.2	-	10	-	-
17	2.2	3.5	50	-	-	-
18	2.7	4.2	-	50	-	-
19	2.3	4.3	-	50	-	-
20	2.6	3.2	20	-	-	-
Along Reference Transect						
1	3.5	6.6	40	-	-	-
2	1.3	0.8	50	-	-	-

Running Count of *Oulastrea* Colonies	Coral Diameter (cm)	Coral Size (cm^2)	Health Status			
			Partial Mortality (% Affected)	Sediment (% affected)	Blanched (% Affected)	Bleached (% Affected)
3	1.5	1.1	-	40	-	-
4	2.7	4.8	-	5	-	-
5	3.51	3.9	55	-	-	-
6	1.5	1.6	-	-	-	-
7	2.1	1.9	-	40	-	-
8	1.2	1.1	10	-	-	-
9	1.9	1.8	-	-	-	-
10	1.7	1.7	-	-	-	-
11	2.1	3.3	-	10	-	-
12	2.2	3.1	-	20	-	-
13	0.9	0.8	-	20	-	-
14	2	2.4	-	-	-	-
15	1.2	0.8	-	-	-	-
16	1.5	1.5	50	-	-	-
17	1.7	1.8	-	-	-	-
18	1.7	1.8	-	-	-	-
19	1.3	1	-	-	-	-
20	1.6	1.6	-	30	-	-

Figures

Figure 1.1 Cruise Terminal Development Layout Plan

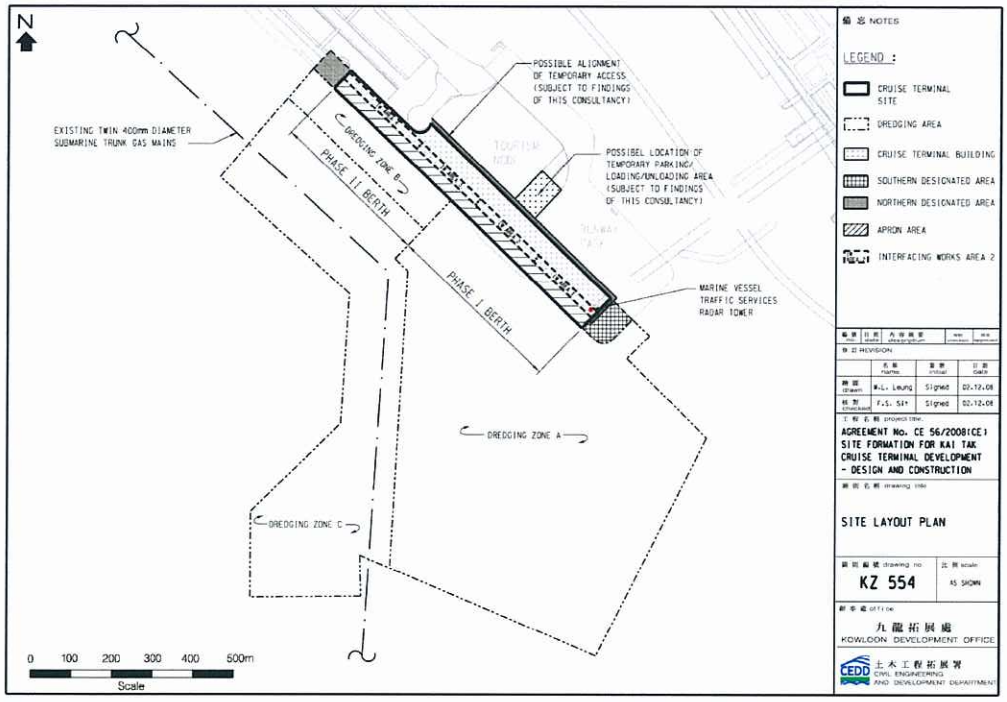


Figure 2.1 Location of the Approved Recipient Site at Tseung Kwan O

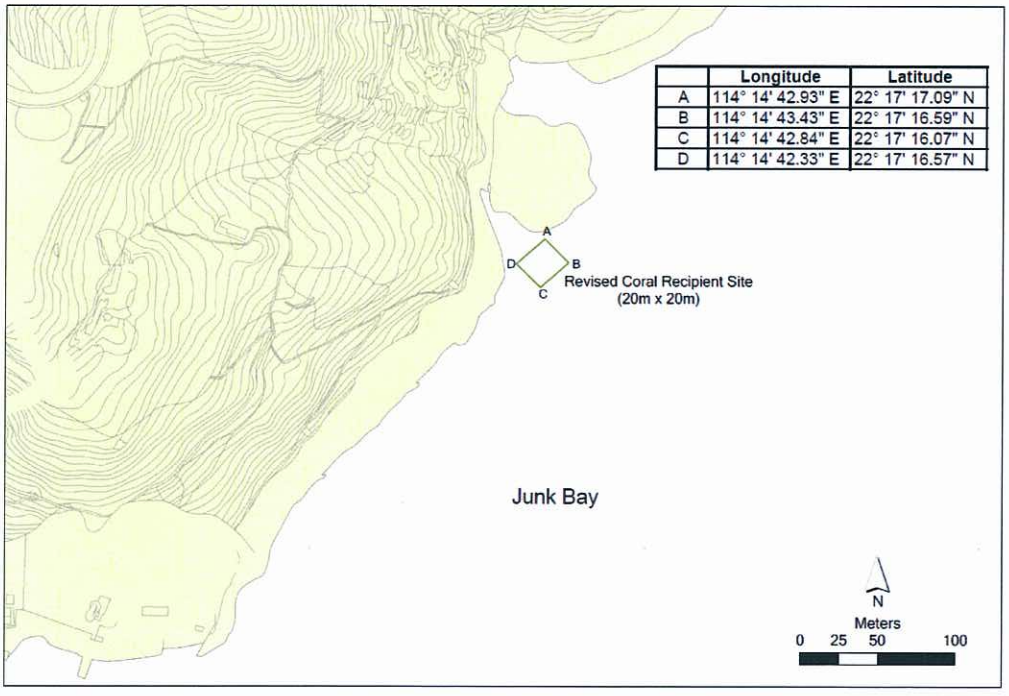


Figure 2.2 **Representative photographs showing the damaged underwater grid (A-B), gluing and tagging activity (C-F), the standardised coral photo (at a fixed height of 25 cm) and the additional close-up photograph with a scale-bar next to the coral colony.**

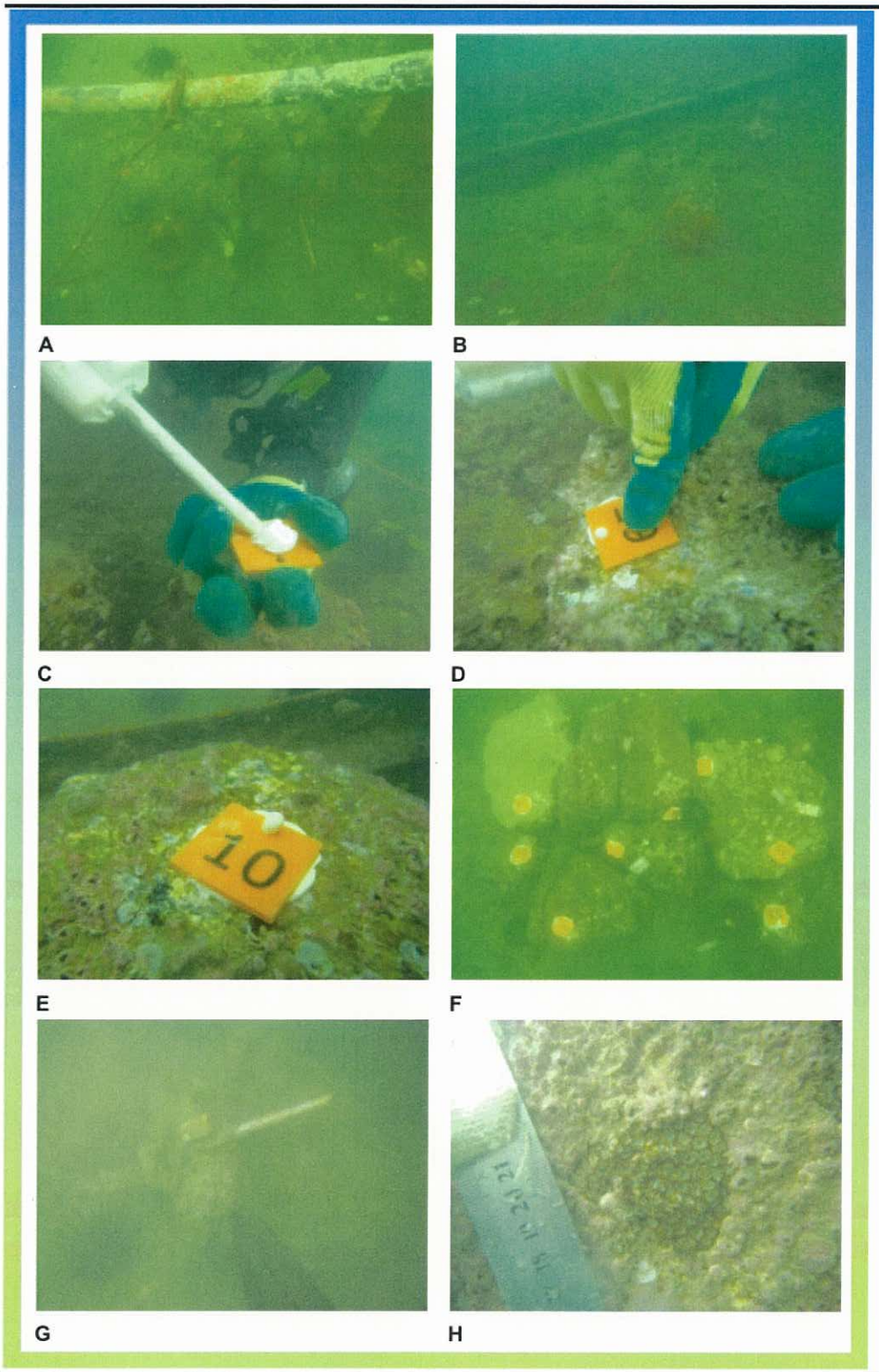


Figure 3.1 **Location Plan of Translocated Boulders/Rocks established during baseline and first post-translocation coral survey. O - indicates boulder/rock with tag number (as in *Tables 3 and 4*). In September 2009, the underwater grid was not re-established but the corals were relocated and then aggregated within the original grid recipient area for increased stabilisation.**

