



Gammon Construction Limited

Contract No. CV/2002/04

Penny's Bay Reclamation Stage 2

Final EM&A Summary Report

January 2009

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Version:	Revision 2	Date: 14 January 2009
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EXECUTIVE SUMMARY

This is the Final EM&A Summary Report prepared by ENSR Asia (HK) Ltd. (ENSR), formerly Maunsell Environmental Management Consultants Limited, the designated Environmental Team (hereinafter called the "ET"), for "Penny's Bay Reclamation Stage 2 (hereinafter called the "Project"). This report summarizes the EM&A works of the Project undertaken during baseline, impact and post-project monitoring period from February 2003 to February 2008. Termination of the EM&A Programme for the Project was approved by EPD on 8 April 2008.

Construction works of the Project commenced on 21 July 2003 and construction activities which had the potential to result in adverse environmental impact were completed on 5 February 2008. Major works undertaken included:

- Sediment dredging by grab dredgers;
- Seawall construction;
- Filling with sand and public fill by barge;
- Rockfilling by barge;
- Access road construction;
- Installation of vertical band drain;
- Reclamation, embankment and surcharge;
- Construction of box culverts; and
- Construction of drainage pipes, manholes and u-channels.

Environmental Monitoring and Audit for Penny's Bay Reclamation Stage 2 was conducted in accordance with the requirements set out in the EM&A Manual of the Project. The EM&A programme included monitoring of air quality, noise, water quality and ecology. Weekly site inspections were conducted to ensure the EIA recommended mitigation measures were effectively implemented. The implementation of Event Action Plans and complaint handling procedures were also checked.

Air Quality

Air quality monitoring was conducted at the Penny's Bay Power Station and Luk Keng Tsuen. Baseline 1-hour and 24-hour TSP levels at 2 air quality monitoring stations were established. Baseline 1-hour TSP monitoring was conducted for a continuous period of two weeks in May 2003. 24-hour TSP monitoring data established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) from February to April 2003 was adopted as the baseline 24-hour TSP monitoring data for the Project. 21 action level and 2 limit level air quality exceedances were recorded during the impact monitoring period, no direct evidence between the exceedance at AM1 and AM2 and the Reclamation Stage 2 works at Penny's Bay could be established for all non-compliances and therefore no action was required to be taken. Therefore, possible dust generating activities of the Project did not cause any noticeable deterioration in air quality at Penny's Bay. The average 24-hour TSP level recorded at AM1 in EM&A programme was in similar magnitude with the daily dust level predicted in the EIA.

Noise

Noise monitoring was conducted at Peng Chau, Discovery Bay and Luk Keng Tsuen throughout the baseline and impact monitoring periods. 28 holidays, 273 evening time and 2,275 night-time limit level noise exceedances were recorded during the impact monitoring period. Monitoring results did not coincide with the dredging and sandfilling quantities and therefore a direct relationship between the works and the exceedances could not be established. In addition, field observations indicated that the exceedances were mostly caused by air traffic, ferry, human activity, dog barking and sea wave. Therefore, noise generating activities of the Project did not cause any noticeable noise impact at the sensitive receivers. The impact noise levels recorded were generally similar to the predicted construction noise levels in the Project EIA except for noise levels recorded during night-time. The noise environment at these monitoring locations at night was dominated by the noisy background and not by the PME's on site.

Water Quality

Water quality monitoring was conducted at 10 sensitive receiver stations, 7 control stations and 15 gradient stations throughout the baseline, impact and post-project monitoring period. Monitoring of TBT, PAHs and PCBs was conducted at 7 designated monitoring locations before the initial phase of dredging operations.

Approval for termination of NH₃-N and TIN monitoring was granted by EPD on 16 January 2004. Monitoring of NH₃-N and TIN was terminated since 21 January 2004. Approval for the termination of PAHs/PCBs and TBT monitoring was granted by EPD on 16 January 2004 and 9 November 2005 respectively. Monitoring of PAHs/PCBs and TBT monitoring was terminated since 21 January 2004 and 11 November 2005 respectively.

All marine works was substantially completed in December 2007. As the approval for the termination of water quality impact monitoring after December 2007 was granted by EPD on 25 January 2008, in accordance with Section 7.36 of the EM&A Manual, post-project monitoring was scheduled for four weeks (from 2 January 2008 to 28 January 2008), in the same manner as the impact monitoring during construction.

A total of 83 dissolved oxygen, 209 turbidity and 528 suspended solids exceedances were recorded during the impact monitoring period. For TBT, a total of 246 exceedances were recorded in the impact monitoring period. Tidal flows and ambient conditions were considered to have strong effects on the water quality monitoring results. The exceedances were considered not due to the works of Reclamation Stage 2 as no correlation between the dredging and filling rates and the number of water quality exceedances recorded per monitoring day was found. In fact, the number of dissolved oxygen exceedances showed seasonal variation with more exceedances recorded in the summer months. The number of turbidity and suspended solids exceedances showed seasonal variation with more exceedances recorded during the dry season than in the wet season. TBT levels recorded were either within the range of the levels recorded prior to dredging or the monitoring station is located upstream of Reclamation Stage 2 works area during ebb tide.

With proper implementation of water quality mitigation measures, marine construction activities of the Project did not cause any unacceptable water quality impacts to the receivers. The DO and SS levels recorded at SR1 to SR7 were in similar magnitude as predicted in the Project EIA. No comparison could be made from SR8 to SR10 as predictions were not made in the Project EIA. For turbidity, as no prediction was made in the Project EIA, no comparison could be made.

Terrestrial Ecology

White-bellied Sea Eagles monitoring was conducted throughout the baseline and impact monitoring period. Based on the survey results, there was no evidence that WBSE behaviour and activity were altered by construction noise or general disturbance during the impact monitoring period. No relationship between the WBSEs activity or behaviour and the extent or nature of construction works of the Project could be discerned. The magnitude of impact to WBSEs associated with the Project was in agreement with EIA predictions.

Marine Mammals

Marine mammals monitoring for the Project was conducted during the impact monitoring period from July 2003 to December 2007. Monitoring observations on the presence and behaviours of sighted marine mammals indicated that there was no evidence of disturbance or impact due to construction activities of the Project. In fact, construction activities of the Project did not deter the dolphins from approaching close to the boundary of site works. It was considered unlikely that cetaceans would restrict their movements further away from Penny's Bay in East Lantau waters. Marine mammals survey results were in agreement with EIA predictions.

Subtidal Ecology

Subtidal ecology monitoring was conducted throughout the impact monitoring period. Monitoring data on subtidal habitats indicated that there was no evidence that the abundance of coral colonies or their diversity had been altered at either Sze Pak Wan or Kau Yi Chau as a consequence of impacts from the works of the Project. The EIA predictions that no unacceptable impacts would affect subtidal habitats at Sze Pak Wan and Kau Yi Chau were supported by the EM&A data.

Audit Results

Implementation of applicable dust, noise, water quality, ecology, waste and landscape and visual mitigation measures were noted during weekly site inspections throughout the impact monitoring period.

Complaints and Prosecutions

A total of 10 complaints (two noise, one air quality and seven water quality complaints) were made against this Project/Penny's Bay Construction Sites since commencement of the Project. All complaints were handled in accordance with the complaint handling procedures specified in the EM&A Manual.

Three (3) and thirteen (13) summonses against this Project and Backfilling of Marine Areas at East Tung Lung Chau Project respectively were received since commencement of the Project. Consolidated Court hearings were carried out in the period from 26 July to 6 August 2004 and the Court had dismissed all charges against the Contractor.

No prosecution was recorded during the construction period of the Project.

Conclusions and Recommendations

The Project did not cause unacceptable environmental impacts or disturbance to air quality, noise, water quality, WBSEs, marine mammals and subtidal habitats in the vicinity of Penny's Bay.

Monitoring and audit of 24-hour TSP, noise, water quality and ecology ensured that any deterioration in environmental condition was readily detected and timely actions were taken to rectify any non-compliance. For future monitoring and audit exercise, it was recommended that ad-hoc 1 hour TSP monitoring should be conducted to confirm assessment findings in case of exceedance. Noise monitoring should be omitted at receivers where there is no line of sight to construction activities and nighttime noise criterion should take the prevailing baseline levels into consideration. Monitoring of water quality parameters which had proved not to be a significant pollution source should be discontinued and monitoring frequency for marine habitats which were not commonly found in the region should be reduced.

1. INTRODUCTION

- 1.1 On 2 November 1999, the Chief Executive announced that an agreement has been reached between the Government and The Walt Disney Company to build Hong Kong Disneyland (HKD) at a site at Penny's Bay on Lantau Island. The HKD would be developed in phases and Phase 1 is completed in 2005. In order to enable the commissioning of the HKD, the Government implemented a Mega Project for the land formation and infrastructure for the HKD.
- 1.2 As part of the Mega Project, Penny's Bay Reclamation Stage 2 (hereinafter called the "Project") commenced in April 2003. The Project site is located at Penny's Bay, North East Lantau. The layout of the work site is shown in Figure 1.1. The Project involves:
- Reclamation of approximately 60 hectares of land;
 - Construction of about 1,470 metres of permanent sloping seawall;
 - Construction of stormwater drainage system;
 - Installation, operation and dismantling of Public Fill sorting facilities at Tuen Mun Area 38 and Tseung Kwan O Area 137 to produce sorted Public Fill material for reclamation works
- 1.3 An Environmental Impact Assessment (EIA) was conducted for this Project and the Final EIA Report for Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures ('hereinafter called the "EIA Report") was issued on 29 February 2000. Annex N of the EIA report includes an EM&A Manual which covers both construction and operation phases of the Hong Kong International Theme Park, the construction impacts as well as mitigation measures were specified in the EIA Report. To ensure that mitigation measures were fully and effectively implemented, the EIA Report recommended details the monitoring and audit programme for the construction of the Project. It provides systematic procedures for the monitoring and auditing of potential environmental impacts that may arise from the works.
- 1.4 ENSR Asia (HK) Ltd. (ENSR), formerly Maunsell Environmental Management Consultants Limited, (hereinafter called the "ET") was appointed by Gammon Construction Limited (GCL) (hereinafter called the "Contractor") to undertake Environmental Monitoring and Audit for this Project. Pursuant to the requirements of Section 4 of the Environmental Permit EP-054/2000/E, the EM&A programme as set out in the EM&A Manual was implemented to monitor the air quality, noise, water quality and ecology impacts from the Project.
- 1.5 This is the Final EM&A Summary Report prepared by the ET. The purpose of this Final EM&A Summary Report is to summarise the EM&A works undertaken during baseline, impact and post-project periods. Termination of the EM&A Programme for the Project was approved by EPD on 8 April 2008.

2. PROJECT INFORMATION

Project Organisation and Contacts of Key Management

- 2.1 The organization and lines of communication among the Project Proponent, Engineer Representative (ER), Independent Environmental Checker (IEC), the Contractor and the Environmental Team (ET) was set up for the Project. The organization and contact details are shown in Appendix A.

Project Programme and Works undertaken during the entire construction period

- 2.2 The construction works of the Project commenced on 21 July 2003 and all construction activities that had the potential to result in adverse environmental impact were completed on 5 February 2008. Construction programmes for the Project are presented in respective monthly EM&A reports. Works undertaken during the entire construction period are presented in Appendix B. Major works undertaken include:

- Sediment dredging by grab dredgers;
- Seawall construction;
- Filling with sand and public fill by barge;
- Rockfilling by barge;
- Access road construction;
- Installation of vertical band drain;
- Reclamation, embankment and surcharge;
- Construction of box culverts; and
- Construction of drainage pipes, manholes and u-channels

- 2.3 The major construction activities undertaken in March 2008 included temporary water management, trimming haul road and relocation of water main. Dredging activities was completed in December 2005. Filling of sand and sorted public fill was completed after 30 July 2007 and 13 June 2007 respectively. The total volume of dredged material, sand filled volume, public fill filled volume and dumped volume since commencement of construction were 6,040,123 m³, 3,624,438 m³, 13,649,782 m³ and 6,224,250 m³ respectively.⁽¹⁾

¹ The volume of 13,649,782 m³ of public fill comprises of mainly the public fill material produced from the Public Fill Sorting Facilities at the Tseung Kwan O and Tuen Mun Fill Banks and the other public fill materials which were delivered to the reclamation site direct from other Government contracts. For clarification, no part of the volume of rock fill materials imported and used in the reclamation work was included in this reported volume of 13,649,782 m³ even though parts of such rock fill materials were also classified as public fill.

3. AIR QUALITY

Monitoring and Audit Requirements

Monitoring Parameters and Methodology

- 3.1 The EM&A Manual designated 2 stations for the ET to monitor air quality impact. Baseline 1-hour and 24-hour total suspended particulates (TSP) monitoring, and impact 24-hour TSP monitoring were carried out for the Project. Baseline 1-hour TSP monitoring was conducted for a continuous period of two weeks under typical weather conditions, in terms of three 1-hour TSP ambient measurements taken daily in May 2003. 24-hour TSP monitoring data established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) covering a period of three months from February to April 2003 was adopted as the baseline 24-hour TSP monitoring data for the Project. The air quality monitoring location is depicted in Figure 3.1. Air quality monitoring requirements are summarised in Table 3.1. Air quality monitoring works were conducted and the monitoring equipment was calibrated in accordance with the requirements specified in Section 5 of the EM&A Manual.

Table 3.1 Air Quality Monitoring Requirements

Location	Parameter	Frequency
AM1 - Penny's Bay Power Station [#]	1-hour TSP [^]	3 times per day
	24-hour TSP	Once every six days
AM2 - Luk Keng Tsuen	1-hour TSP [^]	3 times per day
	24-hour TSP	Once every six days

[^]This only applies after a complaint has been received.

[#]24-hour TSP monitoring at Penny's Bay Power Station was terminated after 9 June 2005 and relocated to the roundabout close to the Hong Kong Disneyland Hotel on 23 May 2007.

Environmental Quality Performance Limits (Action and Limit Levels)

- 3.2 The air quality performance limits, i.e. Action and Limit levels (AL levels), were derived from the baseline air quality monitoring results and the statutory requirements respectively. An alternative set of Action and Limit levels derived and approved from Infrastructure Development for Penny's Bay, Contract 1 (Contract No. CV/2000/09) were adopted for this Project. The AL levels for air quality are detailed in Table 3.2.

Table 3.2 Action and Limit levels for 1-hour and 24-hour TSP

Parameter	Location	Action Level, mg/m ³	Limit Level, mg/m ³
24-hour TSP	AM1	180	260
	AM2	185	
1-hour TSP	AM1	325	500
	AM2	318	

Environmental Mitigation Measures

- 3.3 Air quality mitigation measures were recommended in the EIA Report and a list of air quality mitigation measures were stipulated in the EM&A Manual for the Contractor to implement during the construction phase of the Project. The implementation status of air quality mitigation measures during the construction period is depicted in Appendix C.

Monitoring Results

- 3.4 Air quality monitoring was conducted throughout the baseline and impact monitoring periods. Baseline 1-hour TSP monitoring was performed in May 2003 and 24-hour TSP monitoring data from February to

April 2003 established for Infrastructure Development for Penny's Bay, Contract 1 (Contract No. CV/2000/09) were adopted as the baseline for the Project.

- 3.5 For AM1, 24-hour TSP was terminated after 9 June 2005 since the occupier at AM1 rejected continuously using their power supply for the High Volume Sampler and there was no other alternative location in the vicinity of Penny's Bay Power Plant for relocation of the Sampler. It was agreed that a portable dust meter would be used to measure 1-hr TSP starting from 28 June 2005. A new 24-hr TSP station was approved by EPD on 6 October 2006 at a location to the roundabout close to the Hong Kong Disneyland Hotel. However, the monitoring station was temporarily located within the reclamation stage 2 works area site boundary closest to the proposed roundabout prior to obtaining site access to the roundabout. The new 24-hr TSP monitoring at AM1 was commenced on 30 October 2006 while the 1-hr TSP monitoring was terminated just after the commencement of 24-hr TSP monitoring. During the joint site visit with LCSD, HyD, IEC, HKITP, RE and Contractor on 16 April 2007, all the parties had no objection to set up the sampling equipment / HVS at the roundabout, and the HVS was relocated to the roundabout close to the Hong Kong Disneyland Hotel on 23 May 2007.
- 3.6 As the approval for the termination of air quality monitoring at Luk Keng Tsuen (i.e. at AM2) was granted by EPD on 6 December 2006, no air quality monitoring would be carried out after 31 December 2006.
- 3.7 The baseline and impact air quality monitoring data are provided in the baseline monitoring report and monthly EM&A reports respectively. Graphical presentation of the trend of 24-hour TSP over the impact monitoring period is provided in Appendix D.

Non-compliance (exceedances) of the Environmental Quality Performance Limits (Action and Limit Levels)

Summary of Non-compliance (Exceedances)

- 3.8 Table 3.3 summarises the number of exceedances recorded at two stations throughout the impact monitoring period. There were 17 action level and 2 limit level exceedances for AM1 station and 4 action level and no limit level exceedance for AM2 during the 24-hr TSP impact monitoring period. One exceedance of 1-hour TSP Action level was recorded at AM1 and no 1-hour TSP exceedance was recorded at AM2.

Table 3.3 Summary of 24-hour TSP exceedances at AM1 and AM2

Station	Exceedance Level	1-hour TSP	24-hour TSP
AM1	Action	1	17
	Limit	0	2
AM2	Action	0	4
	Limit	0	0

Summary of Actions Taken in the event of Non-Compliance

- 3.9 Other than the mitigation measures implemented as mentioned in Section 3.3, in the event of non-compliance, actions were taken in accordance with the Event-Action Plan in the EM&A Manual. The Contractor was notified immediately. Investigation was carried out within three working days of identification of non-compliance such as identifying the air pollution sources, checking the implementation status of the mitigation measures, etc., and measurement was repeated to confirm the investigation findings. Further investigation was carried out to identify the source of pollution when deemed necessary. In summary, no direct evidence between the exceedance at AM1 and AM2 and the Reclamation Stage 2 works at Penny's Bay could be established for all non-compliances and therefore no action was required to be taken.

Review of Reasons for and the implications of Non-Compliance

- 3.10 A total of 21 Action level and 2 Limit Level exceedances were recorded during the 24-hr TSP impact monitoring period. One exceedance of 1-hour TSP Action level was recorded at AM1 during the 1-hr TSP impact monitoring period. Investigation into the possible causes of each exceedance was undertaken and reported in the respective monthly EM&A reports.
- 3.11 In accordance with Section 5.23 of the EM&A Manual, three 1-hour TSP measurements at AM1 and AM2 monitoring station were taken on 22 October 2003 in response to the complaint on construction dust (Complaint No. ENPO/200310/13). During this measurement, one exceedance of 1-hour TSP Action level was recorded at AM1. The only land-based construction activity was delivery of sand by two numbers of dump trucks at Portion B1. Therefore, ET's assessment has shown that these were not due to works of Reclamation Stage 2. For other exceedances recorded in the year 2003 to 2008, dust suppression measures were implemented by Contractor, no non-compliant on work method and construction plant was observed. Therefore, the exceedance was not related to the works of Reclamation Stage 2.

