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Hong Kong Project Management Office

Contract No. HY/2011/03

Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road Section between Scenic Hill and Hong Kong Boundary Crossing Facilities

Quarterly EM&A Report No.5 (Sep 2013 to Nov 2013)

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Revision 1

Main Contractor

中國建築工程(香港)有限公司
CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LTD.

Designer

ATKINS

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Executive Summary

The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) serves to connect the HZMB Main Bridge at the Hong Kong Special Administrative Region (HKSAR) Boundary and the HZMB Hong Kong Boundary Crossing Facilities (HKBCF) located at the north eastern waters of the Hong Kong International Airport (HKIA).

The HKLR project has been separated into two contracts. They are Contract No. HY/2011/03 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract) and Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill.

China State Construction Engineering (Hong Kong) Ltd. was awarded by Highways Department as the Contractor to undertake the construction works of Contract No. HY/2011/03. The main works of the Contract include land tunnel at Scenic Hill, tunnel underneath Airport Road and Airport Express Line, reclamation and tunnel to the east coast of the Airport Island, at-grade road connecting to the HKBCF and highway works of the HKBCF within the Airport Island and in the vicinity of the HKLR reclamation. The Contract is part of the HKLR Project and HKBCF Project, these projects are considered to be "Designated Projects", under Schedule 2 of the Environmental Impact Assessment (EIA) Ordinance (Cap 499) and Environmental Impact Assessment (EIA) Reports (Register No. AEIAR-144/2009 and AEIAR-145/2009) were prepared for the Project. The current Environmental Permit (EP) EP-352/2009/C for HKLR and EP-353/2009/G for HKBCF were issued on 5 September 2013 and 6 August 2013, respectively. These documents are available through the EIA Ordinance Register. The construction phase of Contract was commenced on 17 October 2012.

BMT Asia Pacific Limited has been appointed by the Contractor to implement the Environmental Monitoring & Audit (EM&A) programme for the Contract in accordance with the Updated EM&A Manual for HKLR (Version 1.0) and will be providing environmental team services to the Contract.

This is the fifth Quarterly EM&A report for the Contract which summaries the monitoring results and audit findings of the EM&A programme during the reporting period from 1 September 2013 to 30 November 2013.

Environmental Monitoring and Audit Progress

The EM&A programme were undertaken in accordance with the Updated EM&A Manual for HKLR (Version 1.0). A summary of the monitoring activities during this reporting period is presented as below:

Monitoring Activity		Monitoring Date		
		September 2013	**October 2013**	**November 2013**
Air Quality	1-hr TSP	4, 10, 16, 19 and 25	2, 7, 11, 17, 23 and 29	4, 8, 14, 20 and 26
	24-hr TSP	AMS5: 3, 9, 13, 18, 24 and 30 AMS6: 13, 18, 24 and 30	4, 10, 16, 22 and 28	AMS5: 1, 7, 13, 21, 25 and 29 AMS6: 1, 7, 13, 19, 25 and 29
Noise		6, 11, 16 and 25	2, 7, 17, 23 and 29	4, 14, 20 and 26
Water Quality		2, 4, 6, 9, 11, 13, 16, 18, 20, 23, 25, 27 and 30	2, 4, 7, 9, 11, 14, 16, 18, 21, 23, 25, 28 and 30	1, 4, 6, 8, 11, 13, 15, 18, 20, 22, 25, 27 and 29
Chinese White Dolphin		3, 5, 10 and 18	8, 15, 17 and 22	1, 5, 8 and 13
Mudflat Monitoring (Ecology)		1, 7, 8, 14, 15 and 21	-	-
Mudflat Monitoring (Sedimentation rate)		4	-	-
Site Inspection		3, 10, 18 and 27	2, 9, 16, 22 and 29	6, 13, 20 and 29

The 24 hours dust monitoring at station AMS6 was cancelled on 3 September 2013 due to interruption of electricity supply and 9 September 2013 due to malfunction of high volume sampler.

The noise monitoring at NMS5 was cancelled on 4 September 2013 due to the inclement weather and was rescheduled for 6 September 2013.

Due to adverse weather condition, the water quality monitoring at all stations were cancelled on 23 September 2013 during mid-ebb tide and mid-flood tide.

Due to strong winds, the dolphin monitoring was rescheduled from 17 September 2013 to 18 September 2013

Due to the boat arrangement problem, the dolphin monitoring was rescheduled from 10 October 2013 to 22 October 2013.

Due to strong winds, the dolphin monitoring was rescheduled from 12 November 2013 to 13 November 2013.

Due to the electricity supply problem, the 24 hrs dust monitoring at AMS5 was rescheduled from 19 November 2013 to 21 November 2013.

Breaches of Action and Limit Levels

A summary of environmental exceedances for this reporting period is as follows:

Environmental Monitoring	Parameters	Action Level (AL)	Limit Level (LL)
Air Quality	1-hr TSP	0	0
	24-hr TSP	0	0
Noise	$L_{eq\ (30\ min)}$	0	0
Water Quality	Suspended solids level (SS)	10	3
	Turbidity level	0	0
	Dissolved oxygen level (DO)	0	0
Dolphin Monitoring	Quarterly Analysis (September to November 2013)	1	0

The Environmental Team investigated all exceedances and found that they were not project related.

All investigation reports for exceedances of the Contract have been submitted to ENPO/IEC for comments and/or follow up to identify whether the exceedances occurred related to other HZMB contracts.

Implementation of Mitigation Measures

Site inspections were carried out on a weekly basis to monitor the implementation of proper environmental pollution control and mitigation measures for the Project. Potential environmental impacts due to the construction activities were monitored and reviewed.