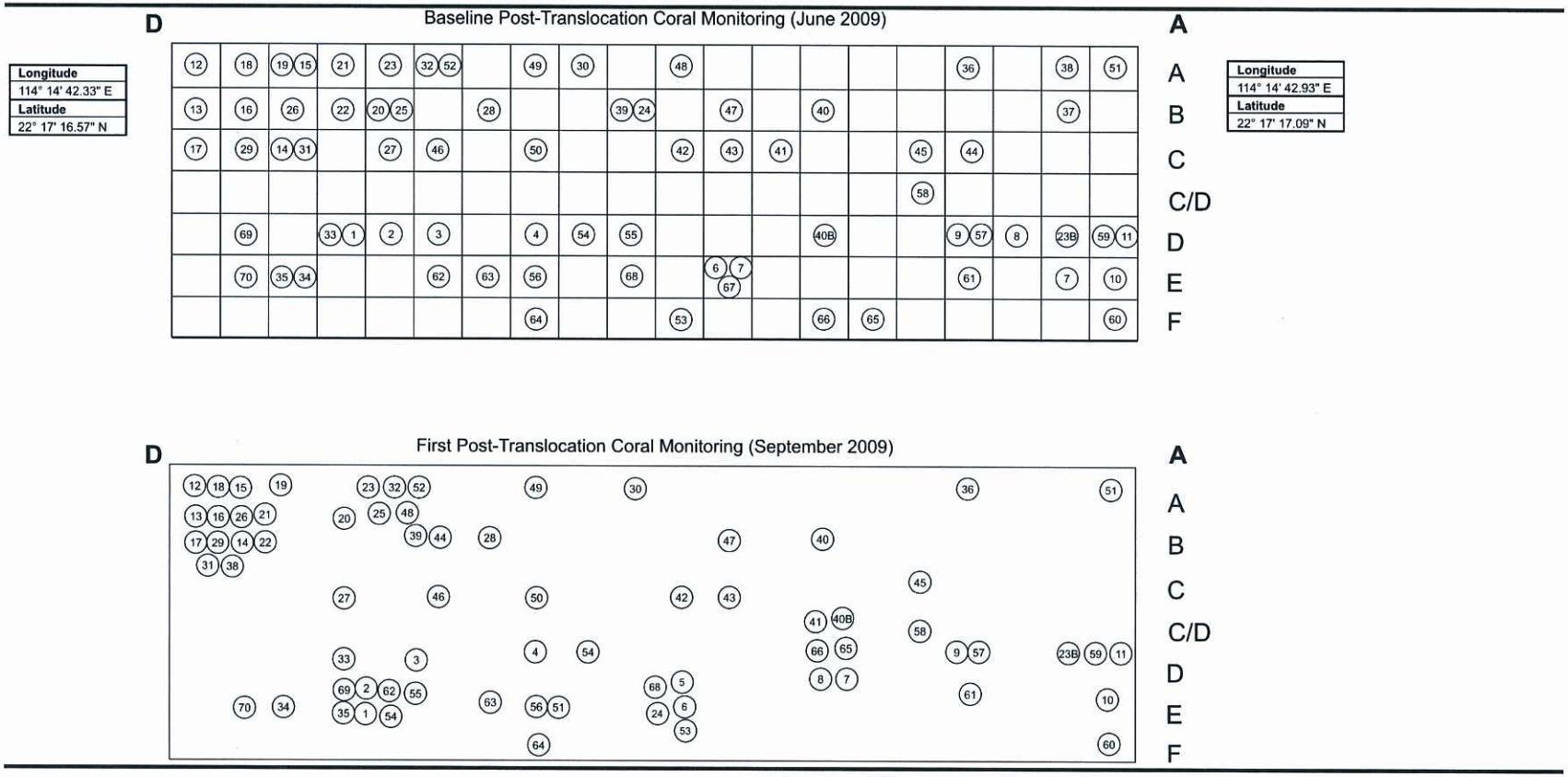


Figure 3.2 **Representative Photographs of some of the Translocated Coral Colonies Assessed Within the Recipient Site (as recorded in July 2009 (baseline immediately following the coral move and then three months later in September 2009).**

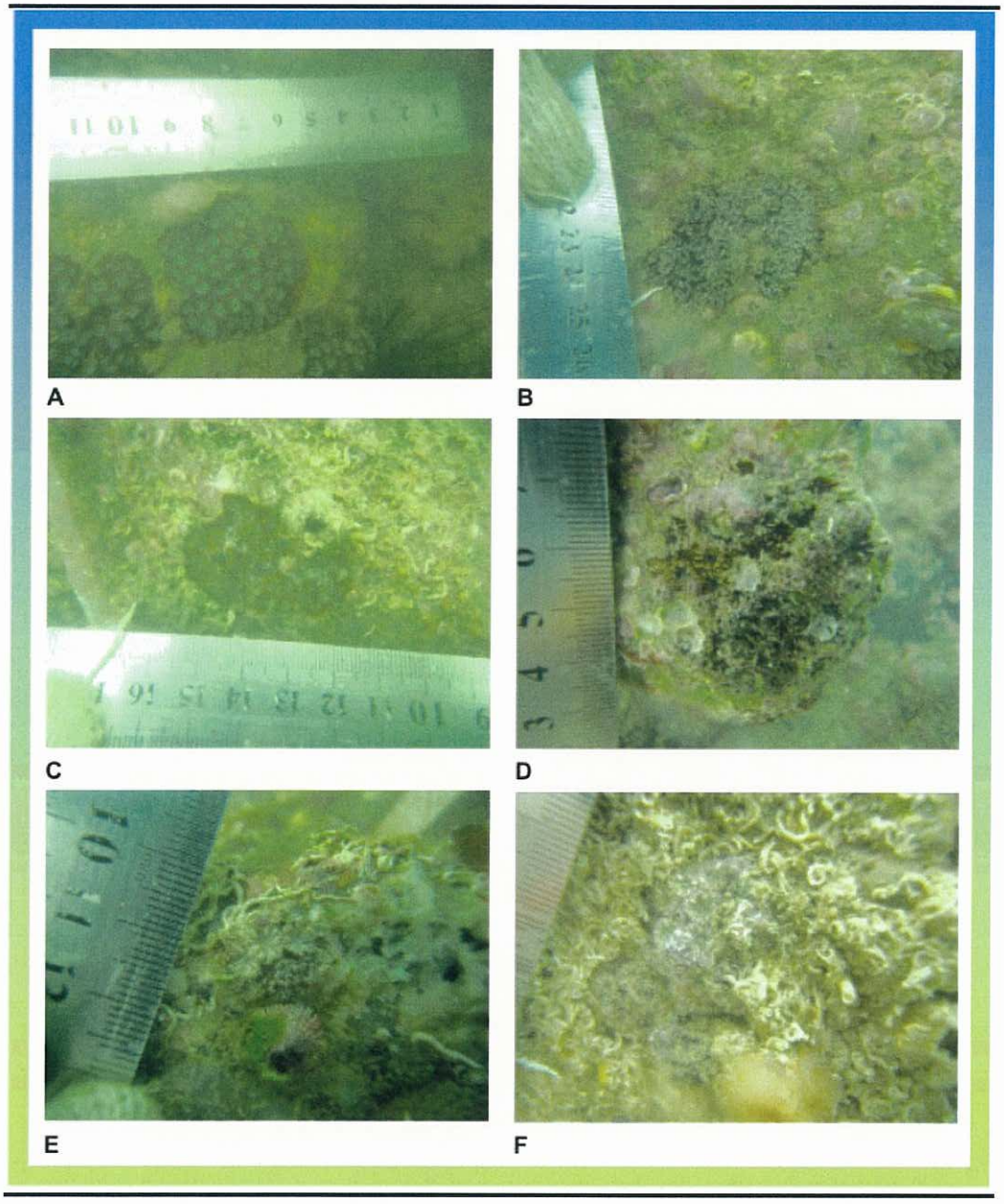


Figure 3.3 **Representative Photographs of Selected *Oulastrea crispata* Colonies immediately following the move from Kai Tak (June, 2009) and three months later (September, 2009)**

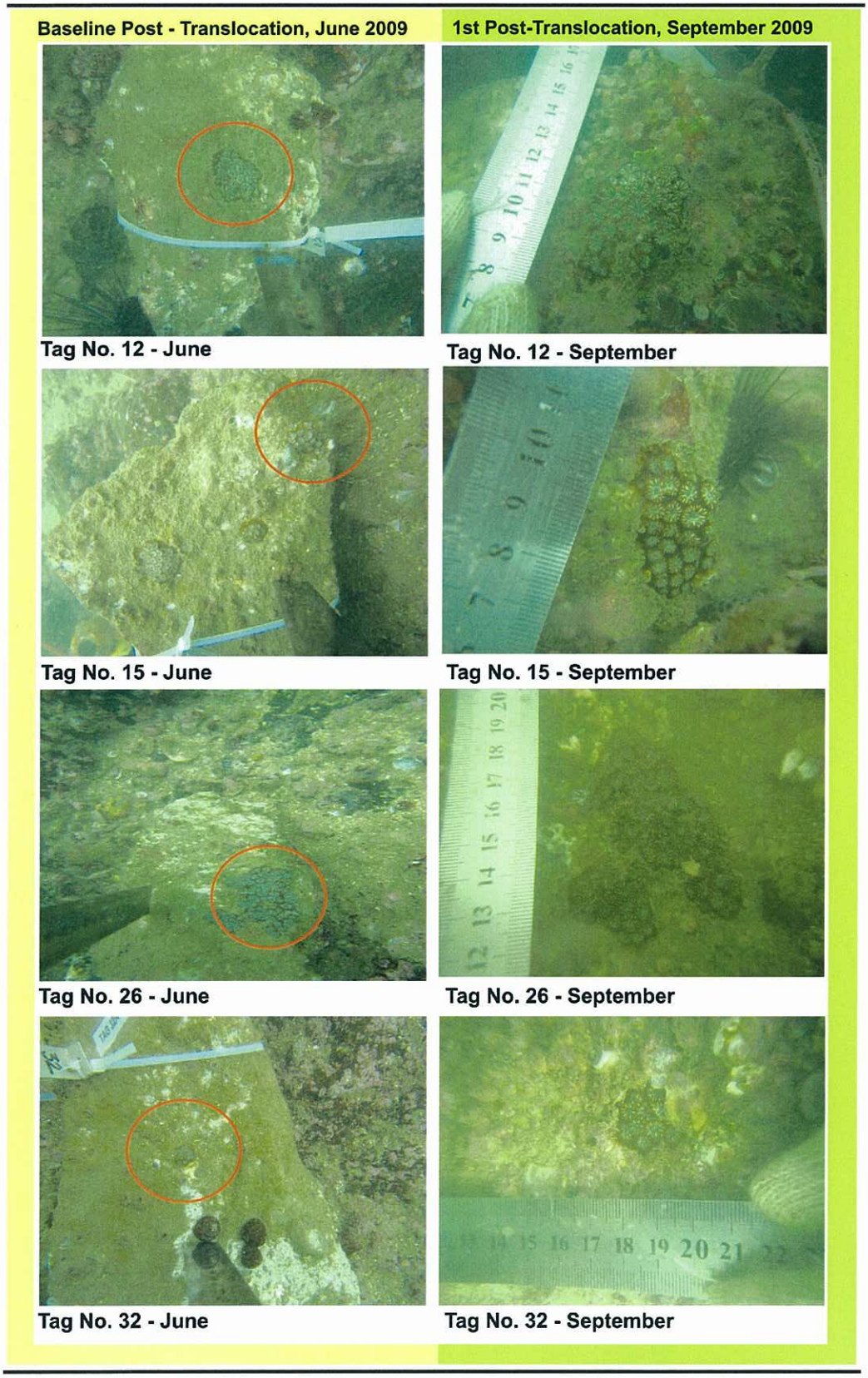


Figure 3.4 Representative Photographs of the Reference Corals examined Within and Adjacent to the Recipient Site (as recorded in September, 2009)