Environmental Acceptability of the Project

Trend of 1-hour and 24-hour TSP

- 3.12 Other than a few isolated events, the 1-hour and 24-hour TSP monitoring results were well below the Action and Limit levels. The trend of TSP at AM1 and AM2 were comparable to the baseline range and showed no noticeable deterioration of air quality during the impact monitoring period.

Correlation between exceedances with possible dust generating activities

- 3.13 Possible dust generating activities of the Project did not cause any noticeable deterioration in air quality at Penny's Bay. With proper implementation of air quality mitigation measures, the monitoring results showed no adverse air quality impact at the monitoring location except for a few isolated and short-term incidents.

Comparison of EM&A results with EIA predictions

- 3.14 The EIA predicted cumulative dust impacts of construction activities at A1 and, the EM&A impact 24-hour TSP levels at AM1 during the impact monitoring period are summarised in Table 3.4 (Predicted Daily Concentrations extracted from Table 3.4I of the EIA Report).
- 3.15 The average 24-hr TSP levels recorded at AM1 in the past were in similar magnitude as the daily dust level predicted for Ground Level and 10m above ground in the Project EIA. No TSP level was predicted by the Project EIA at AM1 (1-hour) and AM2 (24-hour & 1-hour) and therefore, no comparison of EM&A data with EIA predictions could be made.

Table 3.4 Predicted Cumulative Daily Dust Level and Impact 24-hour TSP Monitoring Results

ASR	Location	Predicted Daily Concentrations		Average Impact 24-hour TSP Levels, mg/m ³ (Range)
		Ground Level	10m above Ground	
A1/AM1	Penny's Bay Power Plant	106	102	106.8 (13.2 – 278.2)

- 3.16 At 24-hour TSP monitoring station at AM1, the average 24-hour TSP levels recorded in the EM&A programme were in similar magnitude as the Daily dust level predicted for Ground Level and 10m above ground in the EIA.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 3.17 Monitoring and auditing of air quality was recommended for the construction phase of the Project in the EIA to ensure no exceedance of the TSP standard at the sensitive receiver.
- 3.18 The air quality monitoring methodology was effective in monitoring the air quality impacts of the Project. Baseline monitoring of 1-hour and 24-hour TSP helped to determine the ambient TSP levels at the sensitive receiver prior to commencement of construction works. During periods when there were possible dust generating construction activities, impact monitoring of 24-hour TSP helped to determine whether the Project caused unacceptable air quality impacts on the sensitive receiver. As the scope of the Project mainly includes reclamation works and access road construction only, dust generation from the construction activities is the key concern during the construction phase. The monitoring of TSP was therefore considered to be cost effective for the Project.
- 3.19 All recommended mitigation measures were applicable to the Project. As discussed above, the Project did not cause unacceptable air quality impacts. However, as the nature of the Project is reclamation works of approximately 60 hectares of land in size, some mitigation measures in practice were generally focused on dust generating activities only. Taking surcharge removal works as an example, the surcharge material, marine sand or public fill, would be transferred by the excavator or bulldozer to the dump trucks and transported to other filling area via specified routes. Watering as a dust suppression measure was concentrated on the transferring area and the specified routes instead of the whole reclamation area. Nevertheless, the mitigation measures implemented were effective and efficient in controlling air quality impacts.
- 3.20 Monitoring and audit of 24-hour TSP levels had ensured that any deterioration in air quality was readily detected and timely actions taken to rectify any non-compliance. Assessment and analysis of 24-hour TSP results collected throughout the baseline and impact monitoring periods also demonstrated the environmental acceptability of the Project. Weekly site inspections had ensured that the EIA recommended air quality mitigation measures were effectively implemented. The EM&A program is considered to be cost effective. It is however, recommended that after identification of an air quality exceedance, measurements should be repeated by means of an ad-hoc 1 hour TSP monitoring to confirm the investigation findings. An investigation report should be submitted following the identification of the exceedance taking into account the results of the 1-hour TSP monitoring.

Conclusion

- 3.21 Air quality monitoring for the Project was conducted during the baseline and impact monitoring periods. Key construction activities including dredging, filling with sand and public fill. The trend of 24-hour TSP was comparable to the baseline range and showed no noticeable deterioration of air quality during the monitoring period. Although exceedances were recorded, they were isolated and short-term events. There is no evidence of long-term deteriorating trend.
- 3.22 The average 24-hour TSP levels recorded at AM1 in EM&A programme were in similar magnitude with the Daily dust level predicted in the EIA. No TSP level was predicted by the Project EIA at AM1 (1-hour) and AM2 (24-hour & 1-hour) and therefore, no comparison of EM&A data with EIA predictions could be made. Air quality mitigation measures implemented were effective in controlling air quality impacts.

4. NOISE

Monitoring and Audit Requirements

Monitoring Parameters and Methodology

- 4.1 The EM&A Manual designated 3 stations for the ET to monitor noise impact. Baseline and impact noise monitoring were carried out for the Project. The noise monitoring locations are depicted in Figure 4.1. Noise monitoring requirements are summarised in Table 4.1. Noise monitoring data established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) covering a period of three months from February to April 2003 was adopted as the baseline noise monitoring data of the Project.

Table 4.1 Noise Monitoring Requirements

Location	Time Period	Duration (min)	Parameters	Frequency
NM1 — Sea Crest Villa (Peng Chau)	Daytime (0700 to 1900)	30	L _{eq} , L ₉₀ & L ₁₀	Once every six days
NM2 — Crestmont Villa (Discovery Bay)	^Evening (1900 to 2300)	5		
NM3 — Luk Keng Tsuen	^Night-time (2300 to 0700 of next day)	5		

^ Noise monitoring was conducted only when construction work was in progress.

Environmental Quality Performance Limits (Action and Limit Levels)

- 4.2 The noise performance limits, i.e. Action and Limit levels (AL levels) were derived from *Technical Memorandum on Environmental Impact Assessment Process* and *Technical Memorandum on noise from construction work other than percussive piling*. Should the measured noise parameters exceed the AL levels, the Noise Event-Action Plans would be implemented in accordance with the EM&A Manual. The AL levels for noise are detailed in Table 4.2.

Table 4.2 Action and Limit levels for Construction Noise (L_{eq})

Time Period	Action Level, dB(A)	Limit Level, dB(A)		
		NM 1	NM 2	NM 3
Daytime (0700-1900 hrs on normal weekdays)	When one documented complaint is received	75	75	75
Evening time (0700-2300 hrs on holidays; and 1900-2300 hrs on all other days)		60	60	65
Night time (2300-0700 hrs of next day)		45	45	50

Environmental Mitigation Measures

- 4.3 Relevant noise mitigation measures, as recommended in the EIA Report were stipulated in the EM&A Manual for the Contractor to adopt. The implementation status of noise mitigation measures is depicted in Appendix C. Construction Noise Permits were applied and complied with when construction works were carried out during restricted hours.

Monitoring Results

- 4.4 Noise monitoring was conducted throughout the baseline and impact monitoring periods. Noise monitoring data established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) covering a period of three months from February to April 2003 was adopted as the baseline noise monitoring data of the Project. Impact noise monitoring was conducted from 25 July 2003 to 15 February 2008. The baseline and impact noise monitoring data were provided in the baseline monitoring report and monthly EM&A reports respectively. Graphical presentation of the trend of noise over the impact monitoring period is provided in Appendix E.

Non-compliance (exceedances) of the Environmental Quality Performance Limits (Action and Limit Levels)

Summary of Non-compliance (Exceedances)

- 4.5 Table 4.3 summarised the number exceedances recorded at each monitoring station throughout the impact monitoring period. A total of 2,576 exceedances were recorded during the entire construction period where 28, 273 and 2,275 limit level exceedances were recorded during holiday time, evening time and night-time respectively. 2 action level exceedances as complaints were received throughout the impact monitoring period.

Table 4.3 Summary of Noise exceedances

Station	Exceedance Level	Time Period				Total
		Daytime	Holiday	Evening	Night	
NM1	Limit	0	10	112	825	947
NM2	Limit	0	12	137	828	977
NM3	Limit	0	6	24	622	652
Total	Limit	0	28	273	2275	2576

Review of Reasons for and the implications of Non-Compliance

- 4.6 There were two action level exceedances since two noise complaints were received. A total of 2576 Limit level exceedances were recorded in the impact monitoring period where 947, 977 and 652 exceedances were recorded at NM1, NM2 and NM3 respectively. Investigation into the possible causes of each exceedance was undertaken and reported in the respective monthly EM&A reports.
- 4.7 In summary, the average impact noise levels recorded in the reporting quarter were generally within the range of the predicted construction noise levels in the Project EIA except for noise levels recorded during night-time. The noise environment at these monitoring locations at night was dominated by the noisy background and not by the PME's on site.

Summary of Actions Taken in the event of Non-Compliance

- 4.8 In the event of non-compliance, the Contractor was notified immediately. Investigation was carried out within three working days of identification of non-compliance. Assessments showed that all exceedances were not due to the works and therefore no action was required to be taken and these were confirmed by the IEC.

Environmental Acceptability of the Project

Trend of Measured Noise Level (L_{eq})

- 4.9 Other than a few isolated events, the noise monitoring results for all monitoring stations were below the Limit levels. The trend showed no noticeable noise impact from the Project during the impact monitoring period. Although, night time noise monitoring results for all monitoring stations had exceeded the Limit levels, the trend of night time L_{eq} in Appendix E showed no noticeable noise impact from the Project.

Correlation between exceedances with possible noise generating activities

- 4.10 Exceedances were rarely recorded for all monitoring stations. However, exceedances were recorded during night time for all monitoring stations throughout the entire construction period.
- 4.11 For exceedances recorded at night-time at NM1 and NM2, most of the measured noise levels were within the baseline range at NM1 and NM2. There was no land-based construction activity related to works of Reclamation Stage 2 conducted near NM3. Moreover, the work methods and number of plants employed were similar throughout the reporting period. Field observations indicated that the exceedances were mostly caused by air traffic, ferry, human activity, dog barking and sea wave. ET's assessment had shown that these exceedances were not due to the works of Reclamation Stage 2 and this had been confirmed by the IEC. Therefore, noise generating activities of the Project did not cause any noticeable noise impact at the sensitive receivers. The impact noise levels recorded were generally similar to the predicted construction noise levels in the Project EIA except for noise levels recorded during night-time. The noise environment at these monitoring locations at night was dominated by the noisy background and not by the PME's on site.

Comparison of EM&A results with EIA predictions

- 4.12 The EIA predicted that noise emitted by the use of Powered Mechanical Equipment (PME) on site / at shoreline for each activity during different periods of time would be the major source of noise impact during construction. The predicted cumulative noise impacts of construction activities of Theme Park and associated developments with the concurrent projects are summarised in Table 4.4 (extracted from Table 4.5a, 4.5b and 4.6b of the EIA Report).

Table 4.4 Predicted Cumulative Construction Noise Levels

NSR	Location	Range of Predicted Noise Levels, dB(A)		
		Daytime	Evening	Night
N1	Peng Chau	37 – 62	29 – 59	37 – 43
N2	Discovery Bay	36 – 64	28 – 60	39 – 45
N3	Luk Keng Tsuen	70 – 75	62 – 68	n/a

* n/a — N3 was excluded from night-time construction noise assessment.

- 4.13 During the construction period of the Project, two noise complaints were received and exceedances of Limit levels were recorded in the impact monitoring period. The measured impact noise levels of the Project for each monitoring station are summarised in Table 4.5 for comparison with EIA.

Table 4.5 Summary of Impact Noise Monitoring Results

NSR	Location	Average Impact Noise Levels, dB(A) (Range)		
		Daytime	Evening	Night
NM1	Sea Crest Villa (Peng Chau)	63.2 (51.0 – 74.8)	57.7 (45.4 – 67.1)	57.3 (46.1 – 65.6)
NM2	Crestmont Villa (Discovery Bay)	60.6 (47.8 – 70.1)	58.1 (47.1 – 67.8)	57.6 (47.0 – 65.6)
NM3	Luk Keng Tsuen	63.0 (52.2 – 70.1)	61.8 (49.0 – 67.9)	60.6 (47.5 – 66.2)

- 4.14 The average impact noise levels recorded in EM&A were mostly within the range of the predicted construction noise levels in the EIA Report except for noise levels recorded during night-time. The average baseline noise levels recorded at NM1, NM2 and NM3 during night-time were already higher than the night-time noise criterion of 45 dB(A). ET's assessment had shown that these exceedances were not due to the works of Reclamation Stage 2 and this had been confirmed by the IEC. This indicates that the noise environment at these monitoring locations at night was dominated by the noisy background and not by the PME's on site.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 4.15 Monitoring and auditing of noise was recommended for the construction phase of the Project in the EIA process to ensure compliance with the appropriate criterion at the receivers.
- 4.16 The noise monitoring methodology was effective in monitoring the noise impacts of the Project. Baseline noise monitoring determined the ambient noise levels at the sensitive receivers prior to commencement of construction works. During periods when possible noise generating construction activities were on-going, impact noise monitoring would determine whether the Project caused adverse noise impacts on the sensitive receivers. The monitoring methodology which focus on $L_{eq,30 \text{ minute}}$ during day time and $L_{eq, 5 \text{ minute}}$ during holiday, evening time and night-time are therefore considered to be cost effective for the Project.
- 4.17 Noise mitigation measures recommended in the EIA Report were stipulated in the EM&A Manual for the Contractor to implement during the construction phase of the Project. The list of noise mitigation measures is depicted in Appendix C. All recommended mitigation measures were applicable to the Project. As discussed above, the Project did not cause adverse noise impacts to the receivers. Therefore, the mitigation measures implemented were effective and efficient in controlling noise impacts.
- 4.18 Monitoring and audit of noise levels ensured that any noise impact to the receivers would readily be detected and timely actions could be taken to rectify any non-compliance. Assessment and analysis of noise results collected throughout the baseline and impact monitoring periods also demonstrated the environmental acceptability of the Project. Weekly site inspections ensured that the EIA recommended noise mitigation measures were effectively implemented. The EM&A program is considered to be cost effective. It is however, recommended that night-time monitoring at NM3 should be removed from the EM&A program as there is no line of sight from Luk Keng Tsuen to the construction activities carried out at night-time for the Project. As the approval for the termination of noise monitoring at Luk Keng Tsuen (i.e. at NM3) was granted by EPD on 6 December 2006, no noise monitoring would be carried out after 31 December 2006.

Conclusion

- 4.19 The trend of L_{eq} was comparable to the baseline range and showed no noticeable noise impact during the impact monitoring period. Although exceedances were recorded, there was no evidence of long-term increasing trend. The average impact noise levels recorded in EM&A programme were mostly

within the range of the construction noise levels predicted in the EIA except for noise levels recorded during nighttime. It was apparent that the limit levels for nighttime noise were set below the measured baseline levels, and were not achievable to the real situation. Nighttime noise criterion should take the prevailing baseline levels into consideration. Noise mitigation measures implemented were effective in controlling noise impacts.

5. WATER QUALITY

Monitoring and Audit Requirements

Monitoring Parameters and Methodology

- 5.1 In accordance with the EM&A Manual, baseline dissolved oxygen, turbidity and suspended solids levels at 32 marine water quality monitoring stations were established. For monitoring stations covered by concurrent projects in the region, the ET adopted the monitoring data from Infrastructure Development, Contract 1 (Contract No. CV/2000/09) as the baseline data for the Project after consultation and agreement with the Engineer, IEC, EPD, AFCD and CEDD.
- 5.2 Baseline, impact and post-project water quality monitoring were carried out for the Project. In accordance with the EM&A Manual, thirty-two stations (10 Sensitive Receiver Stations, 7 Control Stations and 15 Gradient Stations) were designated for marine water quality monitoring. The ten Sensitive Receiver (SR) Stations were chosen on the basis of their proximity to the reclamation and thus the greatest potential for water quality impacts, the seven Control Stations (CS) were chosen to facilitate comparison of the water quality of the SR stations with ambient water quality conditions and, the fifteen Gradient Stations (G) were chosen to assist in the identification of the source of any impact. The water quality monitoring locations are depicted in Figure 5.1 and 5.2. Water quality monitoring requirements are summarised in Table 5.1. Water quality monitoring works were conducted and water quality monitoring equipment was calibrated in accordance with the requirements specified in Section 7 of the EM&A Manual.
- 5.3 Baseline marine water quality monitoring for CS4-CS5, CS7, G2-G4, G7-G15, SR1-SR3 and SR8-SR10 were carried out 3 days per week for 4 weeks prior to the commencement of the reclamation works from 2 to 28 May 2003. For other designated marine water quality monitoring stations, marine water quality monitoring data from 2 to 28 May 2003 established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) were adopted as the baseline marine water quality monitoring data for the Project.
- 5.4 In accordance with the EM&A Manual, NH₃-N & TIN and TBT/PAHs/PCBs monitoring was required in the first two months of the Project to assess the relevant water quality impact and hence, review the necessity of continuing such monitoring events. The monitoring programme and locations for NH₃N & TIN would be the same as for the regular marine water quality monitoring programme for other parameters.
- 5.5 Water samples would be taken at all 32 monitoring locations listed in Table 5.1.

Table 5.1 Water Quality Monitoring Requirements

Type	Location	HK Metric Grid E	HK Metric Grid N	Parameters	Frequency	No. of Depths	No. of Samples
Control Stations	CS1*	818 678	823 526	- Depth(m) - Temperature, (°C) - Salinity (ppt) - Dissolved Oxygen (mg/L) - Dissolved Oxygen Saturation (%) - Turbidity (NTU) - Suspended Solids (mg/L) - Nitrogen (Ammonia)^ (NH ₃ -N) (mg/L) - Total Inorganic Nitrogen^ (TIN) (mg/L)	Three times per week during mid-ebb & mid-flood tides	3 (Surface, Mid-Depth & Bottom)	2 (Mid-ebb and Mid-flood)
	CS2*	817 764	820 890				
	CS3*	826 137	822 377				
	CS4	825 255	814 229				
	CS5	823 171	810 014				
	CS6*	825 871	824 880				
	CS7	819 888	808 851				
Gradient Stations	G1*	824 506	821 250				
	G2	824 506	819 229				
	G3	826 256	818 219				
	G4	822 756	818 219				
	G5*	821 272	822 301				
	G6*	822 500	823 400				
	G7	824 222	822 150				
	G8	823 904	820 689				
	G9	824 159	820 632				
	G10	821 000	816 000				
	G11	821 055	814 210				
	G12	820 000	813 000				
	G13	824 090	824 242				
	G14	822 438	814 903				
	G15	821 043	810 667				
Sensitive Receiver Stations	SR1	825 607	816 216				
	SR2	820 268	817 870				
	SR3	821 033	819 153				
	SR4*	823 827	823 208				
	SR5*	823 827	823 705				
	SR6*	824 511	823 518				
	SR7*	823 810	823 590				
	SR8	818 766	811 267				
	SR9	819 133	810 932				
	SR10	818 700	810 600				

* Monitoring data from Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) were adopted as the baseline monitoring data for the Project.