Complaint Log

A summary of environmental complaints for this reporting period is as follows:

Environmental Complaint No.	Date of Complaint Received	Description of Environmental Complaints
COM-2013-033	13 September 2013	Noise
COM-2013-034	17 September 2013	Noise
COM-2013-037	8, 9 and 16 October 2013	Noise
COM-2013-041	31 October 2013	Noise
COM-2013-043	11 November 2013	Noise

Notifications of Summons and Prosecutions

There were no notifications of summons or prosecutions received during this reporting period.

Reporting Changes

This report has been developed in compliance with the reporting requirements for the quarterly summary EM&A reports as required by the Updated EM&A Manual for HKLR (Version 1.0).

The proposal for the change of Action Level and Limit Level for suspended solid and turbidity was approved by EPD on 25 March 2013.

The revised Event and Action Plan for dolphin Monitoring was approved by EPD on 6 May 2013.

It was found that the original monitoring station at IS(Mf)9 (Coordinate- East 813273, North 818850) was inside the perimeter silt curtain on 1 July 2013, as such the original impact water quality monitoring location at IS(Mf)9 was temporarily shifted outside the silt curtain. The new co-ordinates of station IS(Mf)9 are 813226E and 818708N since 1 July 2013.

1 Introduction

1.1 Basic Project Information

1.1.1 The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) serves to connect the HZMB Main Bridge at the Hong Kong Special Administrative Region (HKSAR) Boundary and the HZMB Hong Kong Boundary Crossing Facilities (HKBCF) located at the north eastern waters of the Hong Kong International Airport (HKIA).

1.1.2 The HKLR project has been separated into two contracts. They are Contract No. HY/2011/03 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract) and Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill.

1.1.3 China State Construction Engineering (Hong Kong) Ltd. was awarded by Highways Department (HyD) as the Contractor to undertake the construction works of Contract No. HY/2011/03. The Contract is part of the HKLR Project and HKBCF Project, these projects are considered to be "Designated Projects", under Schedule 2 of the Environmental Impact Assessment (EIA) Ordinance (Cap 499) and Environmental Impact Assessment (EIA) Reports (Register No. AEIAR-144/2009 and AEIAR-145/2009) were prepared for the Project. The current Environmental Permit (EP) EP-352/2009/C for HKLR and EP-353/2009/G for HKBCF were issued on 5 September 2013 and 6 August 2013, respectively. These documents are available through the EIA Ordinance Register. The construction phase of Contract was commenced on 17 October 2012. **Figure 1.1** shows the project site boundary.

1.1.4 BMT Asia Pacific Limited has been appointed by the Contractor to implement the EM&A programme for the Contract in accordance with the Updated EM&A Manual for HKLR (Version 1.0) for HKLR and will be providing environmental team services to the Contract. ENVIRON Hong Kong Ltd. was employed by HyD as the Independent Environmental Checker (IEC) and Environmental Project Office (ENPO) for the Project. The project organization with regard to the environmental works is provided in **Appendix A**.

1.1.5 This is the Fifth Quarterly Environmental Monitoring and Audit (EM&A) report for the Contract which summaries the monitoring results and audit findings of the EM&A programme during the reporting period from 1 September 2013 to 30 November 2013.

1.2 Project Organisation

1.2.1 The project organization structure and lines of communication with respect to the on-site environmental management structure with the key personnel contact names and numbers are shown in **Appendix A**.

1.3 Construction Programme

1.3.1 A copy of the Contractor's construction programme is provided in **Appendix B**.

1.4 Construction Works Undertaken During the Reporting Period

1.4.1 A summary of the construction activities undertaken during this reporting period is shown in **Table 1.1**. The Works areas of the Contract are showed in **Appendix C**.

Table 1.1 Construction Activities during Reporting Period

Site Area	Description of Activities
Portion X	• Removal of existing rock for existing seawall • Stone column installation • Filling works behind stone platform • Temporary stone platform construction • Band drains Installation • Dismantling/trimming of temporary 40mm stone platform for construction of seawall
Portion Y	• Access shaft construction for SHT & HAT • Utility culvert excavation • Excavation for Temporary Diversion of outfall PR10
West Portal	• Site formation • Tree felling • Slope protection/ stabilization (soil nailing works) • Boulder removal/ stabilization works • Pipe Roofing Installation and Excavation for Tunnel SHT
Kwo Lo Wan /Airport Road	• Works for diversion of Airport Road and Kwo Lo Wan Road
Airport Express Line	• Pre-grouting and pipe piling works for AEL access shafts
Kwo Lo Wan /Airport Road /Airport Express Line	• Utilities detection • Establishment of site access • Works for east access shaft

2 EM&A Requirement

2.1 Summary of EM&A Requirements

2.1.1 The EM&A programme requires environmental monitoring of air quality, noise, water quality, dolphin monitoring and mudflat monitoring as specified in the approved EM&A Manual.

2.1.2 A summary of Impact EM&A requirements is presented in **Table 2.1**. The locations of air quality, noise and water quality monitoring stations are shown as in **Figure 2.1**. The transect line layout in Northwest and Northeast Lantau Survey Areas is presented in **Figure 2.2**.