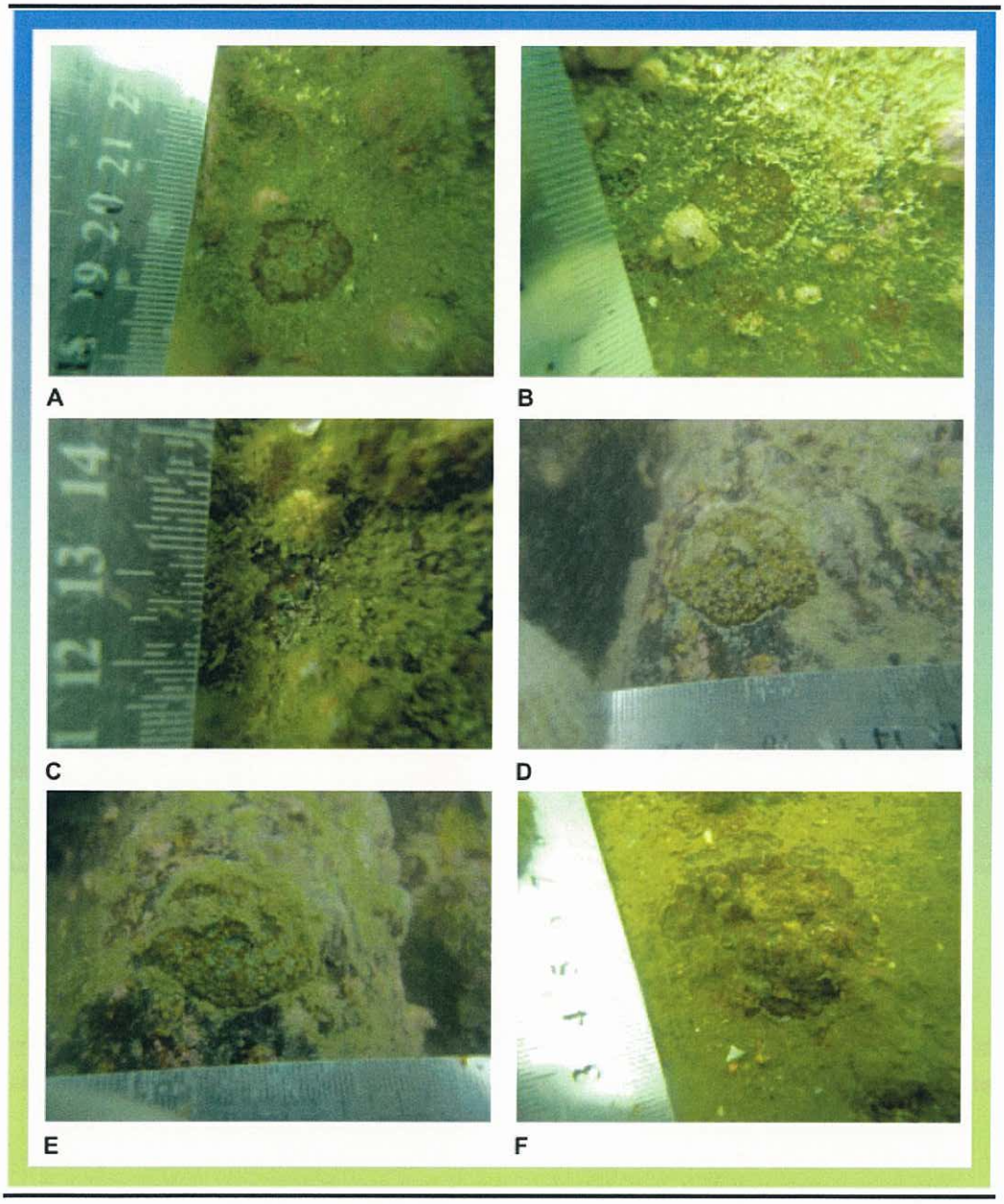


Figure 3.5 **Representative Photographs of Hard Coral Colonies located within the recipient site and adjacent area (*Turbinaria peltata* (A, B, E, F and G); *Favites pentagona* (C) and *Psammocora* sp. (D)) exhibiting partial mortality and sedimentation. Note Photograph G shows the dead and toppled *T. peltata* colony**

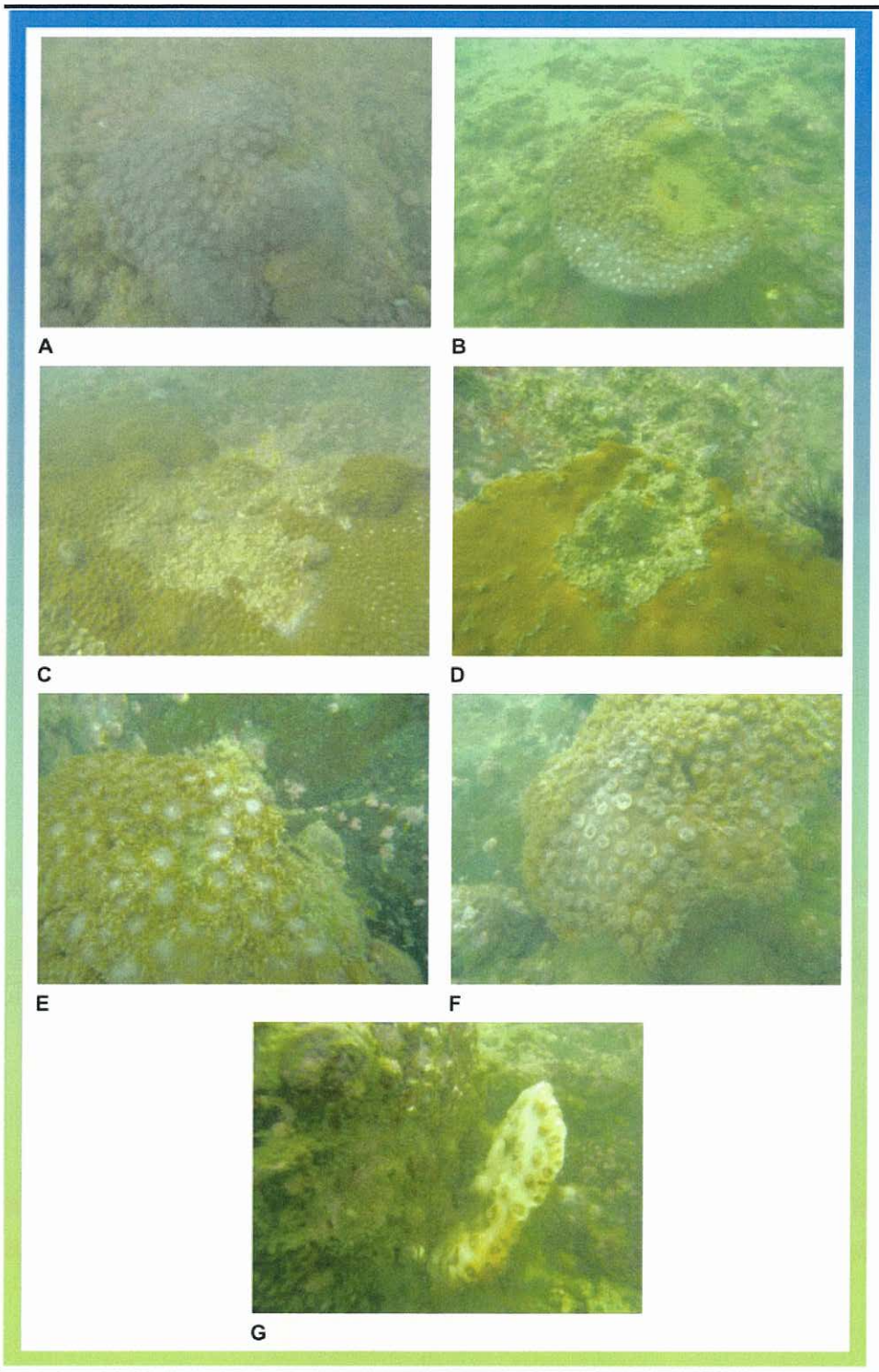


Figure 3.6 **Photographs taken during Baseline (June 2009) and First Post-translocation Coral Monitoring (September 2009). The top two photographs show the increased sediment deposition recorded in September 2009 for the nearshore area adjacent to the recipient site and the bottom two photographs show the same *Turbinaria peltata* colony recorded within the recipient site) exhibiting a large portion of the colony covered in sediment and the elevated sediment deposition on the surrounding substrate in September 2009**