^ Monitoring would be conducted from commencement of dredging and subject to review after initial two months. Approval for termination of NH₃-N and TIN monitoring was granted by EPD on 16 January 2004. Monitoring of NH₃-N and TIN was terminated since 21 January 2004.

Environmental Quality Performance Limits (Action and Limit Levels)

5.6 The Action and Limit levels have been derived in accordance with the Environmental Monitoring & Audit Manual. An alternative set of Action Limit Levels was derived in the following manner and adopted for this Project applied since 3 October 2003.

- Dissolved oxygen $\frac{3}{4}$ derived from baseline dissolved oxygen data of Penny's Bay Reclamation Stage 1 (Contract No. CV/99/12) and baseline dissolved oxygen data for the Project recorded in May 2003
- Turbidity and Suspended solids $\frac{3}{4}$ derived from turbidity and SS data of 4 EPD's routine water quality monitoring stations (SM9, SM10, WM2 and WM4) from January 1995 to June 2000 and baseline turbidity and SS data for the Project recorded in May 2003

5.7 The Action and Limit Levels are shown in Table 5.2.

Table 5.2 Action and Limit levels for Water Quality

Parameter		Action Level	Limit Level
DO, mg/L	Surface & Mid-depth	3.9	3.4
	Bottom	3.8	2.0
Turbidity, NTU		13.9 and 120% of upstream control station's turbidity at the same tide of the same day	20.7 and 130% of upstream control station's turbidity at the same tide of the same day
SS, mg/L		14.3 and 120% of upstream control station's SS at the same tide of the same day	23.7 and 130% of upstream control station's SS at the same tide of the same day

- 5.8 The Action Limit Levels as shown in Table 5.2 takes into account recent regional changes and seasonal variation in water quality in Lantau, this set of Action Limit Levels would be applied for compliance assessment.
- 5.9 Seven stations were designated for TBT, PAHs and PCBs monitoring. Pre-dredging TBT, PAHs and PCBs monitoring was conducted on 2 days within one week, at mid-flood and mid-ebb tides prior to dredging operations on 12 and 16 May 2003 at the 7 designated monitoring stations. The locations of these monitoring stations are summarized in Table 5.3 and depicted in Figure 5.2.
- 5.10 Table 5.3 summarised the monitoring parameters, frequencies and duration of the pre-dredging monitoring of TBT, PAHs and PCBs.

Table 5.3 TBT, PAHs and PCBs Monitoring, Locations, Parameters, Period and Frequency

Location	HK Metric Grid E	HK Metric Grid N	Parameters	Frequency	No. of Depths
TPP1	823 798	823 630	Tributyl Tin (TBT, µg/L), Polycyclic Aromatic Hydrocarbons (PAHs, µg/L), Polychlorinated Biphenyls (PCBs, µg/L)	Two times within one week during mid-ebb and mid-flood tides before dredging	3 (Composite Sample of Surface, Mid-Depth & Bottom)
TPP2	823 842	823 165			
TPP3 (Control)	826 327	818 446			
TPP4	824 084	819 562		Three times per week during mid-ebb and mid-flood tides during dredging (subject to review after 2 months monitoring)	
TPP5	823 238	818 568			
TPP6	823 800	820 000			
TPP7	819 133	810 932			

- 5.11 In accordance with the EM&A Manual, the Limit Levels of TBT, PAHs and PCBs was established in accordance with the Australian Water Quality Guidelines for Fresh and Marine Waters (1992). The Limit Levels are provided in Table 5.4.

Table 5.4 Limit Levels for TBT, PAHs and PCBs

Parameter	Limit Level, mg/L
TBT	0.002
PAHs (light and heavy)	3.0
Total PCBs	0.004

Environmental Mitigation Measures

- 5.12 Relevant water quality mitigation measures, as recommended in the project EIA study final report were stipulated in the EM&A Manual for the Contractor to adopt. The list of water quality mitigation measures is depicted in Appendix C.

Monitoring Results

- 5.13 Water quality monitoring for dissolved oxygen, turbidity and suspended solids was conducted throughout the baseline, impact and post-project monitoring periods. Baseline marine water quality monitoring for CS4-CS5, CS7, G2-G4, G7-G15, SR1-SR3 and SR8-SR10 were carried out 3 days per week for 4 weeks prior to the commencement of the reclamation works from 2 to 28 May 2003. For other designated marine water quality monitoring stations, marine water quality monitoring data from 2 to 28 May 2003 established for Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) were adopted as the baseline marine water quality monitoring data for the Project.
- 5.14 Impact water quality monitoring was conducted from 21 July 2003 to 31 December 2007. All marine works was substantially completed in December 2007. As the approval for the termination of water quality impact monitoring after December 2007 was granted by EPD on 25 January 2008, in accordance with Section 7.36 of the EM&A Manual, post-project monitoring was scheduled for four weeks (from 2 January 2008 to 28 January 2008), in the same manner as the impact monitoring during construction. No exceedance was recorded in the post-project monitoring.
- 5.15 The baseline, impact water quality and post-project water quality monitoring data were provided in the baseline monitoring report and monthly EM&A reports respectively. Graphical presentation of the trend of water quality over the construction period is provided in Appendix F.
- 5.16 Monitoring of NH₃-N & TIN and TBT/PAHs/PCBs monitoring was conducted before the initial phase of dredging i.e. 29 July 2003 until EPD's approval for discontinuation was given. The monitoring data were provided in the monthly EM&A reports. Review reports, which included the assessment of environmental impacts in terms of these parameters arising from the dredging works and evaluation of necessity in continuing the monitoring programmes were submitted in October 2003. Further to the submissions, approval for termination of NH₃-N and TIN monitoring was granted by EPD on 16 January 2004. Monitoring of NH₃-N and TIN was terminated since 21 January 2004. Approval for the termination of PAHs/PCBs and TBT monitoring was granted by EPD on 16 January 2004 and 9 November 2005 respectively. Monitoring of PAHs/PCBs and TBT monitoring was terminated since 21 January 2004 and 11 November 2005 respectively.

Non-compliance (exceedances) of the Environmental Quality Performance Limits (Action and Limit Levels)

Summary of Non-compliance (Exceedances)

- 5.17 Table 5.5 summarised the number of dissolved oxygen, turbidity and suspended solids exceedances recorded at each sensitive receiver station throughout the impact monitoring period. A total of 820 exceedances were recorded during the entire construction period with 713 Action level exceedances and 107 Limit level exceedances.

Table 5.5 Summary of Water Quality Exceedances

Station	Exceedance Level	DO (S&M)		DO (Bottom)		Turbidity		SS		Total	
		Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
SR 1	Action	0	1	0	1	3	2	16	19	19	22
	Limit	0	0	0	0	3	5	1	0	4	5
SR 2	Action	4	2	2	2	19	37	60	60	86	101
	Limit	0	0	0	0	3	7	6	15	9	22
SR 3	Action	1	0	1	1	27	16	43	37	73	54
	Limit	0	0	0	0	4	7	4	3	8	10
SR 4	Action	1	2	2	4	5	12	19	32	28	50
	Limit	1	2	0	0	0	4	2	5	3	11
SR 5	Action	1	5	4	9	2	5	11	14	18	33
	Limit	0	1	0	0	0	0	0	2	0	3
SR 6	Action	1	2	2	2	1	9	8	31	12	44
	Limit	1	0	0	0	0	2	1	7	2	9
SR 7	Action	0	2	1	2	2	2	12	16	15	22
	Limit	1	0	0	0	0	0	2	0	3	0
SR 8	Action	0	1	3	3	10	3	24	18	37	25
	Limit	0	0	0	0	2	0	5	3	7	3
SR 9	Action	1	0	3	5	7	4	18	9	30	18
	Limit	0	0	0	0	1	1	3	1	4	2
SR 10	Action	1	1	2	2	2	0	11	10	17	13
	Limit	0	0	0	0	1	1	0	0	1	1
Total	Action	10	16	20	31	78	90	222	246	713	
	Limit	3	3	0	0	14	27	24	36	107	

5.18 For TBT, PAHs and PCBs, 246 exceedances for TBT were recorded during the impact-monitoring period. No exceedance was recorded for PAHs and PCBs.

Review of Reasons for and the implications of Non-Compliance

5.19 Investigation into the possible causes of each dissolved oxygen, turbidity and suspended solids exceedance was undertaken and reported in the respective monthly EM&A reports. ET's assessment showed that the exceedances were not attributed to the works of Reclamation Stage 2. The IEC had carried out an assessment of the data based on the NOE submissions and concluded that the NOEs recorded in the month were not due to the works and no further action was required.

5.20 For TBT, a total of 246 exceedances were recorded in the impact monitoring period. The exceedances were considered not due to the works of Reclamation Stage 2 as the TBT levels recorded were either within the range of the levels recorded prior to dredging or the monitoring station is located upstream of Reclamation Stage 2 works area during ebb tide

5.21 In summary, tidal flows and ambient conditions were considered to have strong effects on the water quality monitoring results. Exceedances were considered to be due to a combination of the following possible causes:

- poor regional water quality on particular days, which might have been affected by tidal conditions;
- local impacts in the vicinity of the receivers; and
- seasonal variation

Actions Taken during the Construction Period

5.22 The actions taken in the impact monitoring period are summarised below:

- A proposal of 150 m opening in the southern silt curtain outside the marine access in the southern seawall was approved by EPD and Marine Department on 29 August and 25 September 2006 respectively. It would be used as the main access for barges until completion of the project. Additional monitoring station was set up outside the 150m opening in the silt curtain and monitoring was carried out for the first three months to ensure the provision of southern marine access would not result in deterioration of water quality in the sea. The opening work was completed on 29 October 2006 and monitoring was commenced on 30 October 2006. No exceedance of Action and Limit Level for DO, turbidity and SS was recorded during the first three months monitoring period.
- Site inspection was carried out by Environmental Protection Department (EPD) on 13 November 2007 regarding the proposed removal work of the silt curtains. EPD have no adverse comment on the removal work. The removal of silt curtains was commenced on 15 November 2007.

Environmental Acceptability of the Project

Trend of water quality

Dissolved Oxygen

5.23 The dissolved oxygen levels recorded in the impact monitoring period showed a seasonal trend in which lower DO levels were recorded during the wet season and higher DO levels were recorded during the dry season. One reason for this seasonal trend may have been the increase in water temperature during the wet season leading to decreases in the solubility of oxygen in water and vice versa during the dry season. Other than a few isolated events, the trend of dissolved oxygen levels at each monitoring stations in Appendix F did not show any noticeable deterioration of dissolved oxygen levels nor any correlation with the dredging and filling rates during the impact monitoring period.

Turbidity

5.24 The turbidity levels recorded in the impact monitoring period showed seasonal variation in which lower turbidity levels were recorded during the wet season and higher turbidity levels were recorded during the dry season. The trend of turbidity levels of each monitoring station was shown in Appendix F. Moreover, the trend did not show any correlation with the dredging and filling rates during the impact monitoring period.

Suspended solids

5.25 The suspended solid levels recorded in the impact monitoring period showed seasonal variation in which lower suspended solid levels were recorded during the wet season and higher suspended solid levels were recorded during the dry season. The trend of suspended solid levels showed a consistent elevation during the period of dry season in year 2004 to 2007. This could be regarded as a seasonal fluctuation of water quality rather than the impacts caused by the filling activities close to the southern marine access. Moreover, the trend did not show any correlation with the dredging and filling rates during the impact monitoring period.

Correlation between exceedances with possible marine construction activities

5.26 The number of water quality exceedances recorded at the sensitive receiver stations per monitoring week and the corresponding average daily dredging and filling rates would give an indication of correlation between exceedances and marine construction activities.

5.27 Table 5.6 summarised the total number of exceedances per monitoring week and the average daily dredging and filling rates of each month during the impact monitoring period.

Table 5.6 Summary of number of water quality exceedances per monitoring day

Month	No. of Monitoring Days	Average Dredging Rate m ³ /week	Average Sand Filling Rate m ³ /week	Average Public Filling Rate m ³ /week	DO (S&M)	DO (B)	Turbidity	SS	Total
Jul-03	5	26,194	3,721	0	0.20	0.20	1.00	0.80	2.20
Aug-03	11	40,266	1,147	0	0.00	0.36	0.45	0.45	1.27
Sep-03	13	64,694	0	0	0.15	0.31	2.69	0.54	3.69
Oct-03	13	62,670	3,321	0	0.54	0.54	2.15	3.85	7.08
Nov-03	13	41,410	15,269	0	0.31	0.23	1.00	3.38	4.92
Dec-03	13	51,519	12,277	0	0	0	0.92	1.69	2.62
Jan-04	13	49,955	5,114	0	0	0	0.54	1.54	2.08
Feb-04	13	49,330	4,260	0	0	0	0.77	2.54	3.31
Mar-04	13	33,934	8,368	0	0	0	0.77	3.38	4.15
Apr-04	14	34,045	8,274	0	0	0	1.07	2.64	3.71
May-04	12	43,795	15,292	0	0	0	0	1.25	1.25
Jun-04	14	31,404	19,871	8,960	0	0	0.5	1.07	1.57
Jul-04	12	16,082	14,705	10,743	0.08	0.33	0.33	0.42	1.17
Aug-04	13	41,687	15,292	10,605	0.77	0.77	0.38	0.46	2.38
Sep-04	14	47,107	6,728	17,203	0.5	0.71	0.64	1.86	3.71
Oct-04	13	46,954	19,547	19,516	0	0	0.54	3.23	3.77
Nov-04	13	51,831	15,332	19,775	0	0	0.15	1.38	1.54
Dec-04	13	59,303	20,013	26,360	0	0	1.15	2.38	3.54
Jan-05	13	55,444	52,985	43,664	0	0	0.38	1.54	1.92
Feb-05	13	37,102	23,686	53,721	0	0	0	0.23	0.23
Mar-05	12	35,385	46,053	79,974	0	0	0.5	0.67	1.17
Apr-05	14	25,707	56,743	100,641	0	0	0	0.14	0.14
May-05	12	19,528	35,400	107,150	0	0	0	0	0
Jun-05	14	25,525	26,510	95,688	0	0	0.07	0.43	0.5
Jul-05	12	38,648	6,928	122,913	0	0.67	0	0	0.67
Aug-05	14	21,094	19,161	115,046	0	0	0	0	0
Sep-05	13	29,061	22,645	133,537	0	0	0.23	1.00	1.23
Oct-05	13	16,800	13,492	119,293	0	0	0	1	1
Nov-05	13	29,061	17,721	129,888	0	0	0	0.38	0.38
Dec-05	13	27,825	48,195	134,818	0	0	0.15	0	0.15
Jan-06	13	0	39,507	111,547	0	0	0	0	0
Feb-06	14	0	8,541	121,258	0	0	0	0	0
Mar-06	12	0	25,131	150,350	0	0	0	0	0
Apr-06	13	0	22,841	150,475	0	0	0	0.15	0.15
May-06	12	0	26,773	106,857	0	0	0	0	0
Jun-06	13	0	29,237	77,002	0	0	0	0	0
Jul-06	13	0	17,479	81,125	0	0	0	0	0
Aug-06	14	0	4,731	50,450	0	0	0	0.14	0.14
Sep-06	12	0	15,136	123,835	0	0	0	0.33	0.33
Oct-06	13	0	4,642	145,995	0	0	0.23	0.38	0.62
Nov-06	13	0	5,127	109,417	0	0	0	0.85	0.85
Dec-06	12	0	9,941	111,867	0	0	0	0.83	0.83
Jan-07	14	0	11,213	111,469	0	0	0	0	0
Feb-07	13	0	4,142	91,331	0	0	0	0	0
Mar-07	12	0	3,380	88,764	0	0	0	0	0
Apr-07	14	0	7,523	57,201	0	0	0	0	0

Month	No. of Monitoring Days	Average Dredging Rate m ³ /week	Average Sand Filling Rate m ³ /week	Average Public Filling Rate m ³ /week	DO (S&M)	DO (B)	Turbidity	SS	Total
May-07	12	0	8,513	48,654	0	0	0	0	0
Jun-07	14	0	1,622	17,783	0	0	0	0	0
Jul-07	13	0	1,249	0	0	0	0	0	0
Aug-07	13	0	5,197	0	0	0	0	0	0
Sep-07	13	0	0	0	0	0	0	0	0
Oct-07	13	0	0	0	0	0	0	0	0
Nov-07	13	0	0	0	0	0	0	0	0
Dec-07	13	0	0	0	0	0	0	0	0
Jan-08	14	0	0	0	0	0	0	0	0
Feb-08	1	0	0	0	0	0	0	0	0

- 5.28 As shown in Table 5.6, there was no apparent correlation between the dredging and filling rates and the number of water quality exceedances recorded per monitoring day.
- 5.29 For dissolved oxygen, the number of dissolved oxygen exceedances show a seasonal variation with more exceedances recorded in the summer months. This was likely due to higher water temperature in the summer months leading to decreases in the solubility of oxygen in marine water.
- 5.30 For turbidity, the number of turbidity exceedances show a seasonal variation with more exceedances recorded during the dry season than in the wet season.
- 5.31 For suspended solids, the number of suspended solid exceedances show a seasonal variation with more exceedances recorded during the dry season than in the wet season.
- 5.32 The trend of turbidity and suspended solid levels showed a consistent elevation during the period of dry season. This could be regarded as a seasonal fluctuation of water quality rather than the impacts caused by the filling activities close to the southern marine access. Moreover, the trend did not show any correlation with the dredging and filling rates during the impact monitoring period.
- 5.33 With proper implementation of water quality mitigation measures and additional mitigation measures, marine construction activities of the Project were not observed to cause any unacceptable water quality impacts to the sensitive receiver stations.