Table 2.1 Summary of Impact EM&A Requirements

Environmental Monitoring	Description	Monitoring Station	Frequencies	Remarks
Air Quality	1-hr TSP	AMS 5 & AMS 6	At least 3 times every 6 days	While the highest dust impact was expected.
	24-hr TSP		At least once every 6 days	--
Noise	$L_{eq\ (30mins)}$, $L_{10\ (30mins)}$ and $L_{90\ (30mins)}$	NMS5	At least once per week	Daytime on normal weekdays (0700-1900 hrs).
Water Quality	• Depth • Temperature • Salinity • Dissolved Oxygen (DO) • Suspended Solids (SS) • DO Saturation • Turbidity • pH	• Impact Stations: IS5, IS(Mf)6, IS7, IS8, IS(Mf)9 & IS10, • Control/Far Field Stations: CS2 & CS(Mf)5, • Sensitive Receiver Stations: SR3, SR4, SR5, SR10A & SR10B	Three times per week during mid-ebb and mid-flood tides (within ± 1.75 hour of the predicted time)	3 (1 m below water surface, mid-depth and 1 m above sea bed, except where the water depth is less than 6 m, in which case the mid-depth station may be omitted. Should the water depth be less than 3 m, only the mid-depth station will be monitored).
Dolphin	Line-transect Methods	Northeast Lantau survey area and Northwest Lantau survey area	Twice per month	--
Mudflat	Horseshoe crabs, seagrass beds, intertidal soft shore communities, sedimentation rates and water quality	San Tau and Tung Chung Bay	Once every 3 months	--

2.2 Action and Limit Levels

2.2.1 **Table 2.2** presents the Action and Limit Levels for the 1-hour TSP, 24-hour TSP and noise level.

Table 2.2 Action and Limit Levels for 1-hour TSP, 24-hour TSP and Noise

Environmental Monitoring	Parameters	Monitoring Station	Action Level	Limit Level
Air Quality	1-hr TSP	AMS 5	352 μg/m^3	500 μg/m^3
		AMS 6	360 μg/m^3	
	24-hr TSP	AMS 5	164 μg/m^3	260 μg/m^3
		AMS 6	173 μg/m^3	
Noise	$L_{eq\ (30\ min)}$	NMS 5	When one documented complaint is received	75 dB(A)

2.2.2 The Action and Limit Levels for water quality monitoring are given as in **Table 2.3**.

Table 2.3 Action and Limit Levels for Water Quality

Parameter (unit)	Water Depth	Action Level	Limit Level
Dissolved Oxygen (mg/L)	Surface and Middle	5.0	4.2 except 5 for Fish Culture Zone
	Bottom	4.7	3.6
Turbidity (NTU)	Depth average	27.5 or 120% of upstream control station's turbidity at the same tide of the same day; The action level has been amended to "27.5 ***and*** 120% of upstream control station's turbidity at the same tide of the same day" since 25 March 2013.	47.0 or 130% of turbidity at the upstream control station at the same tide of same day; The limit level has been amended to "47.0 ***and*** 130% of turbidity at the upstream control station at the same tide of same day" since 25 March 2013.
Suspended Solid (SS) (mg/L)	Depth average	23.5 or 120% of upstream control station's SS at the same tide of the same day; The action level has been amended to "23.5 ***and*** 120% of upstream control station's SS at the same tide of the same day" since 25 March 2013.	34.4 or 130% of SS at the upstream control station at the same tide of same day and 10mg/L for Water Services Department Seawater Intakes; The limit level has been amended to "34.4 ***and*** 130% of SS at the upstream control station at the same tide of same day and 10mg/L for Water Services Department Seawater Intakes" since 25 March 2013

Notes:
(1) Depth-averaged is calculated by taking the arithmetic means of reading of all three depths.
(2) For DO, non-compliance of the water quality limit occurs when monitoring result is lower that the limit.
(3) For SS & turbidity non-compliance of the water quality limits occur when monitoring result is higher than the limits.
(4) The change to the Action and limit Levels for Water Quality Monitoring for the EM&A works was approved by EPD on 25 March 2013. Therefore, the amended Action and Limit Levels are applied for the water monitoring results obtained on and after 25 March 2013.

2.2.3 The Action and Limit Levels for dolphin monitoring are shown in **Tables 2.4 and 2.5**.

Table 2.4 Action and Limit Level for Dolphin Impact Monitoring

	North Lantau Social Cluster	
	NEL	**NWL**
Action Level	STG < 70% of baseline & ANI < 70% of baseline	STG < 70% of baseline & ANI < 70% of baseline
Limit Level	STG < 40% of baseline & ANI < 40% of baseline	

Remarks:
(1) STG means quarterly average encounter rate of number of dolphin sightings.
(2) ANI means quarterly average encounter rate of total number of dolphins.
(3) For North Lantau Social Cluster, AL will be trigger if either NEL or NWL fall below the criteria; LL will be triggered if both NEL and NWL fall below the criteria.

Table 2.5 Derived Value of Action Level (AL) and Limit Level (LL)

	North Lantau Social Cluster	
	NEL	**NWL**
Action Level	STG < 4.2 & ANI < 15.5	STG < 6.9 & ANI < 31.3
Limit Level	(STG < 2.4 & ANI < 8.9) and (STG < 3.9 & ANI < 17.9)	

Remarks:
(1) STG means quarterly average encounter rate of number of dolphin sightings.
(2) ANI means quarterly average encounter rate of total number of dolphins.
(3) For North Lantau Social Cluster, AL will be trigger if either NEL or NWL fall below the criteria; LL will be triggered if both NEL and NWL fall below the criteria.

2.3 Event Action Plans

2.3.1 The Event Actions Plans for air quality, noise, water quality and dolphin monitoring are annexed in **Appendix D.**

2.4 Mitigation Measures

2.4.1 Environmental mitigation measures for the contract were recommended in the approved EIA Report. **Appendix E** lists the recommended mitigation measures and the implementation status.

3 Environmental Monitoring and Audit

3.1 Implementation of Environmental Measures

3.1.1 In response to the site audit findings, the Contractors carried out corrective actions. Details of site audit findings and the corrective actions during the reporting period are presented in **Appendix F**.

3.1.2 A summary of the Implementation Schedule of Environmental Mitigation Measures (EMIS) is presented in **Appendix E**.

3.1.3 Regular marine travel route for marine vessels were implemented properly in accordance to the submitted plan and relevant records were kept properly.