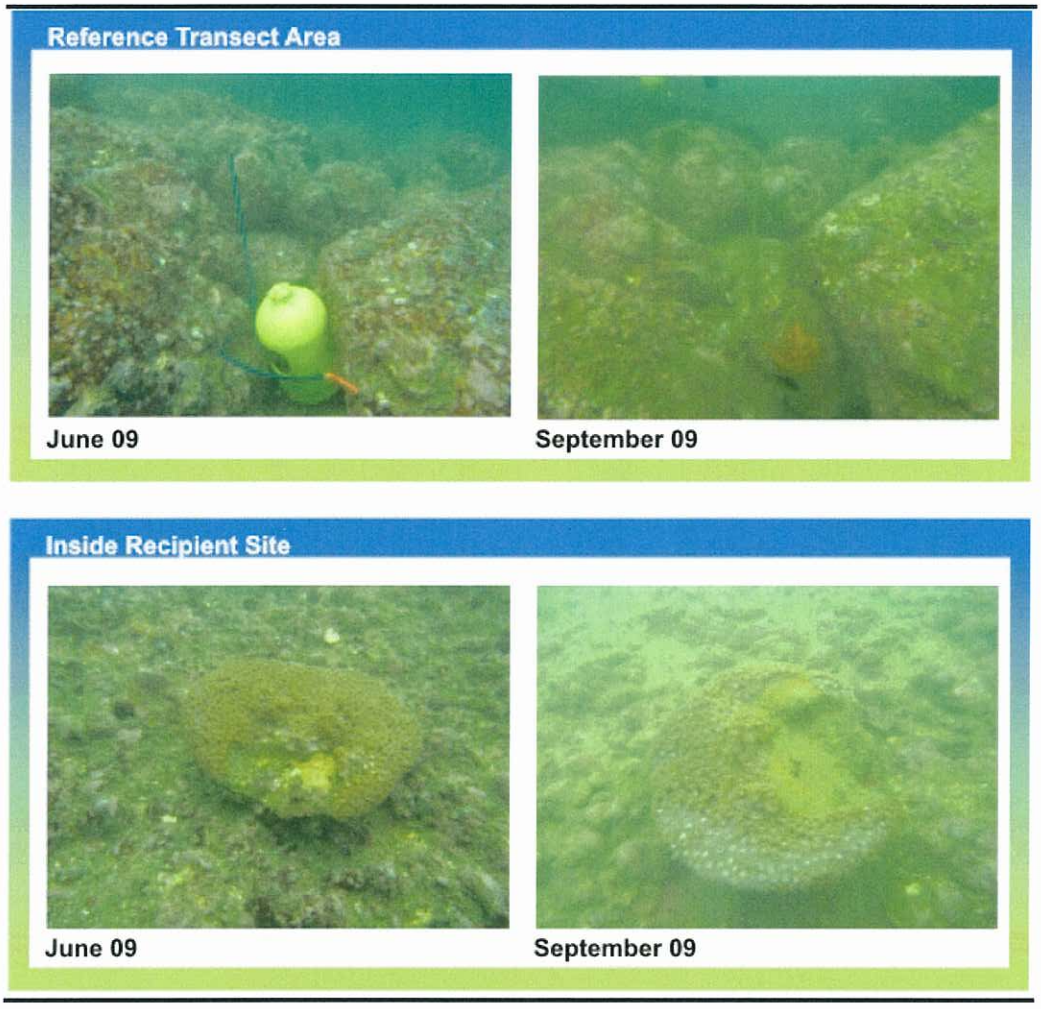
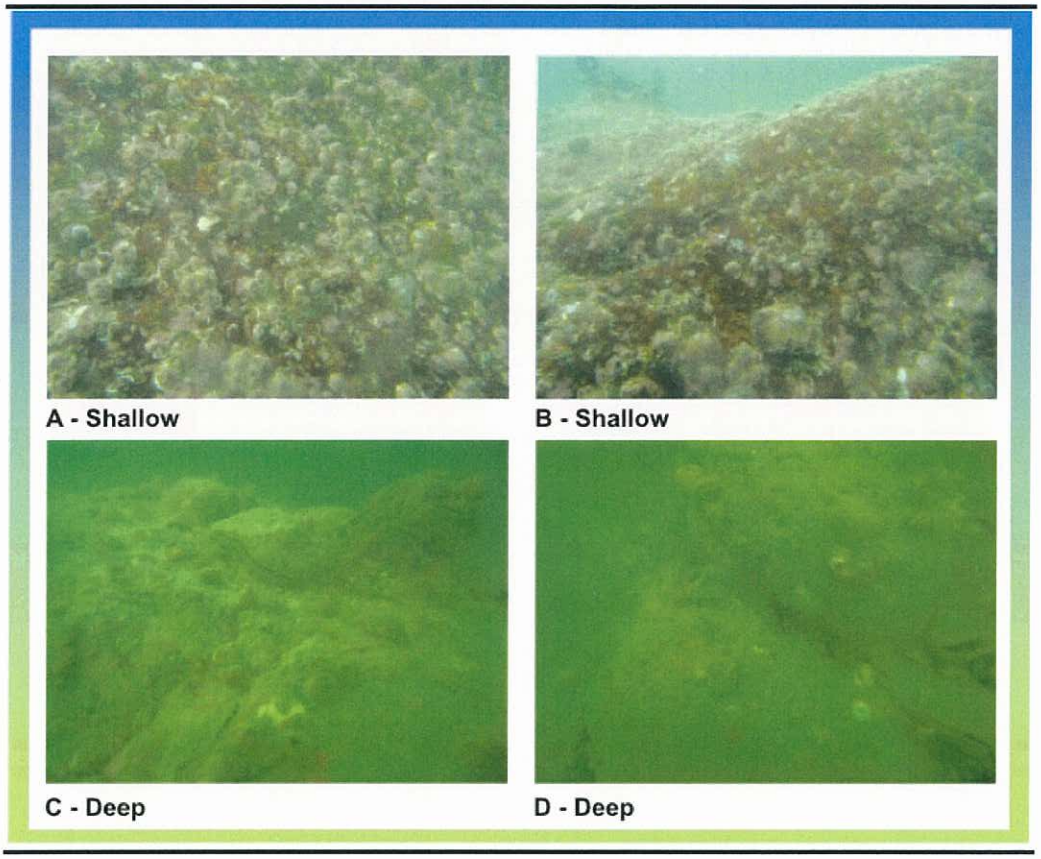


Figure 3.7 **Representative Photographs showing the Difference in the Sediment Deposition in Shallow (-1 to -3 m CD) and Deep (> -5 m CD) areas within the Recipient Site at Tseung Kwan O, September 2009**

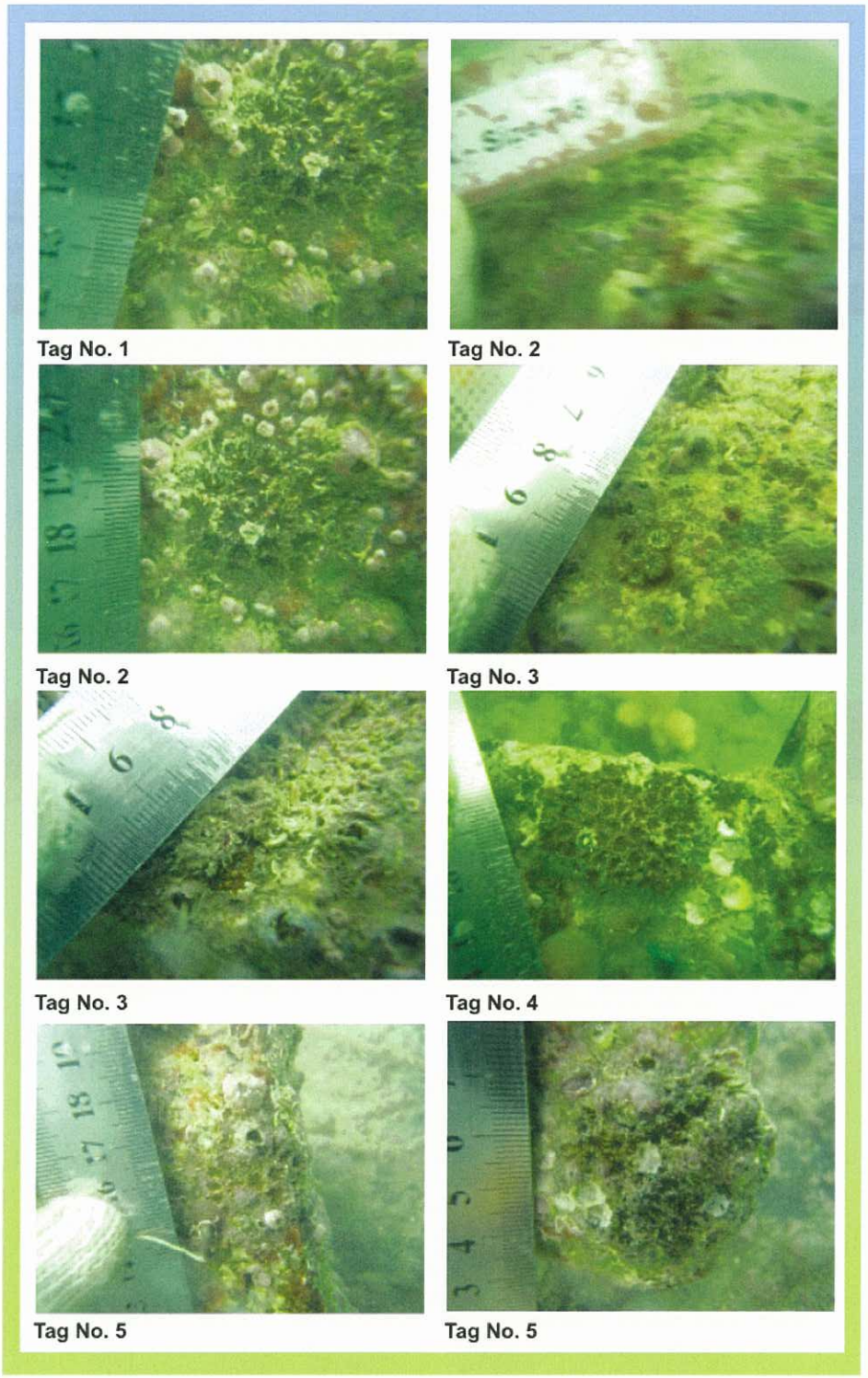


Annex A

Photographic Images Recorded for Each of the Translocated and Reference Coral Colonies Assessed During the First Post-translocation Survey, September 2009

CONTENT

A1	*TRANSLOCATED CORAL COLONIES*	*1*
A2	*REFERENCE CORAL COLONIES (INSIDE THE RECIPIENT SITE)*	*19*
A3	*REFERENCE CORAL COLONIES (ALONG REFERENCE TRANSECT)*	*22*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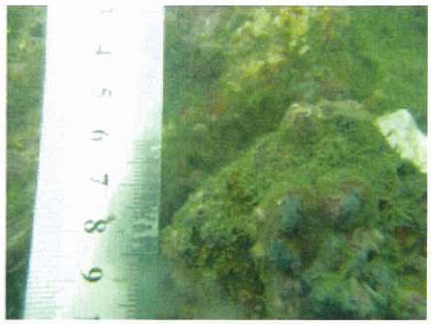
Tag No. 5



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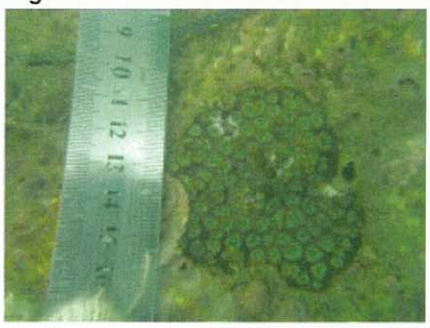