Comparison of EM&A results with EIA predictions

- 5.34 Results from the sensitive receiver stations were compared with the EIA predictions for the sensitive receivers in the following manner:
- Kau Yi Chau (SM9) with SR1
 - Discovery Bay Beach (SM10) with SR2
 - Sze Pak Wan (SM10) with SR3
 - Ma Wan Fish Culture Zone (WM4) with SR4, 5 and 7
 - Tung Wan Beach, Ma Wan (WM4) with SR6

Dissolved oxygen

- 5.35 According to Section 5.6.37 of the EIA Report, the dissolved oxygen depletion from the loss of sediment to suspension during the construction of the Penny's Bay reclamation for the Theme Park was calculated to be greater than 0.051 mgL⁻¹ in the vicinity of the works. Such depletion would decrease over a wider area, including a portion of the coastline of north east Lantau Island, and was predicted to be in the range of 0.034 to 0.017 mg L⁻¹. Further from the works area, in Sze Pak Wan, Discovery Bay, Peng Chau and around Ma Wan Island, the reductions in dissolved oxygen levels were predicted to be

less than 0.017 mgL⁻¹. The background dissolved oxygen values adopted in the EIA were 4.2 mgL⁻¹ and 4.9 mgL⁻¹ at Stations WM4 and SM10 respectively. The predicted depletions in dissolved oxygen concentrations would only persist during the maximum rates of dredging and filling, and at other times the reductions in dissolved oxygen concentrations would be less.

- 5.36 During the construction phase, the highest rate of dredging was recorded in September 2003, while the highest rate of filling (sand filling and public filling) was recorded in December 2005.
- 5.37 The baseline dissolved oxygen levels and the level of depletion in the months with maximum dredging and the month with maximum filling rate at each sensitive receiver are summarised in Tables 5.7 and 5.8.

Table 5.7 Average dissolved oxygen levels (Surface & Mid-depth) during baseline period, maximum rate of dredging and filling (mgL⁻¹)

Sensitive Receiver	Location	Baseline mean	At Maximum Rate of Dredging	At Maximum Rate of Filling	Depletion At Maximum Rate of Dredging	Depletion At Maximum Rate of Filling
SR1	Kau Yi Chau	7.425	5.401	6.82	2.024	0.605
SR2	Discovery Bay	7.84	6.151	6.802	1.689	1.038
SR3	Sze Pak Wan	8.076	6.958	6.827	1.118	1.249
SR4	Ma Wan FCZ South	6.261	5.249	6.82	1.012	-0.559
SR5	Ma Wan FCZ North	6.268	5.241	6.74	1.027	-0.472
SR6	Tung Wan Beach	6.206	5.274	6.823	0.932	-0.617
SR7	Ma Wan FCZ	6.249	5.277	6.768	0.972	-0.519
SR8	Cheung Sha Wan Fish Culture Zone North	7.378	6.873	6.647	0.505	0.731
SR9	Cheung Sha Wan Fish Culture Zone East	7.072	6.539	6.696	0.533	0.376
SR10	Cheung Sha Wan Fish Culture Zone South	7.029	6.637	6.788	0.392	0.241

Table 5.8 Average dissolved oxygen levels (Bottom) during baseline period, maximum rate of dredging and filling (mgL⁻¹)

Sensitive Receiver	Location	Baseline mean	At Maximum rate of Dredging	At Maximum rate of Filling	Depletion At Maximum rate of Dredging	Depletion At Maximum rate of Filling
SR1	Kau Yi Chau	6.996	5.264	6.868	1.732	0.128
SR2	Discovery Bay	7.457	5.906	6.818	1.551	0.639
SR3	Sze Pak Wan	7.569	6.349	6.824	1.22	0.745
SR4	Ma Wan FCZ South	5.950	5.093	6.866	0.857	-0.916
SR5	Ma Wan FCZ North	5.658	4.965	6.760	0.693	-1.102
SR6	Tung Wan Beach	-	5.132	6.867	-	-
SR7	Ma Wan FCZ	5.602	5.066	6.825	0.536	-1.223
SR8	Cheung Sha Wan Fish Culture Zone North	7.076	6.358	6.691	0.718	0.385
SR9	Cheung Sha Wan Fish Culture Zone East	6.749	6.05	6.801	0.699	-0.052
SR10	Cheung Sha Wan Fish Culture Zone South	6.841	6.065	6.814	0.776	0.027

- 5.38 For dissolved oxygen, in the month with maximum rate of dredging at a magnitude of 64,694 m³ per week, depletion at most of sensitive receiver locations was observed. In the month with the maximum rate of filling at a magnitude of 183,013 m³ per week, depletion at most of sensitive receiver locations was observed, there was no adverse effect on dissolved oxygen concentrations as a result of the mud-dredging, sand-filling and public fill works of the Project as the depleted dissolved oxygen concentrations did not breach the Water Quality Objectives nor did they exceed the AL levels adopted for the Project.

Suspended solids

- 5.39 The EIA determined the acceptability of elevations in suspended sediment concentrations based on the Water Quality Objectives. The Water Quality Objectives for suspended sediments for the Southern, Western Buffer and North Western Water Control Zones were defined as being an allowable elevation of 30% above the background. The ambient and tolerance values for suspended sediment concentrations in the vicinity of sensitive receivers adopted in Table 5.5a of the EIA Report are presented in Table 5.9.

Table 5.9 Ambient and Tolerance Values for Suspended Sediment Concentrations (mgL⁻¹) in the Vicinity of Sensitive Receivers adopted in the EIA

Sensitive Receiver (Relevant EPD Monitoring Station)	Ambient value (90th Percentile)		Tolerance value (30% Tolerance)	
	Dry Season	Wet Season	Dry Season	Wet Season
Kau Yi Chau (SM9)	12.6	35.2	3.8	10.6
Discovery Bay Beach (SM10)	12.5	11.0	3.8	3.3
Sze Pak Wan (SM10)	12.5	11.0	3.8	3.3
Ma Wan Fish Culture Zone (WM4)	15.0	10.7	4.5	3.2
Tung Wan Beach, Ma Wan (WM4)	15.0	10.7	4.5	3.2
Silvermine Bay Beach (SM11)	12.6	18.0	3.8	5.4

- 5.40 The predicted suspended sediment concentrations in the month with maximum rate of dredging and in

the months with maximum rate of filling of the Project as shown in Table 5.6g and h in the EIA Report are summarised in Table 5.10.

Table 5.10 Calculated Elevations in Suspended Sediment Concentrations at Sensitive Receivers (mgL⁻¹) for the Maximum Rate of Dredging and Filling from the EIA

Sensitive Receiver (Relevant EPD Monitoring Station)	Calculated Elevations for the Maximum rate of Dredging		Calculated Elevations for the Maximum rate of Filling	
	Dry Season	Wet Season	Dry Season	Wet Season
Kau Yi Chau (SM9)	0	0.4	0	0.6
Discovery Bay Beach (SM10)	0	0	0.1	0.1
Sze Pak Wan (SM10)	0.1	0.2	0.6	0.3
Ma Wan Fish Culture Zone (WM4)	2.7	1.7	4.2	2.7
Tung Wan Beach, Ma Wan (WM4)	0.5	0.8	0.7	1.3
Silvermine Bay Beach (SM11)	0	0	0	0

5.41 For suspended solids, as the baseline monitoring was conducted in the transitional season or just the start of wet season while the maximum dredging and filling rates were recorded in the dry season, direct comparison with the EIA predictions could not be made. The comparison of EM&A results with EIA predictions in the following paragraphs was based on the criteria of acceptability of 30 percent elevations above the background as defined in the Water Quality Objectives which was also used in scenario predictions in the EIA.

5.42 Suspended solids level provides a direct indication of impacts from dredging and sand-filling works. Baseline water quality monitoring for the Project was conducted during the transitional season. The mean baseline suspended solids level at each sensitive receiver and 30 percent of the baseline mean are presented in Table 5.11.

Table 5.11 Baseline suspended solids levels and 30% of baseline mean (mgL⁻¹)

Sensitive Receiver	Location	Baseline mean	30% of baseline mean
		Transitional Season	Transitional Season
SR1	Kau Yi Chau	6.583	1.975
SR2	Discovery Bay	7.906	2.372
SR3	Sze Pak Wan	6.583	1.975
SR4	Ma Wan FCZ South	6.320	1.896
SR5	Ma Wan FCZ North	6.263	1.879
SR6	Tung Wan Beach	5.792	1.738
SR7	Ma Wan FCZ	5.833	1.750
SR8	Cheung Sha Wan Fish Culture Zone North	5.159	1.548
SR9	Cheung Sha Wan Fish Culture Zone East	5.056	1.517
SR10	Cheung Sha Wan Fish Culture Zone South	5.323	1.597

5.43 The average elevations in suspended solids concentrations of the month with maximum dredging rate (September 2003) and the month with maximum filling rate (December 2005) compared with the baseline levels are provided in Table 5.12.

Table 5.12 Average suspended solids levels at sensitive receivers (mgL⁻¹) at the maximum rates of dredging and filling

Sensitive Receiver	Location	SS level at Maximum rate of Dredging (September 2003)		SS level at Maximum rate of Filling (December 2005)	
		Average	Elevation	Average	Elevation
SR1	Kau Yi Chau	9.851	3.268	6.564	-0.019
SR2	Discovery Bay	15.540	7.634	7.115	-0.791
SR3	Sze Pak Wan	11.221	4.638	6.769	0.186
SR4	Ma Wan FCZ South	13.909	7.589	7.135	0.815
SR5	Ma Wan FCZ North	8.641	2.378	7.154	0.891
SR6	Tung Wan Beach	10.357	4.565	7.019	1.227
SR7	Ma Wan FCZ	8.086	2.253	7.346	1.513
SR8	Cheung Sha Wan Fish Culture Zone North	10.855	5.696	7.276	2.117
SR9	Cheung Sha Wan Fish Culture Zone East	10.990	5.934	6.834	1.778
SR10	Cheung Sha Wan Fish Culture Zone South	10.160	4.837	6.795	1.472

- 5.44 In the month with maximum rate of dredging at 64,694 m³ per week, the average elevations in suspended solids levels were above 30 percent of the baseline suspended solids levels at all stations. As discussed above, regional influences would have stronger effects on the deterioration in water quality than activities at the Penny's Bay work site. A combination of poor regional water quality affected by tidal and climatic conditions, local impacts from the vicinity of the receiver would have strong effects on the water quality. According to the EIA flow pattern, water quality at SR6 would not be affected by the works of the Project. Moreover, seasonal variation in regional water quality dominated the trend of suspended solids levels.
- 5.45 In the month with the maximum rate of filling at 183,013 m³ per week, there was no elevation in suspended solids levels at SR1 and SR2 compared to the baseline suspended solids levels. Note that dredging at a rate of 27,825 m³ per week was taking place concurrently. As discussed above, a seasonal variation in regional water quality dominated the trend of suspended solids levels.

TIN and NH₃-N

- 5.46 According to Section 5.6.42 of the EIA Report, the calculated increases in total nitrogen (equated to total inorganic nitrogen) in the immediate vicinity of the works area were predicted to be in excess of 0.018 mgL⁻¹. Outside the works area, and along the coast of northeast Lantau Island, increases were predicted to be in the range of 0.004 to 0.009 mgL⁻¹. These areas were best represented by EPD routine water quality monitoring station SM10, where the depth averaged total inorganic nitrogen concentration was 0.27 mgL⁻¹. The predicted increases in the vicinity of the works area would only elevate the background levels by less than 7%, which represented only a small increase. Further away from the works, increases due to the reclamation construction would elevate the background levels by 3.3%, which was considered to be negligible.
- 5.47 According to Section 5.6.44 of the EIA Report, increases in unionised ammonia in the immediate vicinity of the works area were predicted to be in excess of 0.000014 mgL⁻¹, which was extremely small. The background level of unionised ammonia at Station SM10, the closest EPD routine water quality monitoring station, was 0.003 mgL⁻¹. The addition of the unionised ammonia from the reclamation works would not significantly add to the background levels nor would the additional unionised ammonia breach the WQO of 0.021 mgL⁻¹.

- 5.48 For NH₃-N and TIN, the average TIN and NH₃-N values recorded in August and September 2003 are summarised in Table 5.13.

Table 5.13 Summary of TIN & NH₃-N Levels in August & September 2003

Values	TIN (mg/L)		NH ₃ -N (mg/L)	
	August 2003	September 2003	August 2003	September 2003
Maximum	1.29	1.28	0.87	0.24
Average	0.4264	0.4470	0.0905	0.0467

- 5.49 Although a gradual increase in the daily dredging rate was observed from August to September 2003, no significant change in TIN levels but decrease in NH₃-N levels was observed from the monitoring results collected during the initial two months of dredging operations. This indicated that TIN or NH₃-N levels are not affected by dredging operations of the Project, but are more likely due to local and regional impacts on water quality.

TBT, PAHs and PCBs

- 5.50 The desorbed concentration of TBT, PAHs and PCBs in the marine waters at Penny's Bay as predicted in Table 5.6k in the EIA Report are summarised in Table 5.14.

Table 5.14 Desorbed Concentrations of Pollutants (mgL⁻¹)

Parameter	Desorbed Concentration	Background Concentration	Total Concentration	Assessment Standard
TBT	0.00009	0.01	0.01009	0.002
Total PAHs	0.066	-	0.066	0.2
Total PCBs	0.00009	-	0.00009	0.014

- 5.51 The data in the above table showed that the concentrations of PAHs and PCBs released to the marine waters due to desorption would not result in exceedances of the relevant assessment standards. It was therefore predicted that there would not be adverse impacts to water quality from the release of these pollutants. The release of TBT to the water column from the sediment plumes was predicted to increase background concentrations by less than 0.1%, which would be a negligible increase.
- 5.52 For TBT, PAHs and PCBs, 246 exceedances for TBT were recorded during the impact-monitoring period while no exceedance was recorded for PAHs and PCBs. The exceedances for TBT were considered not due to the works of Reclamation Stage 2 as the TBT levels recorded were either within the range of the levels recorded prior to dredging or the monitoring station is located upstream of Reclamation Stage 2 works area during ebb tide. The dredging and filling works of the Project did not cause any detectable increase in TBT, PAHs and PCBs levels in waters in the vicinity of Penny's Bay.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 5.53 Monitoring and audit of water quality was recommended for the construction phase of the Project in the EIA process to ensure any deterioration in water quality would be readily detected and timely action could be taken to rectify the situation.
- 5.54 Baseline water quality monitoring determined the ambient water quality in the region prior to commencement of construction works. During periods when mud dredging and sand and public fill filling were on going, impact water quality monitoring helped to determine whether the Project would cause unacceptable water quality impacts on the sensitive receivers. Post-project water quality monitoring upon completion of all marine construction activities helped to demonstrate the return of ambient conditions that existed prior to commencement of the construction works.
- 5.55 The monitoring methodology which focused on dissolved oxygen, turbidity, suspended solids, total inorganic nitrogen, un-ionised ammonia, TBT, PAHs and PCBs is considered to be cost effective for the Project. However, NH₃-N, TIN, TBT, PAHs and PCBs should be monitored during the initial phase of

dredging to demonstrate that the Project would not be a significant source of these pollutants as mentioned in the EIA and the Environmental Permit.

- 5.56 Water quality mitigation measures were recommended in the EIA and a list of water quality mitigation measures were stipulated in the EM&A Manual for the Contractor to implement during the construction phase of the Project. The list of water quality mitigation measures is depicted in Appendix C. All recommended mitigation measures were applicable to the Project. Precautionary measures including installation of silt curtains and construction of rock bund was also implemented to prevent migration of suspended solids towards the sensitive receivers. Monitoring results showed that water quality at sensitive receivers was affected by regional water quality influenced by tidal and climatic conditions, local impacts from the vicinity of the receivers. As discussed above, the Project was not observed to cause unacceptable water quality impacts to the sensitive receivers. Therefore, the mitigation measures implemented were effective and efficient in controlling water quality impacts.
- 5.57 Monitoring and audit of water quality ensured that any water quality impacts to the receivers would be readily detected and timely actions could be taken to rectify any non-compliance. Assessment and analysis of water quality results collected throughout the baseline, impact and post-project monitoring periods also demonstrated the environmental acceptability of the Project. Weekly site inspections ensured that the EIA recommended and additional water quality mitigation measures were effectively implemented.

Conclusion

- 5.58 Water quality monitoring for the Project was conducted during the baseline, impact and post-project monitoring periods. For dissolved oxygen, turbidity and suspended solids levels, a total of 820 exceedances were recorded. Assessment indicated that there was no correlation between the dredging and filling rates and the number of water quality exceedances recorded. Exceedances were considered to be due to a combination of factors including poor regional water quality on particular days, which might have been affected by tidal conditions, local impacts in the vicinity of the receivers.
- 5.59 The DO and SS levels recorded at SR1 to SR7 were in similar magnitude as predicted in the Project EIA. No comparison could be made from SR8 to SR10 as predictions were not made in the Project EIA. For turbidity, as no prediction was made in the Project EIA, no comparison could be made. With the implementation of water quality mitigation measures recommended in the EIA and additional water quality mitigation measures implemented during the EM&A programme, marine construction activities of the Project did not cause any unacceptable water quality impacts to the sensitive receivers.

6. TERRESTRIAL ECOLOGY

Monitoring and Audit Requirements

- 6.1 In accordance with the requirements specified in Section 9 of the EM&A Manual and Section 4 of the Environmental Permit EP-054/2000/E, the EM&A programme (as set out in the EM&A Manual) included baseline and impact monitoring on the locally rare White-bellied Sea Eagles (*Haliaeetus leucogaster*) (herein called 'WBSE') at their breeding territory at Pa Tau Kwu. The monitoring location is depicted in Figure 6.1.
- 6.2 Field surveys of the White-bellied Sea Eagles were conducted twice per month during periods of breeding activity (October to April), and once per month at other times of the year. During each survey, observations on the activity of WBSEs, including feeding, perching/roosting, preening, soaring, flying, nesting and territorial guarding and the time spent on each activity, were recorded. The responses and reactions to any disturbance to the WBSEs were also recorded and examined in conjunction with the construction noise and/or other events in the vicinity of Pa Tau Kwu.
- 6.3 Should the White-bellied Sea Eagles be absent for a whole day during the field survey, the White-bellied Sea Eagles Event-Action Plans would be implemented.
- 6.4 Relevant terrestrial ecology mitigation measures for the White-bellied Sea Eagles, as recommended in the EIA Report were stipulated in the EM&A Manual for the Contractor to adopt. The terrestrial ecology mitigation measures for the White-bellied Sea Eagles are depicted in Appendix C.

Monitoring Results

- 6.5 Baseline Monitoring of the White-bellied Sea Eagles at Pa Tau Kwu was required to be conducted by an avian specialist for 3 months prior to the commencement of works of the Project in accordance with the EM&A Manual. Monitoring field survey results carried out for the Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) from February to April 2003 were adopted as the baseline monitoring surveys for the Project.
- 6.6 In total, 88 impact field surveys were conducted at Pa Tau Kwu throughout the impact monitoring period which covered the period between July 2003 and February 2008 and took place twice per month in the breeding season (October to April) and once per month at other times of the year. In addition to the scheduled surveys, confirmatory *ad hoc* surveys were also conducted when deemed necessary. One additional *ad hoc* survey was undertaken on 13 May 2004 since no White-bellied Sea Eagles (adults or fledglings) was observed throughout the whole day (9:00am to 5:00pm) on 12 May 2004.
- 6.7 A summary of WBSE's activity based on observations made during baseline and impact monitoring surveys is provided in graphical form in Figure 6.2.
- 6.8 Based on monitoring observations, no evidence of disturbance due to works at Penny's Bay Reclamation Stage 2 was observed. Discussion on monitoring results including WBSE reactions to disturbance, breeding status, activities and behaviours were reported in monthly EM&A reports for the Project.
- 6.9 Key observations from each month of EM&A programme are summarised in order to provide a chronology of important events (especially breeding-related) for WBSE at Pa Tau Kwu and a summary of disturbance incidents and their relation to the Project works.
- July 2003 - A single White-bellied Sea Eagle, considered to be the male, was observed at the monitoring site for a short period during the monitoring day. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.