3.1.4 Dolphin Watching Plan was implemented during the reporting period. No dolphins were observed. The relevant records were kept properly.

3.2 Air Quality Monitoring Results

3.2.1 The monitoring results for 1-hour TSP and 24-hour TSP are summarized in **Tables 3.1** and **3.2** respectively. Detailed impact air quality monitoring results and relevant graphical plots are presented in **Appendix G**.

Table 3.1 Summary of 1-hour TSP Monitoring Results During the Reporting Period

Reporting Period	Monitoring Station	Average ($\mu g/m^3$)	Range ($\mu g/m^3$)	Action Level ($\mu g/m^3$)	Limit Level ($\mu g/m^3$)
September 2013	AMS5	25	16 – 44	352	500
	AMS6	31	14 – 47	360	
October 2013	AMS5	100	47 – 217	352	
	AMS6	105	66 – 229	360	
November 2013	AMS5	65	35 – 127	352	
	AMS6	77	35 – 132	360	

Table 3.2 Summary of 24-hour TSP Monitoring Results During the Reporting Period

Reporting Period	Monitoring Station	Average ($\mu g/m^3$)	Range ($\mu g/m^3$)	Action Level ($\mu g/m^3$)	Limit Level ($\mu g/m^3$)
September 2013	AMS5	37	15-64	164	260
	AMS6	74	45-125	173	
October 2013	AMS5	105	54-138	164	
	AMS6	141	83-170	173	
November 2013	AMS5	70	12-97	164	
	AMS6	123	88-160	173	

3.2.2 There were no Action and Limit Level exceedances for air during daytime on normal weekdays of the reporting period.

3.3 Noise Monitoring Results

3.3.1 The monitoring results for construction noise are summarized in **Table 3.3** and the monitoring results and relevant graphical plots for this reporting period are provided in **Appendix H.**

Table 3.3 Summary of Construction Noise Monitoring Results During the Reporting Period

Reporting period	Monitoring Station	Average $L_{eq\ (30\ mins)}$, dB(A)*	Range of $L_{eq\ (30\ mins)}$, dB(A)*	Action Level	Limit Level $L_{eq\ (30\ mins)}$, dB(A)
September 2013	NMS5	60	58 – 62	When one documented complaint is received	75
October 2013		61	57 – 63		
November 2013		60	58 – 62		

*+3dB(A) Facade correction included

3.3.2 There were no Action and Limit Level exceedances for noise during daytime on normal weekdays of the reporting period.

3.3.3 Major noise sources during the noise monitoring included construction activities of the Contract and nearby traffic noise.

3.4 Water Quality Monitoring Results

3.4.1 Impact water quality monitoring was conducted at all designated monitoring stations during the reporting period. Impact water quality monitoring results and relevant graphical plots are provided in **Appendix I**.

3.4.2 During the reporting period, there were 10 Action Level exceedances and 3 Limit Level exceedances of suspended solids level.

3.4.3 Water quality impact sources during the water quality monitoring were the construction activities of the Contract, nearby construction activities by other parties and nearby operating vessels by other parties.

3.5 Dolphin Monitoring Results

Data Analysis

3.5.1 Distribution Analysis – The line-transect survey data was integrated with the Geographic Information System (GIS) in order to visualize and interpret different spatial and temporal patterns of dolphin distribution using sighting positions. Location data of dolphin groups were plotted on map layers of Hong Kong using a desktop GIS (ArcView© 3.1) to examine their distribution patterns in details. The dataset was also stratified into different subsets to examine distribution patterns of dolphin groups with different categories of group sizes, young calves and activities.

3.5.2 Encounter rate analysis – Encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort, and total number of dolphins sighted on-effort per 100 km of survey effort) were calculated in NEL and NWL survey areas in relation to the amount of survey effort conducted during each month of monitoring survey. Dolphin encounter rates were calculated in two ways for comparisons with the HZMB baseline monitoring results as well as to AFCD long-term marine mammal monitoring results.

3.5.3 Firstly, for the comparison with the HZMB baseline monitoring results, the encounter rates were calculated using primary survey effort alone, and only data collected under Beaufort 3 or below condition would be used for encounter rate analysis. The average encounter rate of sightings (STG) and average encounter rate of dolphins (ANI) were deduced based on the encounter rates from six events during the present quarter (i.e. six sets of line-transect surveys in North Lantau), which was also compared with the one deduced from the six events during the baseline period (i.e. six sets of line-transect surveys in North Lantau).

3.5.4 Secondly, the encounter rates were calculated using both primary and secondary survey effort collected under Beaufort 3 or below condition as in AFCD long-term monitoring study. The encounter rate of sightings and dolphins were deduced by dividing the total number of on-effort sightings (STG) and total number of dolphins (ANI) by the amount of survey effort for the entire quarterly period (September - November 2013).

3.5.5 Quantitative grid analysis on habitat use – To conduct quantitative grid analysis of habitat use, positions of on-effort sightings of Chinese White Dolphins collected during the quarterly impact phase monitoring period were plotted onto 1-km^2 grids among Northwest Lantau (NWL) and Northeast (NEL) survey areas on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS. Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period. For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

3.5.6 The newly-derived unit for sighting density was termed SPSE, representing the number of on-effort sightings per 100 units of survey effort. In addition, the derived unit for actual dolphin density was termed DPSE, representing the number of dolphins per 100 units of survey effort. Among the 1-km^2 grids that were partially covered by land, the percentage of sea area was calculated using GIS tools, and their SPSE and DPSE values were adjusted accordingly. The following formulae were used to estimate SPSE and DPSE in each 1-km^2 grid within the study area:

$$SPSE = ((S / E) \times 100) / SA\%$$
$$DPSE = ((D / E) \times 100) / SA\%$$

where S = total number of on-effort sightings

D = total number of dolphins from on-effort sightings
E = total number of units of survey effort
SA% = percentage of sea area

3.5.7 Behavioural analysis – When dolphins were sighted during vessel surveys, their behaviour was observed. Different activities were categorized (i.e. feeding, milling/resting, traveling, socializing) and recorded on sighting datasheets. This data was then input into a separate database with sighting information, which can be used to determine the distribution of behavioural data with a desktop GIS. Distribution of sightings of dolphins engaged in different activities and behaviours would then be plotted on GIS and carefully examined to identify important areas for different activities of the dolphins.