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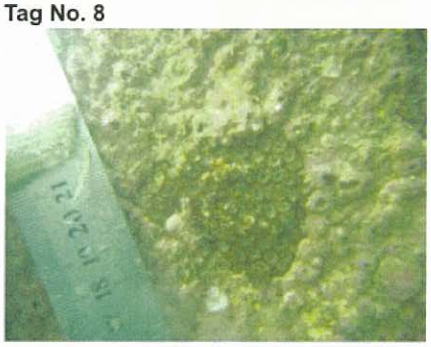

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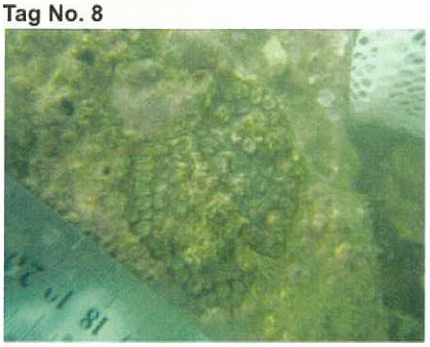

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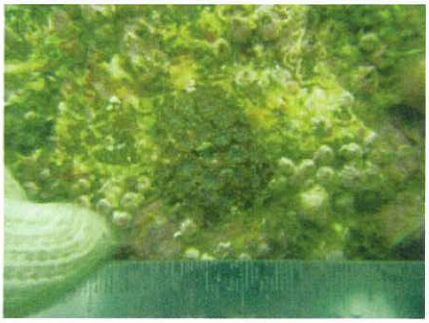

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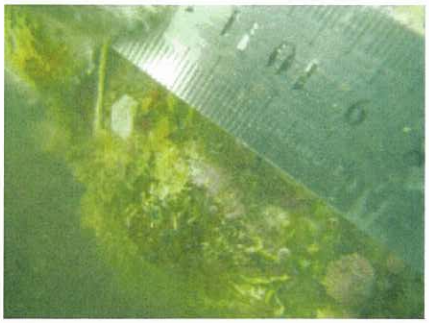

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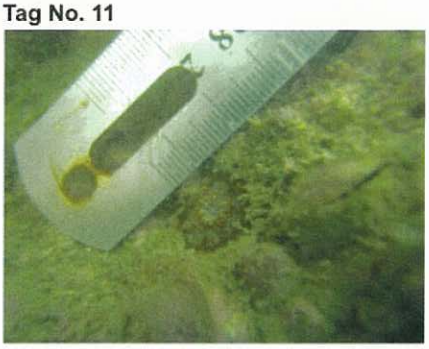

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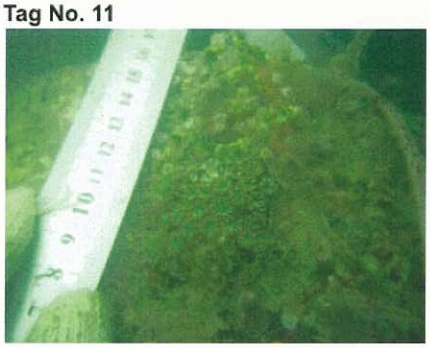

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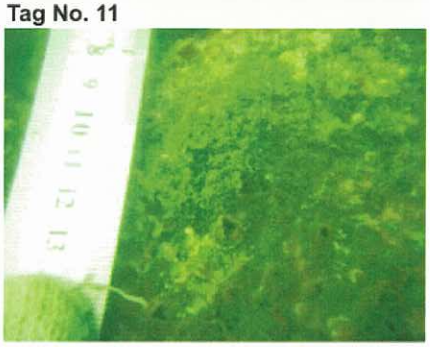

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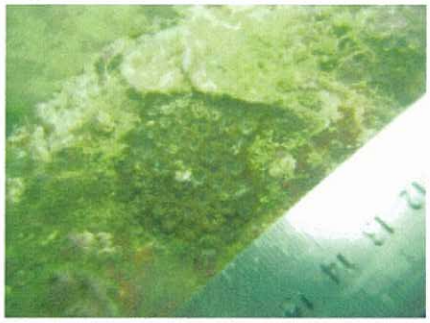

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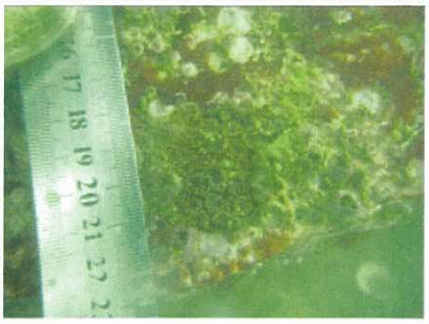

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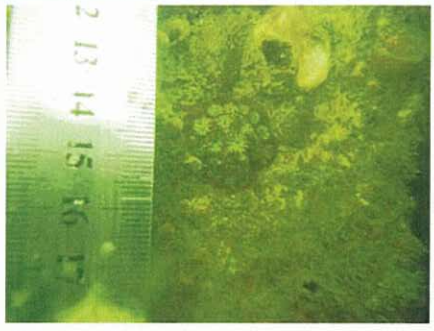

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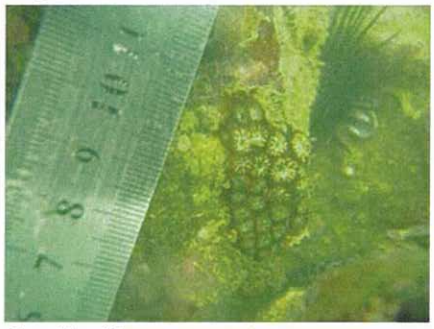

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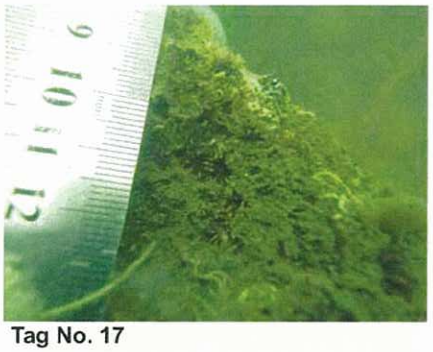

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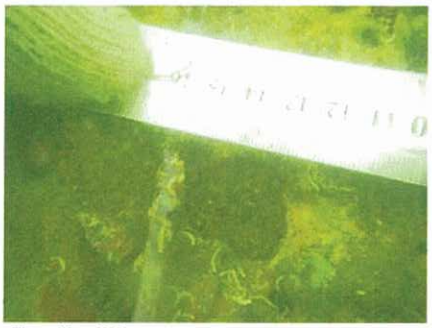

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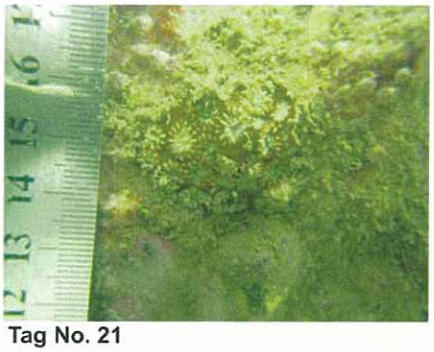

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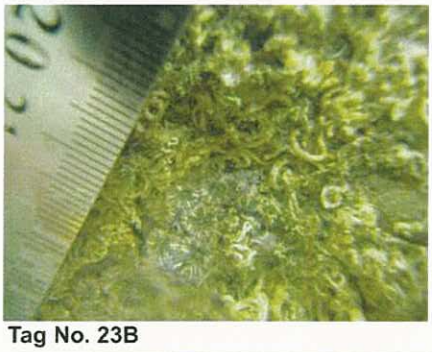
Tag No. 23B

Tag No. 23B



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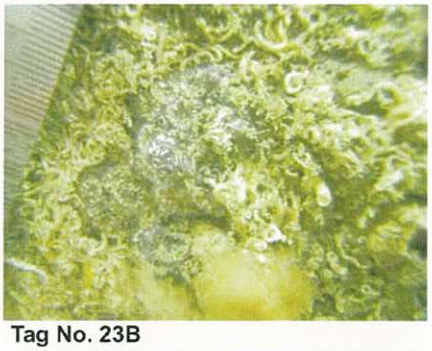

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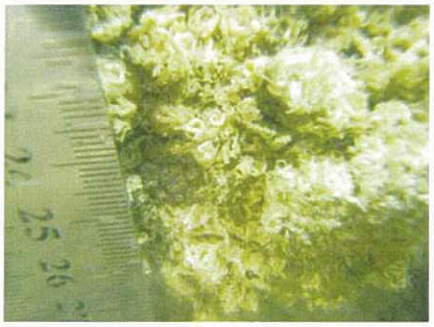

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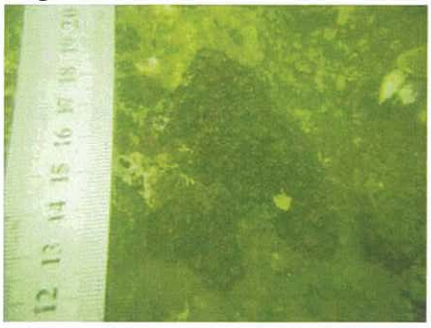

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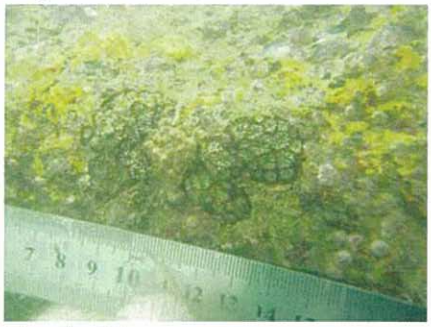

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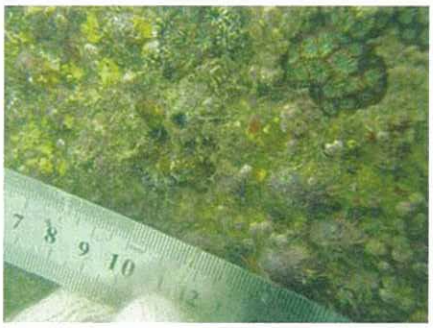

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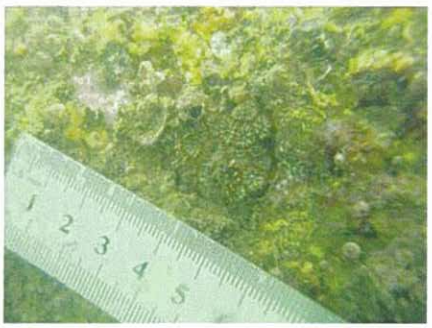