- August 2003 - A single White-bellied Sea Eagle, considered to be the male, was observed at the monitoring site during the monitoring day. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- September 2003 - A single White-bellied Sea Eagle, considered to be the male, was observed at the monitoring site during the survey. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- October 2003 – Breeding season began, both the female and male White-bellied Sea Eagles were observed at the monitoring site. Both birds spent the majority of their time foraging / in distant flight. Both birds appeared to be in healthy condition. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- November 2003 – Both the female and male White-bellied Sea Eagles were observed at the monitoring site on both monitoring days with both birds spending the majority of their time foraging / in distant flight. Both birds appeared to be in healthy condition. On the second monitoring day, both birds were observed delivering nesting material to a tree indicating that the birds may attempt to breed. No behaviour to indicate disturbance from the project works was recorded during the observation period.
- December 2003 – Both birds spent the majority of their time foraging/in distant flight and roosting/preening. On the second survey in December, both birds engaged in duet mating calling indicating that the birds may attempt to breed. No behaviour to indicate disturbance from the project works was recorded during the observation period.
- January 2004 - Both the female and male White-bellied Sea Eagles were observed at the monitoring site on both monitoring days. For the first time during the current breeding season, there was strong evidence that the birds have produced egg(s) with both birds observed taking turns to incubate on the nest. Incubation on the nest was nearly continuous over both monitoring visits and was mainly carried out by the female bird. When not incubating, both birds spent most of their time engaged in foraging/distant flight. There was no evidence to indicate that the works of Reclamation Stage 2 have disturbed the White-bellied Sea Eagles in the reporting month.
- February 2004 - Both the female and male White-bellied Sea Eagles were observed at the monitoring site on both monitoring days. Incubation on the nest, which was first observed last month continued into February. By the time of the second monitoring visit, two chicks had successfully hatched and were observed for the first time. Subsequently, one or both parent birds were observed remaining perched close to the nest throughout the second monitoring day or were observed directly tending to the chicks including feeding. The birds appeared to be in healthy condition and no behaviours indicating disturbance to the WBSE from construction works of Reclamation Stage 2 were observed.
- March 2004 - Both the female and male White-bellied Sea Eagles were observed at the monitoring site on both monitoring days. In addition, the two chicks, which hatched last month, were also observed in the nest. The chicks were observed receiving food items from the parent birds on both monitoring days. On delivery of the prey, which appeared to be fish, the chicks were observed to be capable of feeding on their own. It was also observed that the chicks were beginning to lose their downy white appearance as their feathers develop. The birds appeared to be in healthy condition and no behaviours indicating disturbance to the WBSE from construction works of Reclamation Stage 2 were observed.
- April 2004 - Final month of the annual breeding season, both the female and male White-bellied Sea Eagles were observed at the nesting site during the monitoring month. However, neither of the two nestlings were observed on the two monitoring days. The reason for the apparent disappearance of the nestlings was not known and was difficult to interpret. It was considered possible that the young birds may have fledged and had flown to a location out of view of the observer. However based on previous year's monitoring experience, their absence from the nest site appears to be unusual. Therefore the possibility that the two White-bellied Sea Eagles have not survived for unknown

reasons cannot be discounted. Both adult birds appeared to be in health condition and no behaviours indicating disturbance to the WBSE from construction works of Reclamation Stage 2 were observed.

- May 2004 - This monitoring recorded an exceedance since no White-bellied Sea Eagles (adults or fledglings) were observed throughout the whole day (9:00am to 5:00pm) on 12 May 2004. In accordance with the Event and Action Plan for Ecology, on 13 May 2004, an additional ad hoc survey was undertaken. On this monitoring day, a single adult White-bellied Sea Eagle, thought to be the male bird, was observed, thus indicating its continued occupancy of the nesting territory. A check of the contractor's work methods and monitoring observations indicated there was no evidence that the absence of White-bellied Sea Eagles was linked to construction activities. In addition, there was no noticeable disturbance from construction activities at the monitoring site. It was considered that absence of the adult WBSEs could be accounted for by natural behaviour. Based on recent monitoring observations, there is strong evidence that the 2003 / 2004 breeding season for the WBSEs at Pa Tau Kwu was not successful. Their two offspring have not been observed at the nest site during monitoring in April or May. During summer months after the breeding season and with no fledglings to rear, it is known that WBSE may spend considerable portions of their time in distant flight, as was observed in the reporting month. Therefore, it was considered that remedial action was not warranted. The Project EIA Report predicted the White-bellied Seas Eagles to have a certain degree of tolerance to disturbance. There was no evidence to indicate that the works of Reclamation Stage 2 have disturbed the White-bellied Sea Eagles in the reporting month.
- June 2004 - Both the female and male were observed at the nesting territory during the reporting month including perching in tree branches on the Pa Tau Kwu hillside. Most of their time during the monitoring visit was spent foraging / in distant flight. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- July 2004 - Both the female and male were observed at the nesting territory during the reporting month. All or nearly all of their time during the monitoring visit was spent foraging / in distant flight. The male was observed to return to the nesting territory to feed on a fish. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- August 2004 - Both the female and male were observed at the nesting territory during the reporting month. In general, both birds spent over half of the monitoring time perched in trees at the nesting territory and the remainder of the day foraging/ in distant flight. Feeding by the female was also observed. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- September 2004 - Both the female and male were observed at the nesting territory during the reporting month. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- October 2004 - First month of the breeding season. Both the female and male were observed at the nesting territory during the reporting month. Behaviours indicating that the birds may attempt to breed were observed, including delivery of nest material. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- November 2004 - Both the female and male were observed at the nesting territory during the reporting month. Behaviours indicating that the birds may attempt to breed were observed, including delivery of nest material and duet calling. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- December 2004 - Both the female and male were observed at the nesting territory during the reporting month. For the first time during the current breeding season, there was strong evidence that the birds have produced egg(s) with both birds observed taking turns to incubate on the nest. Incubation on the nest was mainly carried out by the female bird. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- January 2005 - It was found that the White-bellied Sea Eagles had discontinued incubation activities

on the nest. This means this season's breeding attempt was unsuccessful. On the first monitoring day, the White-bellied Sea Eagles spent almost the entire day away from the nesting site, which coincided with the presence of vessels close-by. On the second monitoring day, when no vessels were in close vicinity of the nesting site, the White-bellied Sea Eagles spent most of their time perched at the nesting territory. Based on the available monitoring information, the reason for the breeding failure was difficult to interpret. The possibility that vessel movements in proximity to the Pa Tau Kwu headland may have caused disturbance to the breeding pair could not be ruled out. However, it was considered that further evidence from future monitoring would be needed before this conclusion could be substantiated.

- February 2005 - On both monitoring days, the White-bellied Sea Eagles spent almost the entire monitoring period away from the monitoring site at Pa Tau Kwu. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- March 2005 - On both monitoring days, the White-bellied Sea Eagles spent almost the entire monitoring period away from the monitoring site at Pa Tau Kwu. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- April 2005 - Final month of the annual breeding season, on both monitoring days, the female White-bellied Sea Eagles spent most of the monitoring period away from the monitoring site at Pa Tau Kwu and the male White-bellied Sea Eagles spent most of the monitoring period roosting and in distant flight. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- May 2005 - Both the male and birds spent most of the day from the monitoring site at Pa Tau Kwu. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- June 2005 - Both the male and female birds spent the whole of the day in foraging/distant flight. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- July 2005 - The male White-Bellied Sea Eagle spent most of the monitoring day in foraging/distant flight, and the female spent the entire day in foraging/distant flight. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- August 2005 - The male White-Bellied Sea Eagle spent most of the monitoring day in foraging/distant flight, and the female spent the entire day in foraging/distant flight. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- September 2005 - Only one bird (male) was observed at the monitoring site during survey date. The observed bird was observed for only a short period and no evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- October 2005 - Breeding season began. The female white-bellied sea eagle was observed fighting with a black kite at Fa Peng and only spent a short period of time roosting on the tree within the monitoring site while the male white-bellied sea eagle was observed brought with branches to the longan tree (*Dimocarpus longan*) where the birds are likely making a nest. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.
- November 2005 - Both male and female White-bellied Sea Eagle was observed at the monitoring site and nest building activity performing by birds was also observed on 6 November 2005. Only male bird was observed on site on 23 November 2005. Since the foliage of the longan tree where the birds built breeding nest was quite dense, it is impossible to observe the situation inside the tree crown by binoculars and telescope. Therefore, it is difficult to determine whether the female bird hid inside the nest (incubation) or not.
- December 2005 - Both male and female birds were observed at the monitoring site in the current month. Both birds have spent most of time on distant flight/forage. No breeding or incubation activity was observed. No evidence of disturbance due to works at Penny's Bay Reclamation Stage 2.

- January 2006 - Both male and female birds were observed at the monitoring site in the current month. Both birds have spent most of time on distant flight/forage. No breeding or incubation activity was observed. No direct impacts attributable from the Project were observed.
- February 2006 - Both male and female WBSE were observed at the monitoring site on 7 February. One WBSE was observed for a short period on 24 February. The observed birds were likely in healthy condition although the WBSE spent less time at the nesting site than the previous month.
- March 2006 - Only WBSE (probably male) was observed near the monitoring site on 11 March. Both WBSE were observed for a short period on 23 March. The observed birds were likely in healthy condition although the WBSE spent less time at the nesting site than before. It is noticed that there was a trend that the WBSE became more sensitive to people and spent less time at the monitoring site.
- April 2006 - Final month of the annual breeding season, both male and female WBSE at the monitoring site were observed for a short period time on the both monitoring days. The observed birds were likely in healthy condition although the WBSE spent less time at the nesting site than before.
- May 2006 - Both male and female WBSE at the monitoring site were observed for a short period time on the monitoring day. The observed birds were likely in healthy condition although the WBSE spent less time at the nesting site than before.
- June 2006 - Both birds were observed at the monitoring site during the scheduled monitoring date. The observed bird was likely in healthy condition and no direct impacts attributable to the Project were observed, however, the WBSE spent short period of time at the nesting site than the early stage of the current monitoring programme.
- July 2006 - Both birds were observed at the monitoring site during the scheduled monitoring date. The observed bird was likely in healthy condition and no direct impacts attributable to the Project were observed.
- August 2006 - Both birds were observed at the monitoring site during the scheduled monitoring date. The observed bird was likely in healthy condition and no direct impacts attributable to the Project were observed.
- September 2006 - Both birds were observed at the monitoring site during the scheduled monitoring date. The observed bird was likely in healthy condition and no direct impacts attributable to the Project were observed.
- October 2006 - Breeding season began. Both birds were observed at the monitoring site during the scheduled monitoring days. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- November 2006 - Both birds were observed at the monitoring site during the scheduled monitoring day on 26 November 2006. Only male WBSE was observed at the monitoring site for a short period on 6 November 2006. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- December 2006 - Both WBSE birds were observed at the monitoring site for a short period for both monitoring days. The birds spent most of time on distant flight/forage (including out of sight time). No breeding or incubation activity was observed. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- January 2007 - Both WBSE birds were observed at the monitoring site for both monitoring days. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.

- February 2007 - Both WBSE birds were observed at the monitoring site for both monitoring days. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- March 2007 - Both WBSE birds were observed at the monitoring site for both monitoring days. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- April 2007 - Final month of the annual breeding season, both WBSE birds were observed at the monitoring site for both monitoring days. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- May 2007 - Both male and female WBSE were observed at the monitoring site. The observed birds were likely in healthy condition and no direct impacts attributable to the Project were observed.
- June 2007 - Both birds were more active and have spent more time on territory guarding at the nesting site than before. No breeding activity or behavior or juvenile was observed in the current monitoring month.
- July 2007 - Only male WBSE bird was observed at the monitoring site on 26 July 2007. The male bird has spent a short time foraging at the nesting site. No other behavior such as breeding activity, feeding, roosting/preening or juvenile was observed in the current monitoring month.
- August 2007 - Both birds spent a longer time roosting / preening at the nesting site, this was likely due to raining weather condition. No breeding activity was observed in the current monitoring month.
- September 2007 - Only male WBSE bird was observed at the monitoring site, the bird spent most of time on foraging outside the nesting site, this was a normal behavior likely due to good weather condition. No breeding activity was observed in the current monitoring month.
- October 2007 - Breeding season began. One bird of WBSE was observed on 7 October and two birds of WBSE were observed on 23 October at the monitoring site in the current month. No breeding activity was observed in the current monitoring month.
- November 2007 - One bird of WBSE was observed on 7 November 2007 and two birds of WBSE were observed on 22 November 2007 at the monitoring site in the current month. No mating or incubating behavior was observed in the current monitoring month.
- December 2007 - Two birds of WBSE were observed on 6 December 2007 and one bird of WBSE was observed on 16 December 2007 at the monitoring site. No breeding activities were observed. The observed birds were likely in healthy condition.
- January 2008 - Only one bird of WBSE was observed on both days at the monitoring site. No breeding activities were observed. The observed birds were likely in healthy condition.
- February 2008 - Both male and female birds of WBSE were observed at the monitoring site for short period. No breeding activities were observed. The observed birds were likely in healthy condition. Stage 2 reclamation works end.

Environmental Acceptability of the Project

Changes in activity/behaviour of WBSEs

- 6.10 Baseline survey on WBSE activities and behaviours at Pa Tau Kwu were conducted to characterise pattern of activities and behaviours prior to commencement of the Project.

- 6.11 Monitoring field survey results carried out for the Infrastructure for Penny's Bay Development, Contract 1 (Contract No. CV/2000/09) from February to April 2003 were adopted as the baseline monitoring surveys for the Project.
- 6.12 Baseline monitoring coincided with the latter half of the breeding season for WBSE in Hong Kong. During both days of observation in late January / February 2003, the female WBSE spent nearly all of its time incubating on the nest. This activity was not observed again in surveys conducted in March and April 2003 and no chicks were observed. This situation was interpreted that the eggs had failed to hatch and that the season's breeding attempt was unsuccessful.
- 6.13 The Project EIA Report predicted the WBSEs to have a certain degree of tolerance to disturbance. There was no evidence to indicate that the works of Reclamation Stage 2 have disturbed the WBSEs in the reporting period.

Correlation between activity of the WBSEs with possible disturbance by construction activities

- 6.14 As described above, qualified avian specialists monitoring the WBSEs over the impact monitoring period did not detect any change in activity or behaviour to indicate a Project-related disturbance. Based on the monitoring results, no relationship between WBSE activity or behaviour and the extent or nature of construction works of the Project could be discerned. With proper implementation of terrestrial ecology mitigation measures for the WBSEs, the Project did not cause any unacceptable impacts to the WBSEs.

Comparison of EM&A results with EIA predictions

- 6.15 The EIA Report identified the potential for indirect impacts on WBSE through noise and general disturbance effects during construction activities of the Project. Increased human access to the Project Area was also expected to be a source of impact because of the increased possibility of hillfire, nest predation or human theft of eggs or young birds. Although the EIA Report expected the WBSEs to have a certain degree of tolerance to disturbance, nevertheless the possibility of nest abandonment or in the worst case, breeding failure due to these impacts was not ruled out.
- 6.16 Based on these considerations, potential impacts on the WBSE were expected to be low to moderate. Based on observations made during impact monitoring (presented above), the magnitude of impact to WBSE associated with the Project was considered to be in agreement with the EIA predictions. Throughout the impact monitoring period, the WBSEs were observed to exhibit no signs of disturbance as a consequence of construction noise or general disturbance from construction activities of the Project.
- 6.17 None of the observed disturbances to WBSE was considered to have been a result of the Project works at Penny's Bay. There was no evidence from monitoring observations to indicate that works for the Project was the reason for the lack of breeding success in the breeding seasons. The fact that the WBSEs have not been reproductively successful is not unusual in Hong Kong. Each year, there are very few reports of breeding in the WBSE population across Hong Kong, and, as has been the case at Pa Tau Kwu, when attempted, breeding success is not high.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 6.18 Monitoring and auditing of the WBSEs was recommended for the construction phase of the Project in the EIA process to ensure the proposed mitigation measures were effective.
- 6.19 Methodology used to monitor the Pa Tau Kwu nesting territory involved direct observation of the WBSEs by a qualified avian specialist. Observations were aided by Fieldscope 20-60x and Binoculars 10x from a vantage point 100m from the nest. Surveys typically lasted for about 8 hours on each monitoring visit and during this time WBSE activities were categorised and the time spent on each recorded. Other

pertinent observations such as size of prey and the effects of disturbance on the WBSEs were also recorded. In general, this methodology and the frequency of its employment was considered to be adequate and cost-effective for determining the extent of noise and general disturbance impacts from reclamation works on the WBSE activities as identified in the EIA Report.

- 6.20 Terrestrial ecology mitigation measures for WBSEs were recommended in the EIA Report and these mitigation measures were stipulated in the EM&A Manual for the Contractor to implement during the construction of the Project. The terrestrial ecology mitigation measures for the WBSEs are depicted in Appendix C. All recommended mitigation measures were applicable to the Project. As discussed above, the Project did not cause unacceptable disturbance to the WBSEs. Therefore, the mitigation measures implemented were effective and efficient in controlling disturbance to the WBSEs.
- 6.21 Monitoring and audit of the WBSEs had ensured that any disturbance to the WBSEs would be readily detected and timely actions could be taken to rectify any non-compliance. Field surveys carried out throughout the baseline and impact monitoring periods also demonstrated the environmental acceptability of the Project. Weekly site inspections had ensured that the EIA recommended terrestrial ecology mitigation measures for the WBSEs were effectively implemented. The EM&A program is considered to be cost effective.

Conclusion

- 6.22 WBSEs monitoring for the Project was conducted during the baseline and impact monitoring periods. Based on monitoring observations, no evidence that WBSE behaviour and activity had altered by construction noise or general disturbance during the construction phase of the Project was found. The magnitude of impact to WBSE associated with the Project was considered to be in agreement with EIA predictions.