3.5.8 Ranging pattern analysis – Location data of individual dolphins that occurred during the 3-month baseline monitoring period were obtained from the dolphin sighting database and photo-identification catalogue. To deduce home ranges for individual dolphins using the fixed kernel methods, the program Animal Movement Analyst Extension, was loaded as an extension with ArcView© 3.1 along with another extension Spatial Analyst 2.0. Using the fixed kernel method, the program calculated kernel density estimates based on all sighting positions, and provided an active interface to display kernel density plots. The kernel estimator then calculated and displayed the overall ranging area at 95% UD level.

Summary of Survey Effort and Dolphin Sightings

3.5.9 During the period of September to November 2013, six sets of systematic line-transect vessel surveys were conducted to cover all transect lines in NWL and NEL survey areas twice per month.

3.5.10 From these surveys, a total of 862.46 km of survey effort was collected, with 94.3% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility). Among the two areas, 331.22 km and 531.24 km of survey effort were conducted in NEL and NWL survey areas respectively. In addition, the total survey effort conducted on primary lines was 644.87 km, while the effort on secondary lines was 217.59 km. Survey effort conducted on primary and secondary lines were both considered as on-effort survey data. Summary table of the survey effort is shown in **Annex I of Appendix J**.

3.5.11 During the six sets of monitoring surveys in September to November 2013, a total of 45 groups of 187 Chinese White Dolphins were sighted. All except two sightings were made during on-effort search. Thirty-four on-effort sightings were made on primary lines, while another nine on-effort sightings were made on secondary lines. In this quarterly period, only two groups of eight dolphins were sighted in NEL, while the other 43 groups of 179 dolphins were sighted in NWL. Summary table of the dolphin sightings is shown in **Annex II of Appendix J**.

Distribution

3.5.12 Distribution of dolphin sightings made during monitoring surveys in September, October and November 2013 was shown in **Figure 1 of Appendix J**. Almost all sightings were made in the northwestern portion of the North Lantau region, similar to the dolphin distribution pattern in the previous quarter. In particular, dolphin groups were mainly sighted around Lung Kwu Chau, Shau Chau, Black Point, and along the Urmston Road section between Black Point and Lung Kwu Chau (**Figure 1 of Appendix J**). Moreover, a few sightings were also made to the west and northeast of Chek Lap Kok airport platform, and two sightings were made near Tai Mo To (**Figure 1 of Appendix J**).

3.5.13 A few dolphin groups were sighted in the vicinity of the HKBCF reclamation site, but none was sighted near HKLR03 reclamation site **(Figure 1 of Appendix J)**. In contrary to the previous quarter, no sighting was made along or near the HKLR09 alignment.

3.5.14 Sighting distribution between the impact phase monitoring period (September to November 2013) was compared to the one in the baseline monitoring period (September to November

2011). During the present monitoring period, dolphins rarely occurred in NEL region, which was in stark contrast to their frequent occurrence around the Brothers Islands and HKBCF reclamation site during the baseline period (**Figure 1 of Appendix J**).

3.5.15 The low occurrence of dolphins in NEL region (particularly around the Brothers Islands and Shum Shui Kok) has been documented repeatedly in previous quarters. This should be a serious concern for the HZMB-related construction activities (including the upcoming TM-CLKL bored piling works) in this area, especially when considered that the present period (September to November) in 2013 was exactly the same three-month period as the baseline monitoring period, and any speculation of seasonal fluctuation in dolphin occurrence can be ruled out. To ensure the continuous usage of NEL waters by the dolphins, every possible measure should be implemented by the contractors and relevant authorities to minimize all disturbances to the dolphins, as a future marine park around the Brothers Islands will be established in this important dolphin habitat as a compensation measure for the habitat loss resulted from the HKBCF and HKLR reclamation works.

3.5.16 On the other hand, dolphin occurrence in the western portion of North Lantau region was largely similar between the two periods, except that fewer dolphins were sighted to the west of the airport and near Pillar Point (**Figure 1 of Appendix J**).

Encounter Rate

3.5.17 For the three-month study period in September, October and November 2013, the encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data from the primary transect lines under favourable conditions (Beaufort 3 or below) from each of the survey areas are shown in **Table 3.4**. The average encounter rates deduced from the six sets of surveys were also compared with the ones deduced from the baseline monitoring period in September to November 2011 (See **Table 3.5**).