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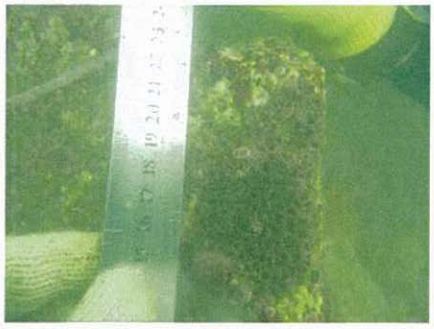

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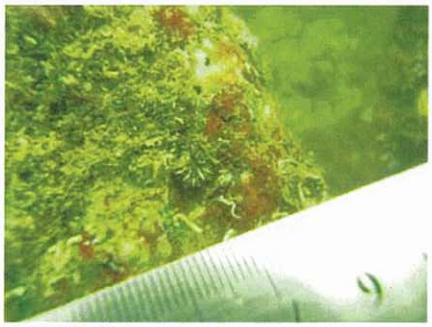

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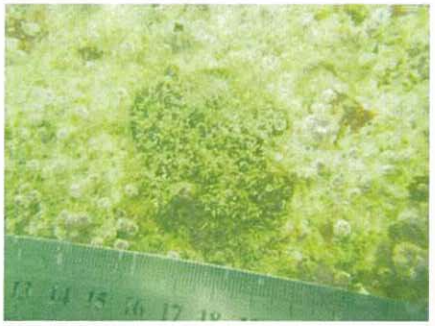

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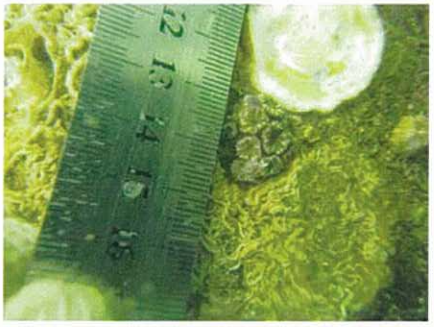

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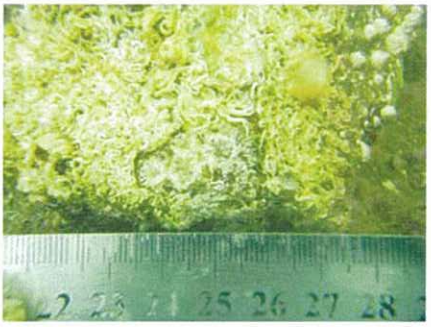

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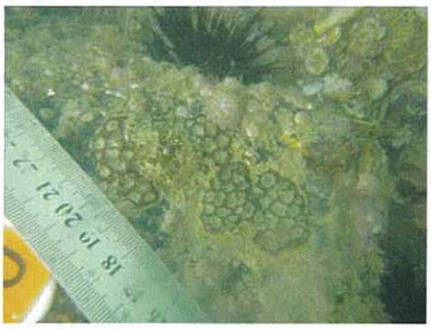

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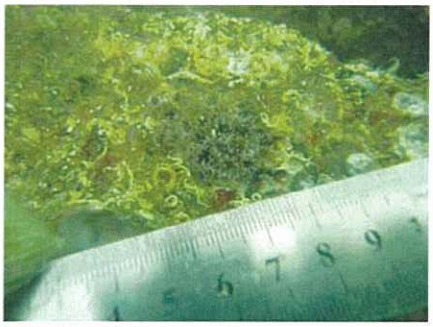

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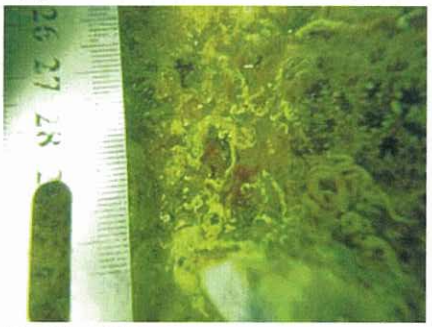

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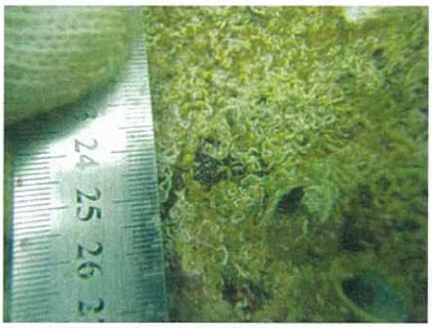

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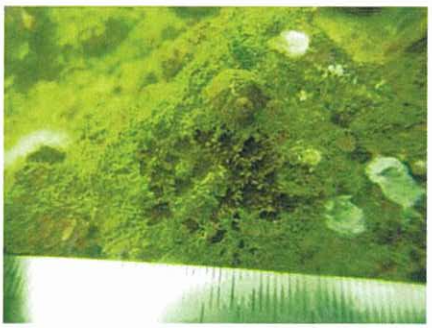

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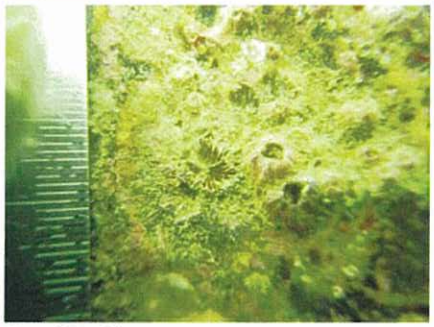

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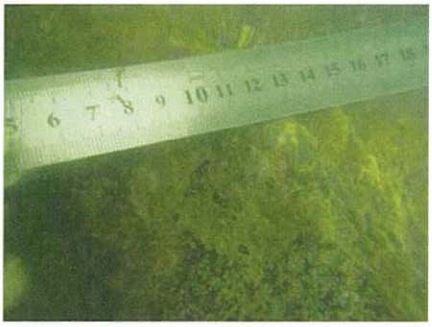

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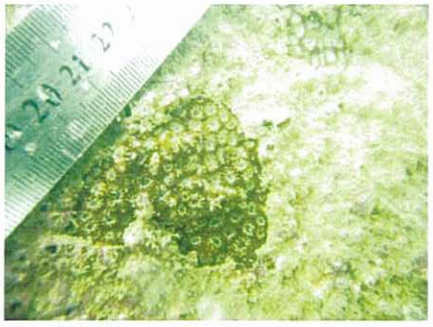

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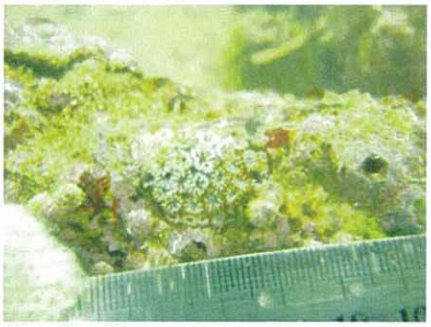

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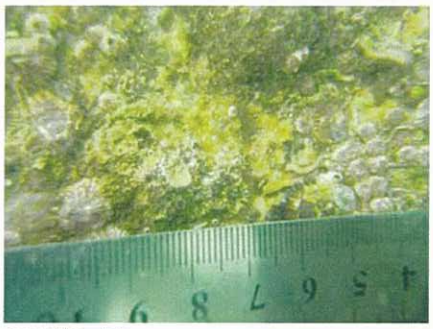

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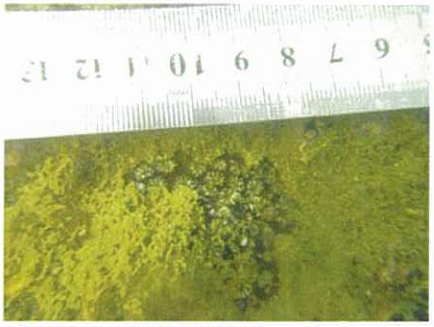

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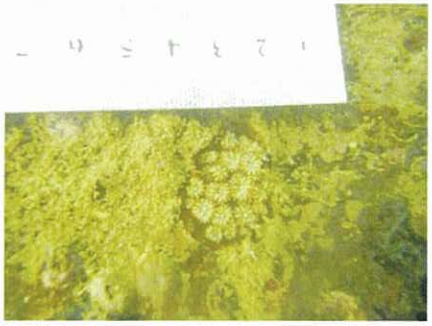

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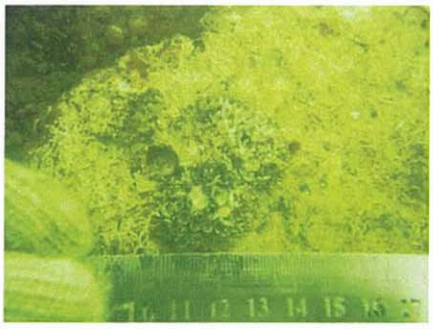

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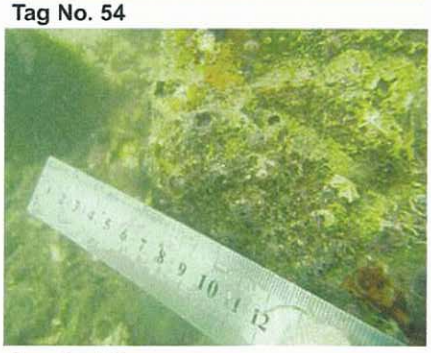

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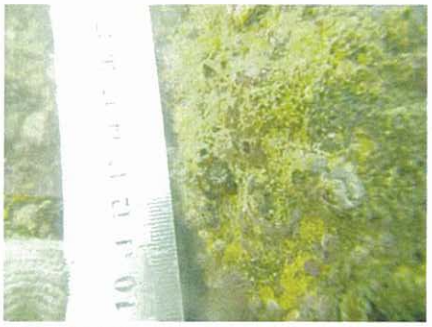

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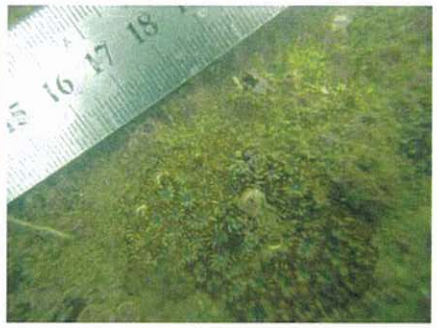

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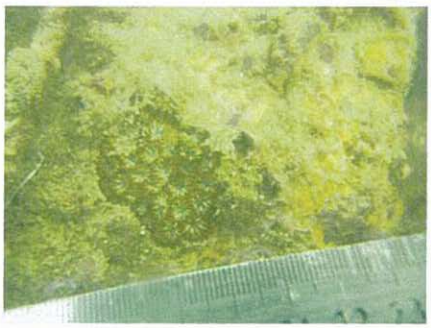