7. MARINE MAMMALS

Monitoring and Audit Requirements

- 7.1 In accordance with the requirements specified in Section 10 of the EM&A Manual and Section 4 of the Environmental Permit EP-054/2000/E, the EM&A programme (as set out in the EM&A Manual) included surveys to monitor impacts on the Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*) and the Finless Porpoise (*Neophocaena phocaenoides*). Marine mammals monitoring was conducted at East Lantau. The monitoring location in transect lines is depicted in Figure 7.1.
- 7.2 Field surveys of marine mammals were conducted twice per month during the entire impact monitoring period. Monitoring of marine cetaceans involved line transect surveying techniques in East Lantau waters by a qualified research team to evaluate whether there had been any effects on marine mammals during the construction phase of the works.
- 7.3 Should any impacts on the marine mammals be detected, the procedures outlined in the Water Quality Event-Action Plans would be implemented.
- 7.4 Relevant marine ecology mitigation measures for marine mammals, as recommended in the EIA Report were stipulated in the EM&A Manual for the Contractor to adopt. The marine ecology mitigation measures for marine mammals are depicted in Appendix C.

Monitoring Results

- 7.5 Marine mammals monitoring was conducted during the impact monitoring period. A total of 107 marine mammal surveys were conducted at a frequency of twice per month, commencing in late July 2003 and ending in late December 2007. No marine mammal monitoring was carried out after December 2007 as the approval for the termination of marine ecological monitoring was granted by EPD on 25 January 2008.
- 7.6 During the impact monitoring period, a Humpback Dolphin was sighted during the survey on 7 October 2003 near south of Tsing Yi, a Chinese white dolphin was sighted during the survey on 8 December 2004, a Humpback dolphin was sighted during the survey on 5 January 2007 and a finless porpoise was sighted during the survey on 7 March 2007 while no dolphin or porpoise was observed during the rest of the monitoring. Detail discussions on marine mammals monitoring results were reported in respectively monthly EM&A reports of the Project. A summary of the three dolphin sightings is presented in Table 7.1. Locations of dolphin sightings are shown in Figure 7.2.

Table 7.1 Summary of Marine Mammal Sightings during EM&A Surveys

Date	Location	Observations
7 October 2003	22 ^o 18.45 114 ^o 05.71	A sighting of an individual Humpback Dolphin briefly surfaced several times before disappearing from view
8 December 2004	22 ^o 15.776 114 ^o 01.434	The dolphin was feeding, breaching and spy-hopping at the time of the sighting and was observed to be very active.
5 January 2007	22 ^o 17.214 114 ^o 01.573	A Humpback dolphin was sighted during the survey
7 March 2007	22 ^o 14.254 114 ^o 04.058	A finless porpoise was sighted during the survey

- 7.7 Based on observations on the presence and behaviours of sighted marine mammals, there was no evidence of disturbance due to construction activities.

Environmental Acceptability of the Project

Changes in activity/behaviour of marine mammals

- 7.8 From the literature and experience of dolphin researchers involved in the monitoring, it is known that sightings of dolphins and porpoises in East Lantau waters are rare. For instance, between September 1995 and November 1998, Jefferson² made only 18 on-effort sightings of Hump-Backed Dolphins in East Lantau water in 84 days of survey effort. Likewise, over a similar period Jefferson³ recorded 5 on-effort sightings of Finless Porpoises in these waters. Owing to the small numbers of cetacean sightings despite high survey effort, the Co-efficient of Variance for Jefferson's estimates of population levels in these waters was very high reaching up to 122%. This indicated that there was a very high degree of uncertainty regarding establishing reliable estimates of the densities of these animals in East Lantau waters. Due to the low number of sightings and high variability, comparison with EM&A must be undertaken cautiously.
- 7.9 Based on EM&A marine mammal surveys over 107 monitoring days, 4 on-effort sightings of a Humpback Dolphin, a Chinese white dolphin, a Humpback dolphin and a finless porpoise were sighted during the surveys. While these data confirm that marine cetaceans are rarely sighted in East Lantau waters, it was not possible to draw conclusions on whether the Project had changed the movement patterns and abundance in the Study Area. A difference in the abundance or distribution of dolphins and porpoises during construction phase of the Project was not discernible based on the monitoring data.
- 7.10 Nevertheless, on the evidence available from the EM&A monitoring results, it appeared that disturbance from construction works did not repel cetaceans from these waters.
- 7.11 There was no evidence that the Project had caused any unacceptable impact on the dolphin or porpoise populations.

Correlation between activity of marine mammals with possible disturbance by construction activities

- 7.12 Based on the monitoring results, no relationship between activity or behaviour of Hump-Backed Dolphins or Finless Porpoises and the extent or nature of construction works of the Project could be discerned. With proper implementation of marine ecology mitigation measures for marine mammals, the Project did not cause any unacceptable impacts to the marine mammals.

Comparison of EM&A results with EIA predictions

- 7.13 In the EIA Report, it was anticipated that reclamation at Penny's Bay could potentially result in loss of habitat for dolphins and porpoises that may use this area on a seasonal basis. However, it was considered that the Penny's Bay area was not critical habitat for hump-backed dolphins and that such an impact would be unlikely to affect the dolphin population as a whole. Similarly, the loss of habitat in Penny's Bay was predicted not to affect the Finless Porpoise since there was no record of this species occurring as far north in East Lantau waters as Penny's Bay.
- 7.14 Several indirect impacts to both marine cetacean species were also identified. Indirect impacts were predicted to occur due to underwater noise and disturbance from vessel traffic (including collision with vessels) or through changes in water quality.

² Jefferson T.A (2000). Population biology of the Indo-Pacific Hump-backed Dolphin in Hong Kong waters. *Wildlife Monographs*. Supplement to The Journal of Wildlife Management 64: 4

³ Jefferson T.A (2000). Conservation Biology of the Finless Porpoise (*Neophocaena phocaenoides*) in Hong Kong water: Final Report. Submitted to AFCD.

- 7.15 The EIA Report considered water quality-related indirect impacts on cetaceans, such as impacts on feeding resources, to be low in magnitude because constraints for controlling impacts to water quality were also expected to control impacts on marine ecology to acceptable levels.
- 7.16 Vessel passes and noise which could cause behavioural disturbances were not anticipated to cause significant impact to dolphins or porpoises because the increase in vessel traffic would be moderate and mostly comprise slow-moving vessel types.
- 7.17 Based on the monitoring results, there was no evidence for disturbance or impacts on Hump-Backed Dolphins or Finless Porpoises. The marine mammals monitoring results during impact monitoring were in agreement with the EIA predictions.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 7.18 Monitoring and auditing of marine mammals was recommended for the construction phase of the Project to evaluate whether there would be any effects on these animals.
- 7.19 Methodology used to monitor impacts on marine mammals involved line transect surveying techniques, which in recent years has become the standard way in HKSAR. The primary purpose of this technique is to determine the distribution and abundance of cetaceans. The details on this method were provided in each monthly EM&A report but in general involved a research team of 4 qualified observers visually scouring the seascape in all directions around their elevated position on the survey vessel with the aid of range-finding marine binoculars, whilst travelling over a set course of transects and at a set speed (13-15 km/hr).
- 7.20 A critical consideration when using the line transect survey technique was to ensure a strict timed quantification of "sighting effort" in order to maximise the comparative value of the field survey results. The time and position for the start and end of a period of intensive, uninterrupted effort and the sighting conditions associated with it were recorded. The collection of effort data allowed comparisons to be made with a single study as well as between studies. Strict recording of time, speed, position and distance travelling along the designated transect ("on-effort") were recorded. Time spent during any deviation from the transect was recorded as "off-effort". This effort data allowed dolphin abundance to be calculated using line transect methodology.
- 7.21 Sighting records for the initial sighting with time, position, distance, and angle data were recorded during the survey, and verified between primary observer and data recorder. All other information, such as sea state, weather conditions (Beaufort Scale), as well as notes on dolphin group size, age classes, behaviour, association with fishing boat, direction of movement, response to boat and others were completed at the end of the sighting. Standard forms for all dolphin monitoring were used.
- 7.22 In this way, the monitoring data was compatible with long-term studies of small cetacean ecology in Hong Kong and was also made available for this purpose.
- 7.23 In general, it was considered that using the line transect technique to monitor whether there had been any effects on cetaceans due to the Penny's Bay reclamation, as required by the EIA Report, was a valid approach in the longer-term monitoring of Hong Kong's resident cetacean populations.
- 7.24 Marine ecology mitigation measures for marine mammals were recommended in the project EIA Report for reclamation works and these mitigation measures were stipulated in the EM&A Manual for the Contractor to implement during the construction phase of the Project. The mitigation measures is depicted in Appendix C. Other than the mitigation measures related to under water percussive piling (as construction activities of the Project did not involve underwater percussive piling), all mitigation measures were applicable to the Project. As discussed above, the Project did not cause unacceptable impacts to the marine mammals. Therefore, the mitigation measures implemented were effective and efficient in controlling disturbance to marine mammals.
- 7.25 Monitoring and audit of marine mammals had ensured that any disturbance to the marine mammals

would be readily detected and timely actions could be taken to rectify any non-compliance. Weekly site inspections had ensured that the EIA recommended marine ecology mitigation measures for marine mammals were effectively implemented. Field surveys carried out during the impact monitoring period also demonstrated the environmental acceptability of the Project. However, as mentioned in Section 7.8 and Section 7.13, it was known that sightings of dolphins and porpoises in East Lantau waters would be rare. As monitoring results, dolphin sightings were observed in 4 out of 107 surveys by a qualified research team. In terms of cost effectiveness of the monitoring, at least the scope of the monitoring should be reviewed such as reducing the monitoring frequency, concentrating the monitoring works on particular period with dolphin sightings in the past, etc. It is also suggested that the availability and feasibility of innovative technology in the form of underwater dolphin/porpoise detectors that can distinguish cetacean acoustic sonar signals might be investigated. Potentially, this technology may be useful in detecting and logging dolphin/porpoise presence in an area.

Conclusion

- 7.26 Marine mammals monitoring for the Project was conducted during the impact monitoring period from July 2003 to December 2007. Monitoring results were in agreement with EIA predictions. Based on monitoring observations on the presence and behaviours of sighted marine mammals, there was no evidence of disturbance or impact due to construction activities of the Project. In fact, construction activities of the Project did not deter the dolphins approaching close to the boundary of site works, it was considered unlikely that cetaceans would restrict their movements further away from Penny's Bay in East Lantau waters.

8. SUBTIDAL ECOLOGY

Monitoring and Audit Requirements

- 8.1 In accordance with the requirements specified in Section 10 of the EM&A Manual and Section 4 of the Environmental Permit EP-054/2000/E, the EM&A programme (as set out in the EM&A Manual) included surveys to monitor impacts on the subtidal habitat and associated organisms at Sze Pak Wan and Kau Yi Chau. The monitoring locations are depicted in Figure 8.1.
- 8.2 One 30 m (depends on the depth of coral growth) vertical transect would be laid at the two monitoring sites. The presence of subtidal species, depth distributions and mortality would be recorded, to generate a general site description. Two monitoring sites would be assessed quantitatively by quantitative underwater video sampling. This technique has been adopted for territory-wide baseline survey of coral communities. (Wachenfeld⁴1996; Carlton & Done⁵, 1995; and Clark⁶, 1998)
- 8.3 Three (or two, depends on the abundance of coral community at each monitoring sites), 50 metre permanent transects would be laid at the two monitoring sites. Transects would be parallel to the shore where possible, with depth ranged from -1 to -6 m C. D. (depends on the depth of coral growth). For the benefit of future survey, markings would be made at each transect, adding to the existing ones. The locations of the transects in the two monitoring sites are shown in Figure 8.1.
- 8.4 Standard operating procedures of videoing would be adopted from Wachenfeld⁴ (1996). Films would be taken at about 40 cm above the substratum with a rate of approximately 90 seconds (7.2 – 9.0 metre per minute) at each transect. Each video transect would record a 40 cm swathe of coral. The video camera would be held perpendicular to the substratum to minimise parallax error and to keep it in focus.
- 8.5 The video transects would be studied. The species composition, percentage coverage, size, mortality and evidence of siltation would be estimated.

Monitoring Results

- 8.6 Subtidal ecology monitoring was conducted throughout the impact monitoring period. A total of 9 subtidal ecology monitoring surveys were conducted. These surveys were conducted at both monitoring sites once every 6 months from August 2003 to August 2007. No subtidal monitoring was carried out after August 2007 as the approval for the termination was granted by EPD on 25 January 2008.
- 8.7 The percentage of bleaching was calculated in the field by measuring the area of bleaching on the coral over the size of the coral. i.e. area of bleaching / size of coral.
- 8.8 The mean mortality (%) would be calculated by total mortality of corals over total number of corals measured. i.e. overall mortality for all corals / total no. of corals measured.

⁴ D. Wachenfeld; Standard operational Procedure Video-monitoring of sessile Bentic communities; Research Publications No.42; Great Barrier Reef Marine Park Authority 1996)

⁵ Carlton, J. H. and Done, T. 1995. Quantitative video sampling of coral benthos large-scale application. Coral Reefs 14: 35-46

⁶ Clark, T. H. 1998a. The ecology of indigenous and transplanted corals in the Cape d'Aguilar Marine Reserve, Hong Kong. PhD Thesis, The University of Hong Kong.

Sze Pak Wan

8.9 Key findings of the subtidal ecology monitoring surveys at Sze Pak Wan are presented below and summarised in Table 8.1. Photographic records are provided in Figure 8.2.

- **August 2003 survey results** – Subtidal habitat along the transects supported hard corals. Corals encountered along the fixed transects were *Favia* sp. (4 colonies), *Platygyra* sp. (4 colonies), *Cyphastrea* (4 colonies), *Plesiastrea* sp. (2 colonies) *Goniastrea aspera* (2 colonies), *Turbinaria peltata* (2 colonies), *Favites* (2 colonies), *Leptastrea* sp. (1 colony) and *Oulastrea crispata* (1 colonies). Large colonies included one *Platygyra* colony (1600cm²) and one *Cyphastrea* colony (2400cm²) along Transect 1, and one *Leptastrea* colony (1200cm²) and one *Favites* colony (3600cm²) along Transect 2. More than half the corals along the Sze Pak Wan transects (12 out of 22 colonies) exhibited no signs of partial mortality. The remaining colonies, ranging in size from 18cm² to 3600cm², exhibited partial mortality levels of between 5 to 70% of their tissue surface area. In addition, tissues of both *Turbinaria peltata* colonies were affected by bleaching (loss of algal partners called zooxanthellae). While one of these colonies had 20% of its tissues affected, the other was 100% bleached. The mean partial mortality level of corals along Transect 1 was 5.2%. Along Transect 2, it was 9.5%. Along both 50m transects at Sze Pak Wan, sediment thickness on horizontal surfaces along the transect was 2 - 4mm and minimum underwater visibility was 0.4m. There is little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Sze Pak Wan.
- **February 2004 survey results** – Subtidal habitat along the transects supported hard corals. Some coral colonies at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. Overall, there were two colonies of *Plesiastrea* sp. and one colony of *Platygyra* sp. which showed an increase in partial mortality levels of 5%. Compared to the last survey, along Transect 1, one *Plesiastrea* sp. colony had an increase in partial mortality level from 5% to 10%. Similarly, along Transect 2, one *Plesiastrea* colony and one *Platygyra* colony exhibited a partial mortality level of 5%, whereas none was recorded for these colonies in the previous survey. Other coral colonies at Sze Pak Wan (11 coral colonies along Transect 1 and 8 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. It was also observed that the 2 colonies of *Turbinaria peltata*, which were previously observed with 100% and 20% bleached area in August 2003 showed no sign of recovery. The areas affected by bleaching on these two colonies was observed to remain unchanged.
- **August 2004 survey results** – Subtidal habitat along the transects supported hard corals. Several (9 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. Overall, there were two colonies of *Plesiastrea* sp., one colony of *Platygyra* sp. and one colony of *Favites* sp., which showed an increase in partial mortality levels of 5%. Furthermore, two colonies of *Turbinaria* sp. and two colonies of *Cyphastrea* sp. exhibited an increase in partial mortality levels of 10%. The highest increase in partial mortality was recorded for one colony of *Favia* sp., which lost 15% of its live tissue area as compared to the previous survey. The subtidal monitoring indicated several coral colonies along transects at Sze Pak Wan have experienced increased partial mortality since the previous monitoring survey. The cause of the increase in partial mortality of these coral colonies was not known. In general, there are a number of factors, which may lead to coral mortality. Based on water quality monitoring data, no changes in suspended solids or dissolved oxygen were identified that were considered to account for the observed increases in partial coral mortality. With reference to water quality monitoring data, water quality conditions at Sze Pak Wan from February to August 2004 were highly similar to conditions in the 6 month period prior to the previous subtidal survey when corals were comparatively little affected by partial mortality. In conclusion, there was little evidence that reclamation works have had an adverse impact of on subtidal communities at Sze Pak Wan.
- **February 2005 survey results** – Subtidal habitat along the transects supported hard corals. A few (3 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. There were two colonies of *Turbinaria peltata* and one colony of *Cyphastrea* sp., which lost 5% of their live tissue area as compared to the previous survey. Compared to findings of the previous survey, along Transect 1, partial mortality levels have

increased from 10% to 15% for two *Turbinaria peltata* colonies. However, these *Turbinaria* colonies were previously observed with 50% and 20% bleached area respectively. During the latest February survey, it was observed that both colonies continued to be affected by bleaching although some recovery was evident for both of the colonies. Bleached area on the two *Turbinaria* colonies was recorded at 5% and 10% respectively. These *Turbinaria* colonies were not the only coral colonies along Transect 1 observed with bleached area in the latest February survey. In addition, one *Platygyra* sp. colony and one *Oulastrea crispata* were observed with 5% and 10% bleached area respectively. Neither of these colonies were observed with bleached area at the time of the previous survey. Along Transect 2, partial mortality levels increased from 10% to 15% for one *Cyphastrea* colony compared to the previous survey. This coral colony was also observed to be affected by 10% bleaching. Other coral colonies at Sze Pak Wan (10 coral colonies along Transect 1 and 9 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. With reference to water quality monitoring data, water quality results close to Sze Pak Wan from January 2005 to February 2005 were highly similar to conditions in the period when corals were comparatively little affected by partial mortality. There was little evidence that reclamation works had an adverse impact of on subtidal communities at Sze Pak Wan.