Table 3.4 Dolphin Encounter Rates (Sightings Per 100 km of Survey Effort) During three Reporting Period (Sep 2013 – Nov 2013)

Survey Area	Dolphin Monitoring	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	Primary Lines Only
Northeast Lantau	Set 1 (3 & 5 Sep 2013)	0.00	0.00
	Set 2 (10 & 18 Sep 2013)	3.44	6.87
	Set 3 (8 & 15 Oct 2013)	0.00	0.00
	Set 4 (17 & 22 Oct 2013)	2.63	15.78
	Set 5 (1 & 5 Nov 2013)	0.00	0.00
	Set 6 (8 & 13 Nov 2013)	0.00	0.00
Northwest Lantau	Set 1 (3 & 5 Sep 2013)	1.48	8.88
	Set 2 (10 & 18 Sep 2013)	4.19	12.57
	Set 3 (8 & 15 Oct 2013)	3.91	13.69
	Set 4 (17 & 22 Oct 2013)	12.24	33.67
	Set 5 (1 & 5 Nov 2013)	10.30	50.02
	Set 6 (8 & 13 Nov 2013)	16.09	76.06

Table 3.5 Comparison of Average Dolphin Encounter Rates between Reporting Period (Sep 2013 – Nov 2013) and Baseline Monitoring Period (Sep – Nov 2011)

Survey Area	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	Reporting Period	Baseline Monitoring Period	Reporting Period	Baseline Monitoring Period
Northeast Lantau	1.01 ± 1.59	6.00 ± 5.05	3.77 ± 6.49	22.19 ± 26.81
Northwest Lantau	8.04 ± 5.70	9.85 ± 5.85	32.48 ± 26.51	44.66 ± 29.85

Note:
The encounter rates deduced from the baseline monitoring period have been recalculated based only on the survey effort and on-effort sighting data made along the primary transect lines under favourable conditions)

Table 3.6 Comparison of Average Dolphin Encounter Rates in Northeast Lantau Survey Area from All Quarters of Impact Monitoring Period and Baseline Monitoring Period (Sep – Nov 2011)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	6.00 ± 5.05	22.19 ± 26.81
December 2012-February 2013 (Impact)	3.14 ± 3.21	6.33 ± 8.64
March-May 2013 (Impact)	0.42 ± 1.03	0.42 ± 1.03
June-August 2013 (Impact)	0.88 ± 1.36	0.88 ± 1.36
September-November 2013 (Impact)	1.01 ± 1.59	3.77 ± 6.49

Note:
The encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions.

3.5.18 In NEL, the average dolphin encounter rates (both STG and ANI) in the present three-month study period were much lower (reductions of 83.2% and 83.0% respectively) than the ones recorded in the 3-month baseline period (Table 3.5). In fact, dolphin occurrence in NEL in the past three quarters have been exceptionally low when compared to the baseline period (Table 3.6), which has prompted the triggering of the Event and Action Plan (in fact, the present quarter was the fourth consecutive quarter being accessed that have triggered the Action Level under the Event and Action Plan).

3.5.19 On the other hand, the average dolphin encounter rates (STG and ANI) in NWL during the present impact phase monitoring period were also lower (reductions of 18.3% and 27.3% respectively) than the ones recorded in the 3-month baseline period, indicating a reduced dolphin usage of this survey area.

3.5.20 A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline and impact monitoring periods. The two variables that were examined included the two periods (baseline and impact phases) and two locations (NEL and NWL).

3.5.21 For the comparison between the baseline period and the present quarter (fourth quarter of the impact phase), the p-value for the differences in average dolphin encounter rates of STG and

ANI were 0.1424 and 0.2339 respectively. If the alpha value is set at 0.1, no significant difference was detected between the baseline and present quarters in both the encounter rates of STG and ANI.

3.5.22 For the comparison between the baseline period and the cumulative quarters in impact phase (i.e. first four quarters of the impact phase), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0366 and 0.0179 respectively. If the alpha value is set at 0.1, significant differences were detected in both the average dolphin encounter rates of STG and ANI (i.e. between the two periods and the locations).

3.5.23 To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present quarter using both primary and secondary survey effort. The encounter rates of sightings (STG) and dolphins (ANI) in NWL were 8.33 sightings and 33.93 dolphins per 100 km of survey effort respectively, while the encounter rates of sightings (STG) and dolphins (ANI) in NEL were 0.62 sightings and 2.50 dolphins per 100 km of survey effort respectively.

Group Size

3.5.24 Group size of Chinese White Dolphins ranged from 1- 11 individuals per group in North Lantau region during September to November 2013. The average dolphin group sizes from these three months were compared with the one deduced from the baseline period in September to November 2011, as shown in **Table 3.7**.

Table 3.7 Comparison of Average Dolphin Group Sizes between Reporting Period (Sep 2013 – Nov 2013) and Baseline Monitoring Period (Sep– Nov 2011)

	Average Dolphin Group Size	
	Reporting Period	**Baseline Monitoring Period**
Overall	4.16 ± 2.46 (n = 45)	3.72 ± 3.13 (n = 66)
Northeast Lantau	4.00 ± 2.83 (n = 2)	3.18 ± 2.16 (n = 17)
Northwest Lantau	4.16 ± 2.48 (n = 43)	3.92 ± 3.40 (n = 49)

3.5.25 The average dolphin group sizes in the entire North Lantau region as well as in NWL during September to November 2013 were slightly higher than the ones recorded in the 3-month baseline period (Table 3.7). Although the average group size in NEL was quite high during the present monitoring period when compared to the baseline period, the sample size of the two dolphin groups in 2013 was very small for such comparison.

3.5.26 Distribution of dolphins with larger group sizes during September to November 2013 is shown in **Figure 2 of Appendix J,** and was compared with the one in baseline period. In 2013, most larger dolphin groups mainly clustered around Lung Kwu Chau and off Lung Kwu Tan, while these larger groups were more scattered in the Northwest Lantau region without any apparent concentration during the baseline monitoring period in 2011 (Figure 2). Notably, none of the larger dolphin groups were sighted near the HKBCF or HKLR03 reclamation sites in 2011.

Habitat Use

3.5.27 From September-November 2013, the most heavily utilized habitats by Chinese White Dolphins mainly concentrated around Lung Kwu Chau, near Pak Chau, and the Urmston Road section between Lung Kwu Chau and Lung Kwu Tan (**Figures 3a and 3b of Appendix J**). Only two grids in NEL recorded the presence of dolphins, with one of the grids overlap with the HKBCF work site. None of the grids near HKLR03 reclamation site or HKLR09 bridge alignment recorded the presence of dolphins.