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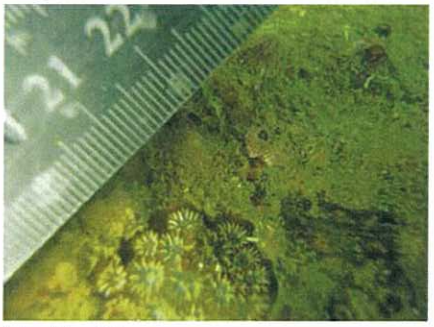

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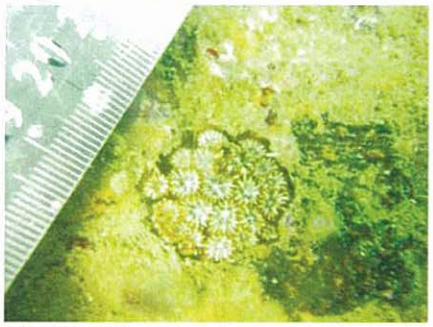

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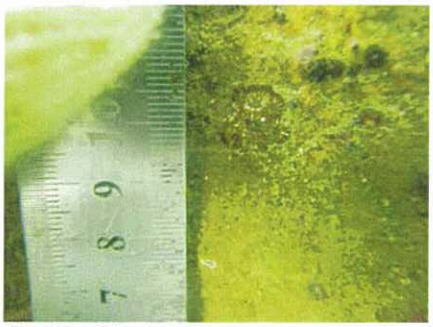

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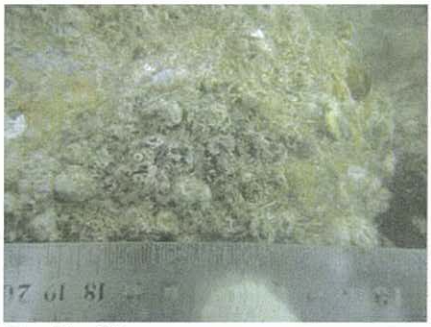

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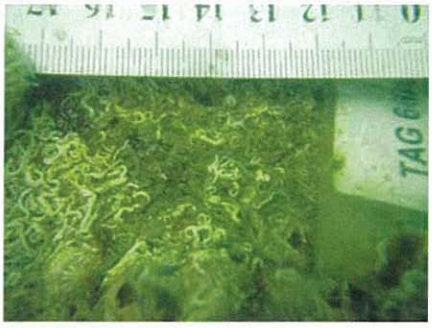

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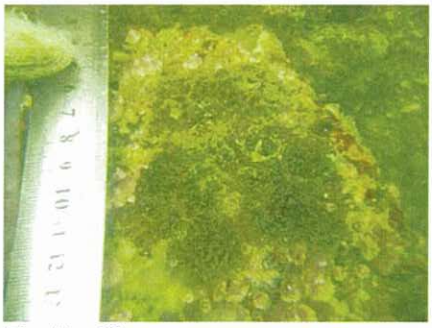

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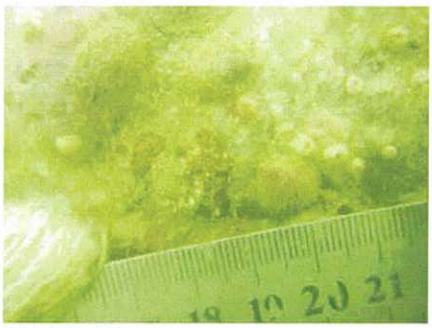

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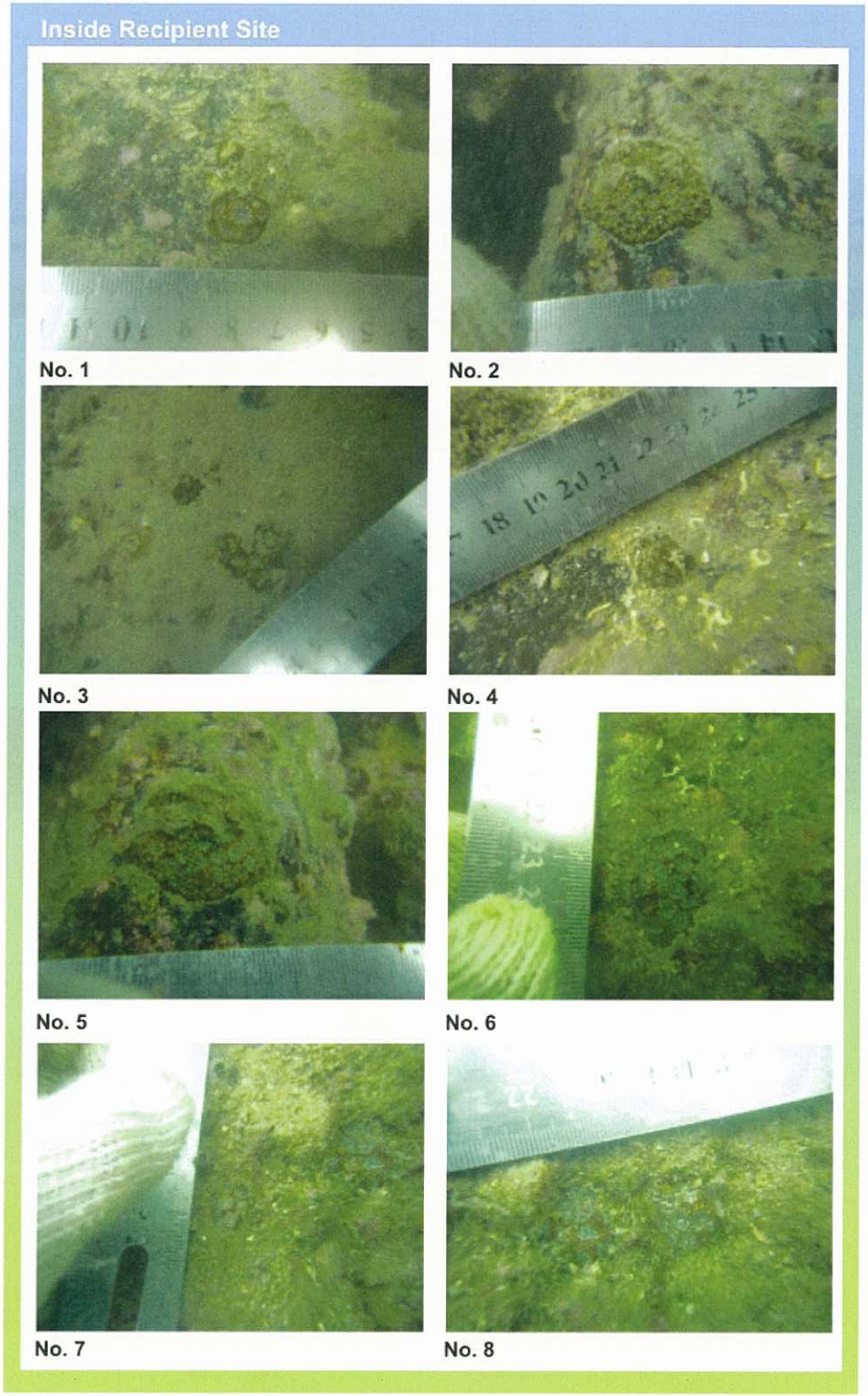
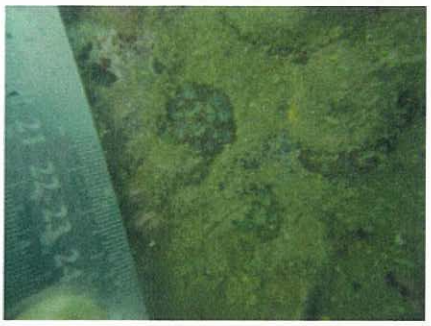
A2 REFERENCE CORAL COLONIES (INSIDE THE RECIPIENT SITE)



Inside Recipient Site



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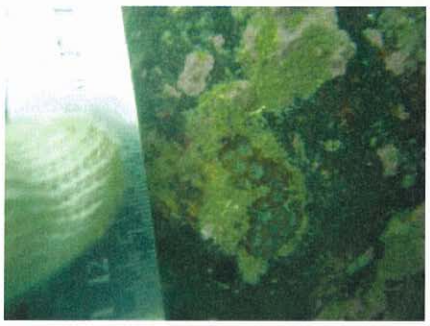

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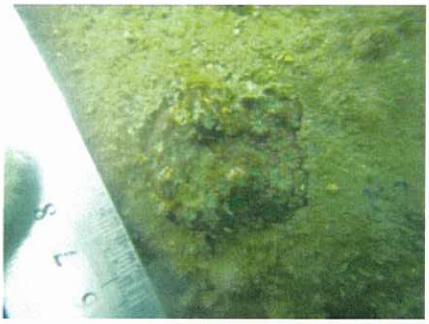

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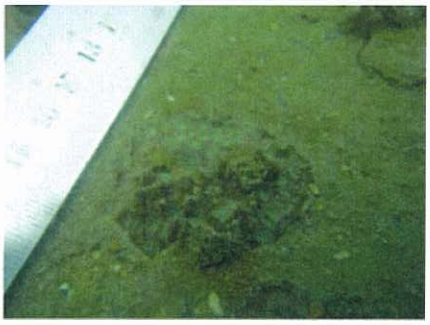

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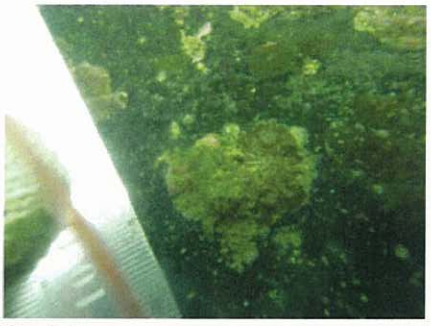
Inside Recipient Site



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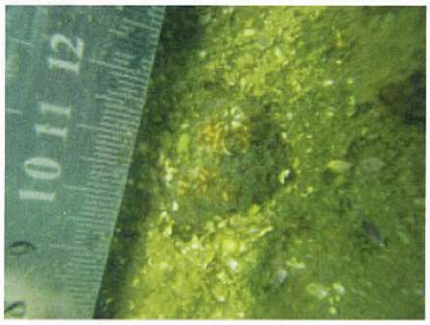