- **August 2005 survey results** – Subtidal habitat along the transects supported hard corals. A few (4 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. Overall, there were one colony of *Turbinaria peltata*, one colony of *Cyphastrea* sp., one colony of *Favites* sp. and one colony of *Oulastrea crispata* which lost 5% of their live tissue area as compared to the previous survey. Compared to findings of the previous survey (February 2005), along Transect 1, partial mortality levels have increased from 15% to 20% for one *Turbinaria peltata* colony and increased from 30% to 35% for one *Oulastrea crispata* colony. However, these *Turbinaria peltata* colony and *Oulastrea crispata* colony were previously observed with 10% bleached area. In this reporting period, one *Platygyra* sp. colony and one *Cyphastrea* sp. were observed with 5% bleached area. The *Platygyra* sp. colony was observed with bleached area at the time of the previous survey. Along Transect 2, partial mortality levels increased from 15% to 20% for one *Cyphastrea* sp. colony compared to the previous survey. This coral colony was previously observed to be affected by 10% bleaching. On the other hand, partial mortality levels increased from 10% to 15% for one *Favites* sp. colony compared to the previous survey. This coral colony was observed to be affected by 10% bleaching in this reporting period. Other coral colonies at Sze Pak Wan (10 coral colonies along Transect 1 and 8 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. With reference to water quality monitoring records, there was little evidence that reclamation works have had an adverse impact of on subtidal communities at Sze Pak Wan.
- **February 2006 survey results** – Subtidal habitat along the transects supported hard corals. A few (3 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. Overall, there were one colony of *Cyphastrea* sp., one colony of *Leptastrea* sp. and one colony of *Favites* sp. which lost 5% of their live tissue area as compared to the previous survey. Compared to findings of the previous survey (August 2005), along Transect 1, partial mortality levels have increased from 10% to 15% for one *Cyphastrea* sp. colony. However, these *Cyphastrea* sp. colony were previously observed with 5% bleached area. In this reporting period, one *Turbinaria peltata* colony was observed with 5% bleached area. Along Transect 2, partial mortality levels have increased from 10% to 15% for one *Leptastrea* sp. and increased from 15% to 20% for one *Favites* sp. colony compared to the previous survey. However, this *Leptastrea* sp. and *Favites* sp. colony were previously observed to be affected by 10% bleaching. In this reporting period, one *Cyphastrea* sp. colony was observed with 5% bleached area. Other coral colonies at Sze Pak Wan (11 coral colonies along Transect 1 and 8 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. With reference to water quality monitoring results in the month, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that reclamation works have had an adverse impact of on subtidal communities at Sze Pak Wan.
- **August 2006 survey results** – Subtidal habitat along the transects supported hard corals. A few (2 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality

increases in their areas since the last survey. Overall, there were one colony of *Turbinaria peltata* and one colony of *Cyphastrea* sp. which lost 5% of their live tissue area as compared to the previous survey. Compared to findings of the previous survey (February 2006), along Transect 1, partial mortality levels have increased from 20% to 25% for one *Turbinaria peltata* colony. However, this *Turbinaria peltata* colony was previously observed with 5% bleached area. In this reporting period, one *Oulastrea crispata* colony was observed with 5% bleached area. Along Transect 2, partial mortality levels have increased from 20% to 25% for one *Cyphastrea* sp. colony compared to the previous survey. However, this *Cyphastrea* sp. colony was previously observed to be affected by 5% bleaching. In this reporting period, one *Goniastrea aspera* colony was observed with 10% bleached area. Other coral colonies at Sze Pak Wan (11 coral colonies along Transect 1 and 9 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in HK (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temp and heavy rainfall during raining season will and cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work. With reference to water quality monitoring results in the month, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that reclamation works have had an adverse impact of on subtidal communities at Sze Pak Wan.

- **February 2007 survey results** – Subtidal habitat along the transects supported hard corals. A few (2 out of 22) coral colonies along the transects at Sze Pak Wan were observed to have mortality increases in their areas since the last survey. Overall, there were one colony of *Cyphastrea* sp. and one colony of *Goniastrea aspera* which lost 5% of their live tissue area as compared to the previous survey. Compared to findings of the previous survey (August 2006), along Transect 1, partial mortality levels have increased from 15% to 20% for one *Cyphastrea* sp. colony. In this reporting period, one *Oulastrea crispata* and one *Turbinaria peltata* colony was observed with 5% bleached area. Along Transect 2, partial mortality levels have increased from 70% to 75% for one *Goniastrea aspera* colony compared to the previous survey (August 2006). However, this *Goniastrea aspera* colony was previously observed to be affected by 10% bleaching. In this reporting period, one *Cyphastrea* sp. colony was observed with 5% bleached area. Other coral colonies at Sze Pak Wan (10 coral colonies along Transect 1 and 9 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in Hong Kong (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temperature and heavy rainfall during raining season will and cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work. With reference to water quality monitoring results in the month, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that reclamation works have had an adverse impact of on subtidal communities at Sze Pak Wan.
- **August 2007 survey results** – Subtidal habitat along the transects supported hard corals. 1 out of 22 coral colonies along the transects at Sze Pak Wan was observed to have mortality increases in areas since the last survey. One colony of *Cyphastrea* sp. which lost 5% of live tissue area as compared to the previous survey. Compared to findings of the previous survey (February 2007), along Transect 1, all corals along this transect did not exhibit any increase in the level of partial mortality. In this reporting period, one *Cyphastrea* sp. colony was observed with 5% bleached area. Along Transect 2, partial mortality levels have increased from 25% to 30% for one *Cyphastrea* sp. colony compared to the previous survey (February 2007). However, this colony was previously

observed to be affected by 5% bleaching. In this reporting period, one *Goniastrea aspera* colony was observed with 5% bleached area. Other coral colonies at Sze Pak Wan (9 colonies along Transect 2) showed no increase in partial mortality levels compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in Hong Kong (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temperature and heavy rainfall during raining season will and cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work. With reference to water quality monitoring results in the month, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that reclamation works have had an adverse impact on on subtidal communities at Sze Pak Wan.

Table 8.1 Summary of EM&A Subtidal Monitoring Results for Sze Pak Wan

Survey date	10 Aug 03		15 Feb 04		15 Aug 04		20 Feb 05		14 Aug 05	
Transect	1	2	1	2	1	2	1	2	1	2
Depth (-mPD)	-2	-3	-2	-3	-2	-3	-2	-3	-2	-3
*Profile distance (m)	5	11	5	11	5	11	5	11	5	11
Minimum visibility (m)	0.5	0.5	<0.3	<0.3	<0.4	<0.4	0.5	<0.5	1	<0.5
No. of colonies	12	10	12	10	12	10	12	10	12	10
No. of genera	8	7	8	7	8	7	8	7	8	7
Mean mortality (%)	5.4	9.5	5.8	10.5	9.6	12.5	11.3	12.5	12.1	13.5
Mean hard coral area (cm ²)	560	685	560	685	560	685	560	685	560	685
Silt depth (mm)	2-4	2-4	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
Survey date	19 Feb 06		19 Aug 06		23 Feb 07		8 Aug 07			
Transect	1	2	1	2	1	2	1	2		
Depth (-mPD)	-2	-3	-2	-3	-2	-3	-2	-3		
*Profile distance (m)	5	11	5	11	5	11	5	11		
Minimum visibility (m)	1	<0.5	1	<1	1	<1	1	<1		
No. of colonies	12	10	12	10	12	10	12	10		
No. of genera	8	7	8	7	8	7	8	7		
Mean mortality (%)	12.5	14.5	12.9	15	13.3	15.5	13.3	16		
Mean hard coral area (cm ²)	560	685	560	685	560	685	560	685		
Silt depth (mm)	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3		

* The distance (from the shore) of the two transects along the perpendicular transect.

Kau Yi Chau

8.10 Key findings of the subtidal ecology monitoring surveys at Kau Yi Chau are presented below and summarised in Table 8.2. Photographic records are provided in Figure 8.3.

- August 2003 survey results** – Subtidal habitat along the transects supported hard corals. Corals encountered along the fixed transects were *Psammocora* sp. (9 colonies), *Favia* sp. (6 colonies), *Cyphastrea* sp. (5 colonies), *Goniopora* sp. (5 colonies), *Plesiastrea* sp. (4 colonies), *Goniastrea* sp. (2 colonies), *Porites* sp. (2 colonies), *Platygyra* sp. (2 colonies), *Dendronephthya* sp. (=soft coral)(2 colonies), *Coscinarea* sp. (1 colony), *Leptastrea* sp. (1 colony), *Pavona decussata* (1 colony) and *Turbinaria* sp. (1 colony) About a third (31%) of the coral colonies along the two transects were considered to be large in size by extending more than 1000cm² in area. Largest corals included the *Pavona decussata* colony (4500cm²) and a *Porites* colony (3250 cm²) along Transect 1 as well as a *Psammocora* sp. colony (4800cm²) and *Cyphastrea* colony (3600cm²) along Transect 2. About two

thirds of the corals at Kau Yi Chau (28 out of 41 colonies) exhibited no signs of partial mortality. Of the remaining coral colonies, partial mortality levels on coral tissues ranged from 5 to 20%. No coral bleaching was observed. Mean partial mortality levels of corals along Transect 1 was 1.5%. Along Transect 2, it was 4.0%. There is little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.

- **February 2004 survey results** – Subtidal habitat along the transects supported hard corals. Along Transect 1, 1 colony of *Porites* sp. and 1 colony of *Turbinaria* sp. were observed to have increases in partial mortality of 5% (both from 5% to 10%). In addition, 1 colony of *Favia* sp., which was previously unaffected by partial mortality at the time of the previous survey, showed an increase in partial mortality of 2%. Furthermore, one colony of *Porites* sp. was observed to have 10% of its tissue area affected by bleaching. The remainder (23 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, one colony of *Coscinaraea* sp. showed an increase in partial mortality of 3%. At the time of the previous survey, partial mortality was 0% for this colony. All other corals (14 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. With reference to water quality monitoring data, water quality results close to Kau Yi Chau from January 2005 to February 2005 were highly similar to conditions in the period when corals were comparatively little affected by partial mortality. There was little evidence that reclamation works had an adverse impact of on subtidal communities at Kau Yi Chau.
- **August 2004 survey results** – Subtidal habitat along the transects supported hard corals. Along Transect 1, increases in partial mortality of 5% were exhibited by two colonies of *Psammocora* sp. (from 5% to 10%), one colony of *Porites* sp. (from 10% to 15%) and one colony of *Turbinaria* sp. (from 10% to 15%). In addition, one colony of *Favia* sp. showed an increase in partial mortality of 3% (from 2% to 5%). Furthermore, one colony of *Porites* sp. was observed to have 15% of its tissue area affected by bleaching. The remainder (21 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, one colony of *Coscinaraea* sp. showed an increase in partial mortality of 2% (from 3% to 5%). A 5% increase in partial mortality levels was exhibited by one *Goniastrea* colony (from 20% to 25%) and one *Cyphastrea* colony (from 10% to 15%). Finally, a partial mortality increase of 10% was observed to have affected one colony of *Plesiastrea* and one colony of *Gonipora*. Both these colonies were previously unaffected by partial mortality at the time of the previous survey. All other corals (10 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. With reference to water quality monitoring records, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.
- **February 2005 survey results** – Subtidal habitat along the transects supported hard corals. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% were exhibited by one colony of *Porites* sp. (from 0% to 5%). In addition, this coral colony was observed with 5% bleached area. At the time of the previous survey in August, this colony had 15% bleached and therefore the latest observation indicated some recovery has occurred. The remainder (25 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels or bleaching since the previous survey. Along Transect 2, one colony of *Cyphastrea* sp. showed an increase in partial mortality of 5% (from 15% to 20%). All other corals (14 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. Bleaching, however was observed. One colony of *Goniastrea* sp. and one colony of *Gonipora* sp. were observed with 10% and 5% bleached area respectively. Neither of these was previously affected by bleaching at the time of the previous survey. With reference to water quality monitoring records, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. There was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.
- **August 2005 survey results** – Subtidal habitat along the transects supported hard corals. A few (4 out of 41) coral colonies along the transects at Kau Yi Chau were observed to have mortality increases in their areas since the last survey. Overall, there were one colony of *Porites* sp., one colony of *Cyphastrea* sp., one colony of *Psammocora* sp. and one colony of *Gonipora* sp. which

lost 5% of their live tissue area as compared to the previous survey. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% was exhibited by one colony of *Porites* sp. (from 15% to 20%) and one colony of *Cyphastrea* sp. (from 0% to 5%). In addition, these two coral colonies were observed with 15% and 10% bleached area in this reporting period. The remainder (24 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels or bleaching since the previous survey. Along Transect 2, one colony of *Psammocora* sp. and one colony of *Goniopora* sp. showed an increase in partial mortality of 5% (from 5% to 10% and from 0% to 5% respectively). Bleaching, however was observed at both colony with 10% and 5% respectively. All other corals (13 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. With reference to water quality monitoring records, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.

- **February 2006 survey results** – Subtidal habitat along the transects supported hard corals. A few (5 out of 41) coral colonies along the transects at Kau Yi Chau were observed to have mortality increases in their areas since the last survey. Overall, there were two colonies of *Cyphastrea* sp., one colony of *Porites* sp., one colony of *Plesiastrea* sp. and one colony of *Psammocora* sp. which lost 5% of their live tissue area as compared to the previous survey. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% was exhibited by one colony of *Cyphastrea* sp. and one colony of *Plesiastrea* sp. (from 5% to 10%) and one colony of *Porites* sp. (from 20% to 25%). However, these colonies, *Cyphastrea* sp., *Plesiastrea* sp. and *Porites* sp. were previously observed with 10%, 5% and 15% bleached area respectively. In this reporting period, one *Pavona decussata* colony and one *Turbinaria* sp. colony were observed with 5% bleached area. The remainder (23 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, one colony of *Psammocora* sp. and one colony of *Cyphastrea* sp. showed an increase in partial mortality of 5% (from 10% to 15% and from 20% to 25% respectively). Bleaching, however, was previously observed at both colony with 10% and 5% respectively. In this reporting period, one *Plesiastrea* sp. colony and one *Goniopora* sp. colony were observed with 5% bleached area. All other corals (13 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. With reference to water quality monitoring results, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.
- **August 2006 survey results** – Subtidal habitat along the transects supported hard corals. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% was exhibited by one colony of *Pavona decussata* (from 0% to 5%). However, this colony, *Pavona decussata* was previously observed with 5% bleached area. In this reporting period, one *Cyphastrea* sp. colony and one *Porites* sp. colony were observed with 5% bleached area. The remainder (25 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, one colony of *Plesiastrea* sp. showed an increase in partial mortality of 5% (from 10% to 15%). Bleaching, however, was previously observed at this colony with 5%. In this reporting period, two *Cyphastrea* sp. colonies were observed with 5% bleached area. All other corals (14 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in HK (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temp and heavy rainfall during raining season will cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work. With reference to water quality monitoring results, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.

- February 2007 survey results** – Subtidal habitat along the transects supported hard corals. A few (2 out of 41) coral colonies along the transects at Kau Yi Chau were observed to have mortality increases in their areas since the last survey. Overall, there were two colonies of *Cyphastrea* sp. which lost 5% of their live tissue area as compared to the previous survey. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% was exhibited by one colony of *Cyphastrea* sp. (from 10% to 15%). However, this colony was previously observed with 5% bleached area. In this reporting period, one *Psammocora* sp. colony was observed with 5% bleached area. The remainder (25 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, one colony of *Cyphastrea* sp. showed an increase in partial mortality of 5% (from 0% to 5%). Bleaching, however, was previously observed at this colony with 5%. In this reporting period, one *Goniastrea* sp. and *Goniopora* sp. colonies were observed with 5% bleached area. All other corals (14 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in Hong Kong (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temperature and heavy rainfall during raining season will and cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work. With reference to water quality monitoring results, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.
- August 2007 survey results** – Subtidal habitat along the transects supported hard corals. 1 out of 41 coral colonies along the transects at Kau Yi Chau was observed to have mortality increases in areas since the last survey. One colony of *Psammocora* sp. which lost 5% of their live tissue area as compared to the previous survey. Along Transect 1 at Kau Yi Chau, an increase in partial mortality of 5% was exhibited by one colony of *Psammocora* sp. (from 10% to 15%). However, this colony was previously observed with 5% bleached area. In this reporting period, one *Porites* sp. colony was observed with 5% bleached area. The remainder (25 hard coral colonies) of the corals along this transect showed no increase in partial mortality levels since the previous survey. Along Transect 2, all corals along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. In this reporting period, one *Cyphastrea* sp. colony was observed with 5% bleached area. All other corals (14 coral colonies) along this transect did not exhibit any increase in the level of partial mortality compared to the previous survey. Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in Hong Kong (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temperature and heavy rainfall during raining season will and cause coral bleaching as well. With reference to water quality monitoring results, turbidity and SS level recorded in the month in the region were low. Impact from the Reclamation Stage 2 project is thus negligible. Therefore, there was little evidence that works of Reclamation Stage 2 have had an adverse effect on subtidal communities at Kau Yi Chau.

Table 8.2 Summary of EM&A Subtidal monitoring results for Kau Yi Chau

Survey date	10 Aug 03		15 Feb 04		15 Aug 04		20 Feb 05		14 Aug 05	
Transect	1	2	1	2	1	2	1	2	1	2
Depth (-mPD)	-1.5	-2	-1.5	-2	-1.5	-2	-1.5	-2	-1.5	-2
*Profile distance (m)	5	25	5	25	5	25	5	25	5	25
Minimum visibility (m)	0.4	0.4	<1	<1	<0.4	<0.4	1	0.5	1.5	1

No. of colonies	26	15	26	15	26	15	26	15	26	15
No. of genera	10	6	10	6	10	6	10	6	10	6
Mean mortality (%)	1	4	2	4.2	2.8	6.3	2.8	6.3	3.3	7.3
Mean hard coral area (cm ²)	950	1070	950	1070	950	1070	950	1070	949	1074
Silt depth (mm)	0-2	0-2	1-2	1-2	2-3	2-3	-1.5	-2	2-3	2-3
Survey date	19 Feb 06		19 Aug 06		23 Feb 07		8 Aug 07			
Transect	1	2	1	2	1	2	1	2		
Depth (-mPD)	-1.5	-2	-1.5	-2	-1.5	-2	-1.5	-2		
*Profile distance (m)	5	25	5	25	5	25	5	25		
Minimum visibility (m)	1	1	1	1	1	1	1	1		
No. of colonies	26	15	26	15	26	15	26	15		
No. of genera	10	6	10	6	10	6	10	6		
Mean mortality (%)	3.9	8	4.04	8.33	4.23	8.67	4.42	8.67		
Mean hard coral area (cm ²)	949	1074	949	1074	949	1074	949	1074		
Silt depth (mm)	2-3	2-2	2-3	2-3	2-3	2-3	2-3	2-3		

* The distance (from the shore) of the two transects along the perpendicular transect.

Environmental Acceptability of the Project

Changes in coral diversity and abundance

- 8.11 Based on the monitoring data, there was no evidence to indicate that the abundance of coral colonies or their diversity had been altered at either Sze Pak Wan or Kau Yi Chau as a consequence of impacts from the works of the Project. No die off colonies along the transects (such that the colonies would be regarded as dead standing coral) was observed. Observed small increases in partial mortality did not result in the complete mortality of any coral colony. Hence, no change in the diversity of corals at the subtidal ecology monitoring sites was discernible. There was no evidence that Penny's Bay works had caused any unacceptable impact on the subtidal habitat and associated marine organisms.