3.5.28 It should be noted that the amount of survey effort collected in each grid during the three-month period was fairly low (6-12 units of survey effort for most grids), and therefore the habitat use pattern derived from the three-month dataset should be treated with caution. A more complete picture of dolphin habitat use pattern will be presented when more survey effort for each grid will be collected throughout the impact phase monitoring programme.

3.5.29 When compared with the habitat use patterns during the baseline period, dolphins usage in NEL was noticeably much lower in the present impact monitoring period (**Figure 4 of Appendix J**). During the baseline period, dolphin densities were particularly higher along the coastline between Shum Shui Kok and Siu Ho Wan, while this area was vacated by dolphins during the present impact phase period. On the other hand, the density patterns between the baseline and impact phase monitoring periods were similar in the Northwest Lantau region.

3.5.30 The absence of dolphins in the identified important habitats around the Brothers Islands and Shum Shui Kok in consecutive quarters in 2013 is of serious concern. The future Brothers Islands Marine Park will be established in this area upon the completion of HKBCF reclamation works, as an important compensation measure for the habitat loss in relation to HZMB projects. It should be further examined whether the very low usage of dolphins would continue in this important dolphin habitat, and the potential measures should be implemented soon that may enhance the dolphin usage of this area.

Mother-calf Pairs

3.5.31 During the three-month study period, a total of four unspotted calves (UC) and 14 unspotted juveniles (UJ) were sighted in NEL and NWL survey areas. These young calves comprised 9.6% of all animals sighted, which was higher than the percentage recorded during the baseline monitoring period (6.8%).

3.5.32 The occurrence of these young calves mainly concentrated around Lung Kwu Chau and off Lung Kwu Tan, and most of them were involved in larger dolphin groups (**Figure 5 of Appendix J**). None of these calves were sighted in the vicinity of the HKBCF or HKLR03 reclamation site during the present quarter.

Activities and Associations with Fishing Boats

3.5.33 A total of five dolphin sightings were associated with feeding and socializing activities during the three-month study period. The percentage of feeding activities comprised of 4.4% of the total number of dolphin sightings, which was much lower than the one recorded during the baseline period (11.6%). On the contrary, the percentage of socializing activities were 6.6% during the present impact phase monitoring period, which was slightly higher than the one recorded during the baseline period (5.4%). Only one group of dolphins was engaged in traveling activity, and the rarity of this observed activity was similar to the baseline monitoring period and previous impact phase monitoring periods.

3.5.34 Distribution of dolphins engaged in different activities during the three-month study period is shown in (**Figure 6 of Appendix J**). No apparent concentration of sightings was found for all three types of observed activities.

3.5.35 During the three-month period, only one of the 45 dolphin groups was found to be associated with an operating gill-netter. The extremely low level of fishing boat association in the present and previous quarters was consistently found, and was likely related to the recent trawl ban being implemented in 2013 in Hong Kong waters.

Photo-identification and Individual Range Use

3.5.36 From September to November 2013, over 3,000 digital photographs of Chinese White Dolphins were taken during the impact phase monitoring surveys for the photo-identification work.

3.5.37 In total, 56 individuals sighted 110 times altogether were identified (see summary table in **Annex III** and photographs of identified individuals in **Annex IV of Appendix J**). Only eight of

these 110 re-sightings were made in NEL, which involved eight different individuals. Notably, these were the same individuals that were repeatedly sighted before in NEL throughout the HKLR03 impact phase monitoring surveys as well as in the baseline monitoring period.

3.5.38 Most identified individuals were sighted only once or twice during the three-month period, with the exception of 11 individuals being sighted thrice, and four individuals being sighted four times (CH34, NL33, NL98 and WL05). One individual, NL220 were sighted five times, but three of those sightings were made on the same survey day.

3.5.39 Notably, nine of these 56 individuals were also sighted in West Lantau waters during the HKLR09 monitoring surveys in the same 3-month period, showing their extensive movement between North and West Lantau regions.

3.5.40 Twelve well-recognized females were accompanied with their calves during their re-sightings. Besides NL80, NL182 and WL 124, the other mothers (NL33, NL93, NL98, NL123, NL145, NL188, NL220, NL221 and NL264) were frequently sighted with their calves throughout the HKLR03 impact phase monitoring surveys.

3.5.41 Ranging patterns of the 56 individuals identified during the three-month study period were determined by fixed kernel method, and are shown in **Annex V of Appendix J**.

3.5.42 Only a few individuals had their range extended to NEL survey area, while other individuals mostly focused their range use in NWL survey area during the present quarter. In contrast to the extensive movements between NEL and NWL survey areas in the first two impact monitoring quarters (October 2012 - February 2013) and the baseline period (September-November 2011), many of these identified individuals appeared to abandon their usage in NEL waters during the present and previous quarters, even though they were regularly sighted there before and their core areas were centered around the Brothers Islands (e.g. NL24, NL33, NL139, NL261) (**Annex V of Appendix J**).

3.5.43 It is apparent that the majority of individual dolphins that utilized NEL waters in the past has either diminished or avoided this area for their recent range use. This coincided well with the dramatic decline in dolphin occurrence in NEL as discussed in **Sections 3.5.16 to 3.5.26**. This is of serious concern, as the Brothers Islands in NEL was once identified an important habitat for many year-round residents that focused their core area use there (Hung 2008). Therefore, the ranging pattern of individual dolphins should be continuously monitored around Lantau waters, and measures should be taken to ensure that dolphins will continue to move between NWL and NEL without any hindrance as a result of the HZMB-related construction works.