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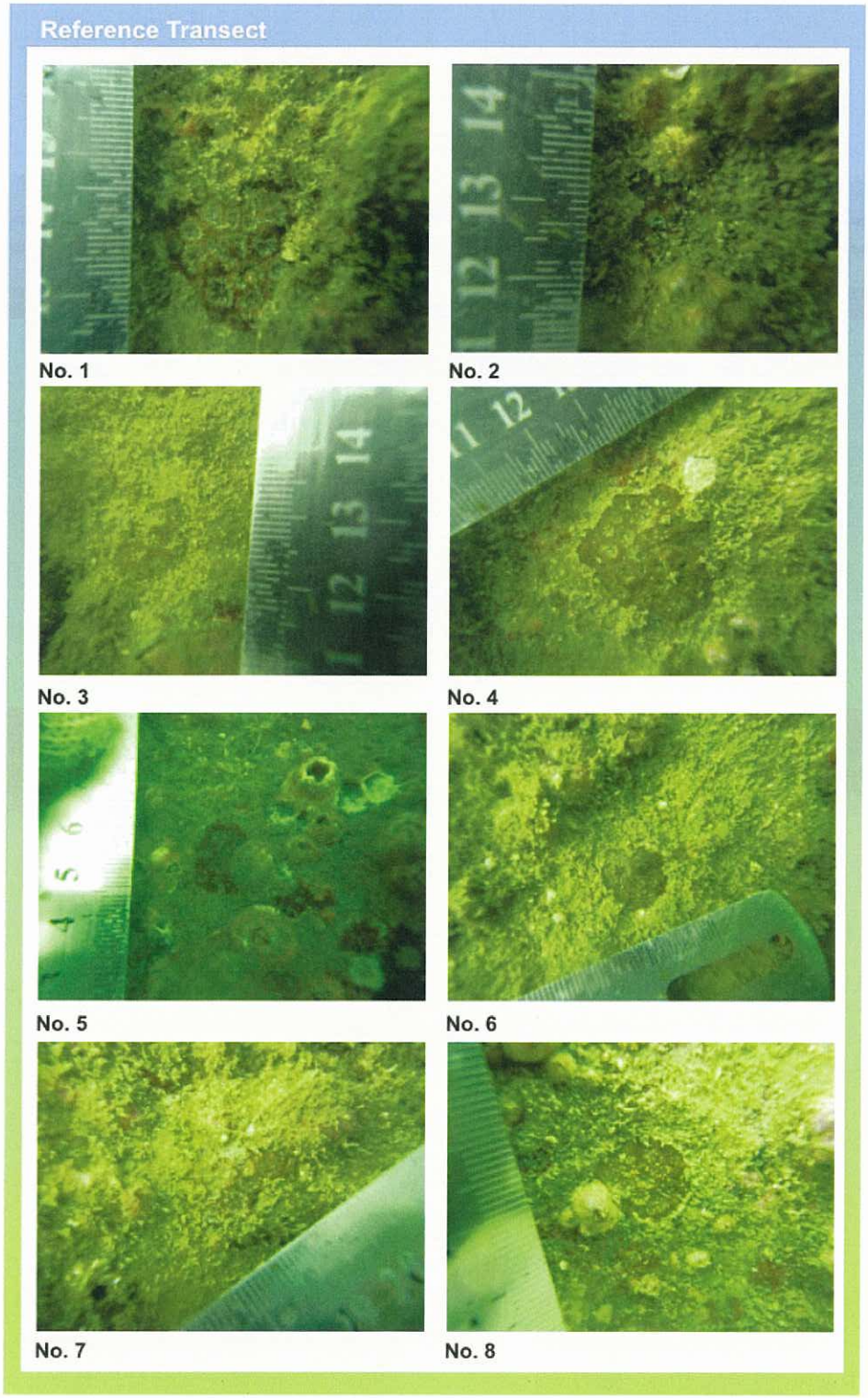
A3 REFERENCE CORAL COLONIES (ALONG REFERENCE TRANSECT)



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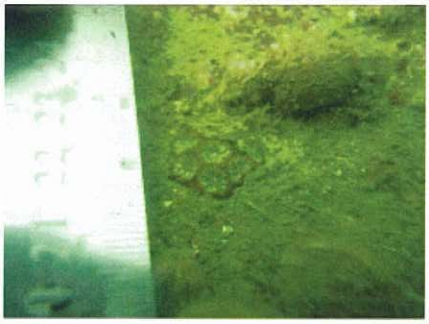

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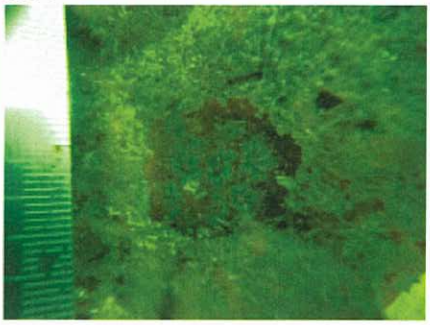

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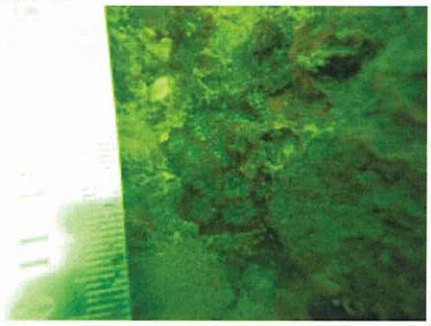

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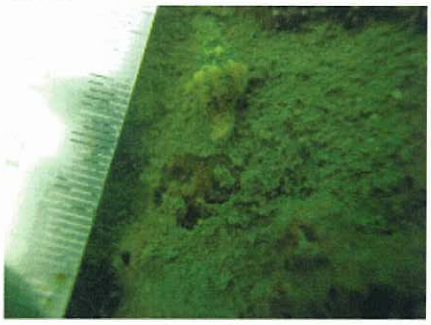

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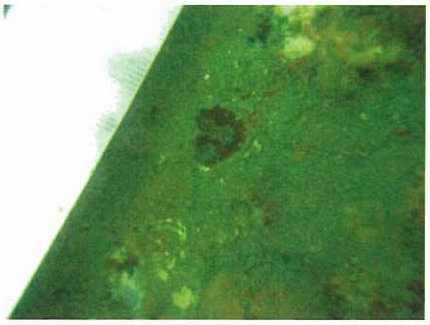

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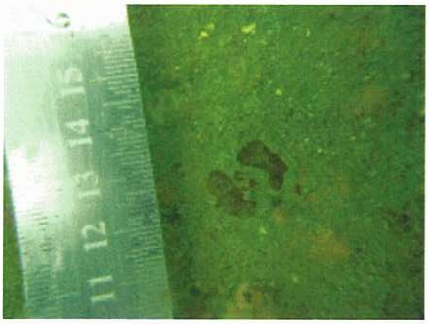

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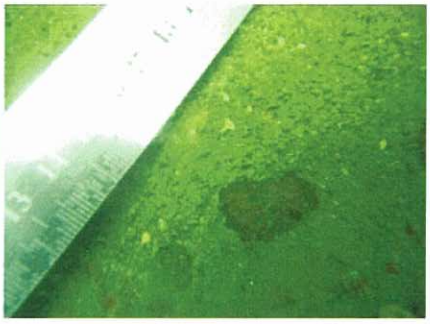

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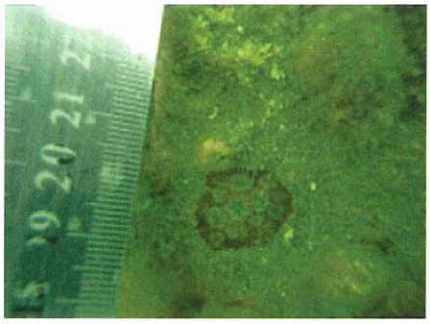

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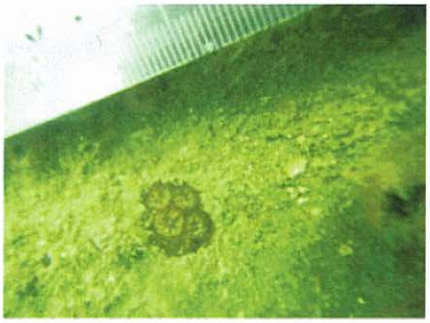

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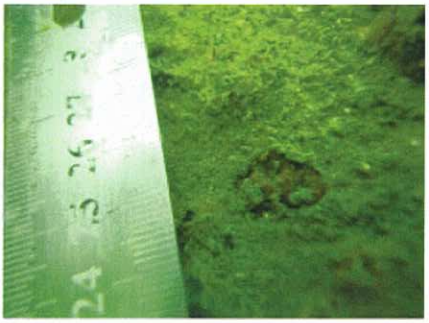

No. 20

Annex B

Comments and Responses

Agreement No. CE 56/2008 (CE)
Site Formation for Kai Tak Cruise Terminal Development -
Design and Construction

First Post-Translocation Coral Monitoring Report (September 2009)
Comments and Responses

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Agreement No. CE 56/2008 (CE)
Site Formation for Kai Tak Cruise Terminal Development -
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Comments and Responses

Ref.	Comments	Responses
	Item 1 IEC **Ref. 2202-O/LSC/L004** **Dated 22 October 2009.**	
1.	No comments and the report was verified	
	Item 2 AFCD **Ref. AF EA 067/07** **Dated 5 November 2009**	
1.	3.1.4 - As the translocated boulders with corals were re-positioned, please insert an updated Table 1 of the Baseline Post-translocation Coral Monitoring Report in the present report.	Table 1 updated to reflect the re-positioning of the Kai Tak boulders.
2.	3.2.2 - As stated in 3rd bullet, two categories on coral bleaching as "blanched" and "bleached" should be recorded in the result, Please clarify whether partial mortality (<50% cover) and (>=50% cover) in Table 1 are equivalent to "blanched" and "bleached" respectively.	Tables 3 and 4 (renumbered as Tables 4 and 5 respectively in the revised report) have been updated to include 'blanched' and 'bleached' coral categories as these tables presented partial mortality categories, only. No coral bleaching was recorded so hence the absence of these data in the tables.

Ref.	Comments	Responses
3.	Table 3 - For better comparison, please include relevant information in Table 2 of the Baseline Post-translocation Coral Monitoring Report. Further checking on the two results is required, as some of the corals seem to have grown significantly, e.g. running count number 2 from 1.3 to 7.6 cm^2 but with 50% partial mortality.	Table 3 (renumbered as Table 4 in the revised report) has been updated to include the relevant information from Table 2 of the Baseline Post-translocation Coral Monitoring Report. Furthermore, the inconsistencies of the size (and growth) data have been checked and updated in the relevant tables. The inconsistency is due to matching of the same coral colony when there was an occurrence of more than one colony per boulder. Some of inconsistencies in the coral colony size will be further investigated at the time of the 2nd Post-translocation Coral Monitoring survey which will take place in December, 2009.