Correlation between coral mortality with possible disturbance by construction activities

- 8.12 As discussed under the section on 'monitoring results', there was no evidence that works at Penny's Bay had impacted the subtidal ecology at either of the monitoring sites.
- 8.13 Coral bleaching is caused by various anthropogenic and natural variations in the reef environment including sea temperature, solar irradiance, sedimentation, sub aerial exposure, inorganic nutrients, and freshwater dilution. Global climate change may play a role in the increase in coral bleaching events. For the monitoring results indicated, bleaching was recorded at very low % and this may be caused by natural environmental effect. The visibility at those sites is relative low when compared with other sites in Hong Kong (Sai Kung). Low light intensity may cause coral bleaching in that site. However, high temperature and heavy rainfall during raining season will and cause coral bleaching as well. For this reason, it is unlikely that the bleached corals are directly caused by the Penny's Bay's work.
- 8.14 With proper implementation of water quality mitigation measures on reclamation formation, the Project did not cause any unacceptable impacts to the subtidal habitats.

Comparison of EM&A results with EIA predictions

- 8.15 The EIA Report explained that indirect impacts to corals occurring at subtidal hard surface habitats could include injury by high SS concentrations in the water column and high sediment deposition rates. Based on water quality modelling results, the EIA Report predicted that impacts to corals on the rocky coasts at Sze Pak Wan and Kau Yi Chau were unlikely to occur because sediment deposition from the reclamation works were expected to be less than 0.11 kg m⁻² day⁻¹ which was lower than the adopted critical threshold value of 0.2 kg m⁻² day⁻¹ and because SS levels would meet the WQO standard at

these areas.

- 8.16 Predictions that no unacceptable impacts would affect subtidal habitats at Sze Pak Wan and Kau Yi Chau were supported by the EM&A data. Based on the monitoring data, there was scant evidence to indicate that Stage 2 Reclamation works at Penny's Bay was the cause of small increases in partial mortality of corals at both monitoring sites.

Practicality and Effectiveness of the EIA process and the EM&A programme

- 8.17 Monitoring and auditing of the subtidal habitats was recommended for the construction phase of the Project to evaluate whether there would be any effects on the subtidal habitats and the associated marine organisms.
- 8.18 Methodology used to monitor impacts on corals at Sze Pak Wan and Kau Yi Chau was considered to be effective for determining whether impacts had occurred due to Stage 2 reclamation works at Penny's Bay.
- 8.19 At each monitoring site, two 25m² belt transects were laid parallel to the coastline extending off a 30m long fixed position transect which was laid perpendicular to the shore (i.e. running from shallow to deep water). By noting the characteristics of habitat along the 30m long transect, the divers made a decision on what distance along this profile transect comprised the most representative swathe of subtidal habitat for laying the belt transects. In general, throughout the EM&A programme, the divers decided to return to the same distance along the 30m transect for laying the belt transects. Thus, divers monitored swathes of subtidal habitat that they had deemed to be the most representative and had monitored in the previous survey. This was advantageous to the monitoring because it allowed direct comparisons on the condition of the same coral colonies at the monitoring sites over the course of the EM&A programme. As a consequence, the condition of individual colonies of several different coral species at each monitoring site on a representative swathe of subtidal habitat was tracked over time, and with reference to water quality and sediment level, observations were used to assess whether impacts had occurred.
- 8.20 Monitoring and audit of the subtidal habitats had ensured that any disturbance to the subtidal habitats would be readily detected and timely actions could be taken to rectify any non-compliance. As discussed above, the Project did not cause unacceptable disturbance to the subtidal habitats. Underwater field surveys carried out throughout the impact monitoring periods also demonstrated the environmental acceptability of the Project. The EM&A program was considered to be cost effective.

Conclusion

- 8.21 Subtidal ecology monitoring for the Project was conducted during the impact monitoring period. Based on the monitoring data, there was no evidence to indicate that the abundance of coral colonies or their diversity had been altered at either Sze Pak Wan or Kau Yi Chau as a consequence of impacts from the works of the Project. There was no evidence that works at Penny's Bay had impacted the subtidal ecology at either of the monitoring sites. Predictions in the EIA that there would be no unacceptable impact on subtidal habitats at Sze Pak Wan and Kau Yi Chau were supported by the EM&A data.

9. AUDIT RESULTS

Implementation Status of Environmental Protection and Pollution Control/Mitigation Measures

9.1 Sediment dredging by grab dredgers, seawall construction, filling with sand and public fill by barge, rockfilling by barge, access road construction, installation of vertical band drain, reclamation, embankment and surcharge, construction of box culverts and construction of drainage pipes, manholes and u-channels were the main construction activities of the Project. Implementation of appropriate mitigation measures was noted during weekly site inspections during the entire construction period. Mitigation measures were implemented as follows:

Dust

- 9.2 Dark smokes were observed occasionally emitting from construction equipment within the Site. The Contractor was reminded to keep well maintenance to equipment on site regularly and the situation was observed to have been improved after maintenance had taken place.
- 9.3 Water trucks were deployed for haul road watering and water sprinklers were in operation for haul road watering for dust suppression. Hydroseeding of completed slope surface was observed within the site.
- 9.4 Water pumps were provided by Contractor to pump collected rainwater runoff to wet temporary embankment surface.
- 9.5 Wheel washing wastewater accumulated at u-channel next to wheel washing bay was pumped out to wet the haul road surface.

Noise

- 9.6 Quiet plants were adopted for construction activities. Quiet plants including grab dredger, hopper barge, tugboat, derrick barge, generator and crane lorry were used for works near Pa Tau Kwu. Noise assessment had shown that these plants adopted on-site were quiet plants as their sound power levels (SPL) were below the SPL as specified in the Technical Memorandum on Noise from Construction Work other than Percussive Piling. Construction Noise Permit was properly displayed at the site entrance.
- 9.7 During one site audit, one air compressor and one generator were not provided with valid noise label as application for valid noise label was still in progress. The affected air compressor was not in use by the time of site audit but the contractor was recommended not to use it until a valid noise label is attached. The situation was subsequently rectified.
- 9.8 During one site audit, a generator on site was not provided with valid noise label. The Contractor was recommended to provide a valid noise label for the generator on site. The situation was rectified by the next site audit session.
- 9.9 Maintenance was provided for equipment regularly to minimise noise generation.
- 9.10 The Contractor was reminded to carry out noise assessment for barge Fortress 3 before use. Noise assessment was conducted for the barge by the follow up weekly site inspection.
- 9.11 In general, the implementation of noise mitigation measures complied with conditions specified in the EM&A Manual. To avoid disturbance to the White-bellied Sea Eagles at Pa Tau Kwu, quiet plant were adopted for silt curtain installation near the Pa Tau Kwu Headland.

Water Quality

Marine Works

- 9.12 Silt curtains were maintained regularly. However, minor splashing of material during barge uploading and silty water generation by departure of barge inside silt curtain were observed. The Contractor followed up these deficiencies and no similar observation was noted in subsequent inspections.
- 9.13 Floating debris was observed occasionally near the shore, within and adjacent to site area. Clearing work was observed during site inspections. The site cleanliness was generally in acceptable condition by the weekly site inspections.
- 9.14 Spillage of muddy water was observed on a barge during the site audit and as a result, immediate mitigation action was taken to stop the spillage. The Contractor was reminded to properly maintain and inspect the barges and the observation was rectified in subsequent audit.
- 9.15 Small amount of dredged material was observed splashed into the gap between the frame-type silt curtain and the barge during the operation of closed grab dredging. The Contractor was reminded to take care in loading dredged materials to the barge by controlling the dredging speed. The Contractor had subsequently rectified the situation.
- 9.16 Filling materials were observed falling into the sea from the seawall area during unloading of fill materials from the barge. The Contractor was reminded to take precautions in loading/unloading materials from barge. The situation was improved in subsequent audit.
- 9.17 Turbid water pumping out for lowering the water level of the bunded area for the construction of the box No. 1 culvert outfall and the turbid water discharged to the sea was observed. The Contractor was requested to stop all pumps and provide proper desilting facilities to reduce the SS level in effluent before discharge. By subsequent audit, concrete sedimentation ponds were constructed by Contractor for controlling the SS level before discharge.
- 9.18 Turbid water was observed spilling out from a barge containing dredged materials. In order to prevent possible spillage in the future, the Contractor was recommended to minimise the amount of water from entering the barge during the dredging operation. No further spillage was however observed from the barge in subsequent site inspection.
- 9.19 Geotextile lined rock bunds were provided by Contractor to control the discharge of muddy water from surface channel which is to follow up the incident of muddy water pumping out for lowering the water level of the bunded area for the construction of the box culvert no. 2.
- 9.20 Soil material was observed overflowing from the flat top barge as a result of heavy rainstorm. The Contractor was reminded to avoid overflowing of materials from barges.
- 9.21 A layer of oil floating on the sea was observed between CM28 & HH22. The Contractor was reminded to remove it as soon as possible and to keep well maintain of the vessel for avoiding further spillage. The problem was rectified in the subsequent site audit.

Site Discharge

- 9.22 Stagnant water and rubbish (including fallen leaves) was accumulated at u-channels around the site office. The Contractor was reminded to clear rubbish and fallen leaves from u-channels to prevent blockage. Accumulation of stagnant water, rubbish and fallen leaves was not observed by the next weekly site inspection.
- 9.23 Deposited mud was observed at u-channel near wheel washing bay, the Contractor was reminded to clear it. The situation was subsequently rectified.
- 9.24 Water from upstream of existing box culvert no. 2 was pumped out into the nearby surface channel. The Contractor was reminded to improve the desilting facilities. The situation was subsequently rectified; desilting measures was in place before water from upstream of existing box culvert no. 2 pumped out to the nearby surface channel.

Waste / Chemical Management

- 9.25 A trip-ticket system was implemented for materials disposed off site. Chemical toilets were provided on site.
- 9.26 Drip trays with sufficient capacity were generally provided for chemical storage. However, oil and diesel drums were observed lying on bare ground and oil spillage was occasionally observed on-site. The Contractor was reminded that bunding or drip trays should be provided for all oil and diesel drums on-site, oil spillage of any kind should be avoided and oil and water in drip trays should be removed regularly.
- 9.27 A designated area was provided for chemical waste storage on-site. Chemical waste and waste oil were subsequently disposed off by a licensed chemical waste collector.
- 9.28 Empty oil containers, waste oil tubes and oily tarpaulin were observed to be mixed with general refuse occasionally. The Contractor was reminded to separate them from general refuse and store them properly.
- 9.29 Incorrect label for chemical waste storage area were noted but rectified by the Contractor in subsequent audit.
- 9.30 Spilt oil was occasionally observed at the workshop. The Contractor was recommended to put plastic sheets and trays on the bare ground to avoid oil spillage during equipment maintenance and remove the contaminated sand and dispose as chemical waste.
- 9.31 Some oil stains and waste oil were observed within the site area and the Contractor was reminded to remove the stain and store the waste oil properly. In addition, the Contractor was reminded to remove and store the chemical containers at designated place.
- 9.32 Oil bottle leakage was observed near a generator. The Contractor was reminded to provide drip tray and clear the oil. The Contractor had rectified the situation by the follow up weekly site inspection.
- 9.33 Stagnant water was observed in drip tray of generator and at chemical waste storage area. The Contractor was reminded to clear the stagnant water. The Contractor had rectified the situation by the follow up weekly site inspection.
- 9.34 General refuse accumulated on site. The Contractor was reminded to clear it up accordingly and the situation was improved in the subsequent site audit.
- 9.35 Chemical wastes were observed to have stored in general waste container within the site area. The Contractor was reminded to properly handle, store and dispose chemical wastes and the situation was rectified accordingly.

Landscape and Visual

- 9.36 In general, the implementation of landscape and visual mitigation measures complied with conditions specified in the EM&A Manual. Completed slope works were hydroseeded as soon as practicable.

Environmental Mitigation Implementation Schedule (EMIS)

- 9.37 The Environmental Permit required that the mitigation measures detailed in the permits be implemented. A summary of the EMIS is presented in Appendix C.

Environmental Licensing and Permitting

- 9.38 Environmental licenses and permits including environmental permit of the Project, construction noise

permits, dumping permits and water discharge license were in place and valid during the impact monitoring period. A summary of licenses and permits for the Project is given in Appendix G.

Advice on the solid and liquid waste management status

9.39 Wastes generated from the Project included construction and demolition waste, dredged mud, excavated materials, chemical waste and general refuse (which was mainly washed up on the site shoreline). Table 9.1 summarised the total waste generated from the Project during the entire construction period.

Table 9.1 Total Waste Generation during the Construction Period

Waste Type	Examples	Total (m ³)	Disposal Location
C&D waste	Used silt curtains and floating refuses	50	TKO Landfill
		535	SENT Landfill
		695	WENT Landfill
C&D waste	Used silt curtains and floating refuses (in Tonnes)	11856.1	SENT Landfill
		6677.35	WENT Landfill
		7	TKO Area 137 Fill Bank
		366	TM38 PFSF
Dredged Material	Marine sediments	2,734,600	East Nine Pins Dumping Ground
		2,999,000	East Tung Lung Chau Dumping Ground
Chemical waste	Contaminated sand, used oil, spent solvent, spent oil filter, empty pail and contaminated lube oil (in L)	2600	Chemical Waste Treatment Centre
	Contaminated lube oil (in L)	2800	Collected by licensed collector
	Contaminated Soil (site) (in kg)	400	SENT Landfill
General waste	Domestic waste (site) collected in garbage bins	817	SENT Landfill
		72	WENT Landfill
	Domestic waste (site) collected in sludge tank	3702	Pillar Point Sewage Treatment Works
	Domestic waste (marine)	5	TKO Landfill
Special Waste	Waste tyres	2.5	Licensed collector

10. SUMMARY OF COMPLAINTS, NOTIFICATION OF SUMMONS AND SUCCESSFUL PROSECUTIONS

Complaints

- 10.1 A total of 10 complaints (two noise, one air quality and seven water quality complaints) were made against this Project/Penny's Bay Construction Sites since commencement of the Project. Brief information of each complaint and concerns of the public is provided in Appendix H. All complaints were handled in accordance with the complaint handling procedures specified in the EM&A Manual. A summary of all complaints received, investigation undertaken and mitigation measures implemented is summarised in Appendix H

Summons

- 10.2 Three (3) and thirteen (13) summonses against this Project and Backfilling of Marine Areas at East Tung Lung Chau Project respectively were received since commencement of the Project. Consolidated Court hearings were carried out in the period from 26 July to 6 August 2004 and the Court had dismissed all charges against the Contractor.

Notification of Successful Prosecutions

- 10.3 No any prosecution for breaches of the current environmental protection/pollution control legislations was recorded during the impact monitoring period.

11. CONCLUSIONS AND RECOMMENDATIONS

- 11.1 Environmental Monitoring and Audit for Penny's Bay Reclamation Stage 2 was conducted in accordance with the requirements set out in the EM&A Manual of the Project. The EM&A programme included site audits and monitoring of air quality, noise, water quality and ecology. Termination of the EM&A Programme for the Project was approved by EPD on 8 April 2008.
- 11.2 21 Action level and 2 Limit Level air quality exceedances were recorded during the entire impact monitoring period. Possible dust generating activities of the Project did not cause any noticeable deterioration in air quality at Penny's Bay. The average 24-hour TSP level recorded at AM1 in EM&A programme was in similar magnitude with the daily dust level predicted in the EIA.
- 11.3 A total of 28 holidays, 273 evening time and 2,275 night-time limit level noise exceedances were recorded during the impact monitoring period. There were two action level exceedances since two noise complaints were received. Noise generating activities of the Project did not cause any noticeable noise impact at the sensitive receivers. The impact noise levels recorded were generally similar to the predicted construction noise levels in the Project EIA except for noise levels recorded during night-time. The noise environment at these monitoring locations at night was dominated by the noisy background and not by the PME's on site.
- 11.4 A total of 820 water quality exceedances were recorded during the impact monitoring period. Tidal flows and ambient conditions were considered to have strong effects on the water quality monitoring results. Exceedances were considered to be due to a combination of poor regional water quality on particular days, which might have been affected by tidal conditions, local impacts in the vicinity of the receivers and seasonal variation. No correlation between the dredging and filling rates and the number of water quality exceedances recorded per monitoring day was found. With proper implementation of water quality mitigation measures and additional mitigation measures, marine construction activities of the Project did not cause any unacceptable water quality impacts to the receivers.
- 11.5 Pa Tau Kwu remained an active site for the WBSEs during the impact monitoring period. There was no evidence that WBSE behaviour and activity were altered by construction noise or general disturbance during the impact monitoring period. No relationship between the WBSEs activity or behaviour and the extent or nature of construction works of the Project could be discerned. The magnitude of impact to WBSEs associated with the Project was in agreement with EIA predictions.
- 11.6 Monitoring observations on the presence and behaviours of sighted marine mammals indicated that there was no evidence of disturbance or impact due to construction activities of the Project. In fact, construction activities of the Project did not deter the dolphins from approaching close to the boundary of site works. It was considered unlikely that cetaceans would restrict their movements further away from Penny's Bay in East Lantau waters. Marine mammals survey results were in agreement with EIA predictions.
- 11.7 Monitoring data on subtidal habitats indicated that there was no evidence that the abundance of coral colonies or their diversity had been altered at either Sze Pak Wan or Kau Yi Chau as a consequence of impacts from the works of the Project. The EIA predictions that no unacceptable impacts would affect subtidal habitats at Sze Pak Wan and Kau Yi Chau were supported by the EM&A data.
- 11.8 A total of 10 complaints were received during the impact monitoring period of the Project. All complaints were handled in accordance with the complaint handling procedures specified in the EM&A Manual. No prosecution was recorded during the construction period of the Project.
- 11.9 Three (3) and thirteen (13) summonses against this Project and Backfilling of Marine Areas at East Tung Lung Chau Project respectively were received since commencement of the Project. Consolidated Court hearings were carried out in the period from 26 July to 6 August 2004 and the Court had dismissed all charges against the Contractor.
- 11.10 As discussed in the above sections, the Project did not cause unacceptable environmental impacts or

disturbance to air quality, noise, water quality, WBSEs, marine mammals and subtidal habitats in the vicinity of Penny's Bay.

- 11.11 Monitoring and audit of 24-hour TSP, noise, water quality and ecology ensured that any deterioration in environmental condition was readily detected and timely actions taken to rectify any non-compliance. For future monitoring and audit exercise, it was recommended that ad-hoc 1 hour TSP monitoring should be conducted to confirm assessment findings in case of exceedance. Noise monitoring should be omitted at receivers where there is no line of sight to construction activities and nighttime noise criterion should take the prevailing baseline levels into consideration. Monitoring of water quality parameters which had proved not to be a significant pollution source should be discontinued and monitoring frequency for marine habitats which were not commonly found in the region should be reduced.