Action Level / Limit Level Exceedance

3.5.44 There was one Action Level exceedances of dolphin monitoring for the quarterly monitoring data (September – November 2013). According to the contractor's information, the marine activities undertaken for HKLR03 during the two quarterly periods (June to August 2013 and September to November 2013) included stone platform construction, reclamation, stone column installation, band drain installation and excavation of stone platform. During the quarterly period of September to November 2013, geotextile laying activities were also carried out. There is no evidence showing the current AL non-compliance directly related to the construction works of HKLR03. It should also be noted that reclamation work under HKLR03 (adjoining the Airport Island) situates in waters which has rarely been used by dolphins in the past, and the working vessels under HKLR03 have been travelling from source to destination in accordance with the Marine Travel Route to minimize impacts on Chinese White Dolphin. In addition, the contractor will implement proactive mitigation measures such as avoid anchoring at Marine Department's designated anchorage site – Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

3.5.45 A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline and impact monitoring periods. The two variables that were examined included the two periods (baseline and impact phases) and two locations (NEL and NWL).

3.5.46 For the comparison between the baseline period and the present quarter (fourth quarter of the impact phase), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.1424 and 0.2339 respectively. If the alpha value is set at 0.1, no significant difference was detected between the baseline and present quarters in the average dolphin encounter rates of STG and ANI.

3.5.47 For the comparison between the baseline period and the cumulative quarters in impact phase (i.e. first four quarters of the impact phase), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0366 and 0.0179 respectively. If the alpha value is set at 0.1, significant difference was detected in both the average dolphin encounter rates of STG and ANI (i.e. between the two periods and the locations).

3.5.48 The AFCD monitoring data during September-November 2013 has been reviewed by the dolphin specialist, and only two groups of three dolphins were sighted from 77.81 km of survey effort on primary lines in NEL during the same quarter. This review has confirmed that the very low occurrence of dolphins reported by the HKLR03 monitoring survey in summer 2013 in NEL is accurate.

3.5.49 There is no evidence showing that the sources of impact directly related to the construction works of HKLR03 that may have affected the dolphin usage in the NEL region.

3.5.50 All dolphin protective measures are fully and properly implemented in accordance with the EM&A Manual. In order to minimise disturbance to the Brother's Island, the Contractor provide training to skippers to ensure that their working vessels travel from source to destination to minimize impacts on Chinese White Dolphin and avoid anchoring at Marine Department's designated anchorage site - Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

3.6 Mudflat Monitoring Results

Sedimentation Rate Monitoring

3.6.1 The baseline sedimentation rate monitoring was in September 2012 and impact sedimentation rate monitoring was undertaken on 4 September 2013. The mudflat surface levels at the four established monitoring stations and the corresponding XYZ HK1980 GRID coordinates are presented in **Table 3.8** and **Table 3.9.**

Table 3.8 Measured Mudflat Surface Level Results

	Baseline Monitoring (September 2012)			Impact Monitoring (September 2013)		
Monitoring Station	Easting (m)	Northing (m)	Surface Level (mPD)	Easting (m)	Northing (m)	Surface Level (mPD)
S1	810291.160	816678.727	0.950	810291.152	816678.733	1.022
S2	810958.272	815831.531	0.864	810958.277	815831.548	0.916
S3	810716.585	815953.308	1.341	810716.599	815953.297	1.393
S4	811221.433	816151.381	0.931	811221.405	816151.371	1.019

Table 3.9 Comparison of measurement

	Comparison of measurement			Remarks and Recommendation
Monitoring Station	Easting (m)	Northing (m)	Surface Level (mPD)	
S1	-0.008	0.006	0.072	Level continuously increased
S2	0.005	0.0017	0.052	Within tolerance, no significant change
S3	0.014	-0.011	0.052	Within tolerance, no significant change
S4	-0.028	-0.010	0.088	Level continuously increased

3.6.2 This measurement result was generally and relatively higher than the baseline measurement at S1 and S4. The mudflat level is continuously increased. For S2 and S3 showed that the level has increased within tolerance and their sea bed depth would not be considered as significant change.

Water Quality Monitoring

3.6.3 The mudflat monitoring covered water quality monitoring data. Reference was made to the water quality monitoring data of the representative water quality monitoring station (i.e. SR3) as in the EM&A Manual. The water quality monitoring location (SR3) is shown in **Figure 2.1**.

3.6.4 Impact water quality monitoring in San Tau (monitoring station SR3) was conducted in September 2013. The monitoring parameters included dissolved oxygen (DO), turbidity and suspended solids (SS).

3.6.5 Due to adverse weather condition, the water quality monitoring at station SR3 was cancelled on 23 September 2013 during mid-ebb tide and mid-flood tide. The Impact monitoring results for SR3 were extracted and summarised below:

Table 3.10 Impact Water Quality Monitoring Results (Depth Average)

Date	Mid Ebb Tide			Mid Flood Tide		
	DO (mg/L)	Turbidity (NTU)	SS (mg/L)	DO (mg/L)	Turbidity (NTU)	SS (mg/L)
02-Sep-13	7.2	4.5	2.4	8.8	9.6	11.1
04-Sep-13	5.3	9.0	10.9	5.5	9.0	9.4
06-Sep-13	6.5	8.4	7.1	6.4	11.1	10.6
09-Sep-13	5.7	7.5	6.7	5.6	8.3	8.3
11-Sep-13	6.8	4.1	4.5	6.4	4.3	4.8
13-Sep-13	5.7	4.3	3.7	6.6	10.3	3.4
16-Sep-13	6.8	4.2	5.2	8.6	12.1	18.0
18-Sep-13	6.7	8.5	5.2	6.8	10.5	9.9
20-Sep-13	6.2	8.5	7.9	5.9	12.8	12.0
23-Sep-13	-	-	-	-	-	-
25-Sep-13	6.5	9.4	10.1	6.5	9.5	9.8
27-Sep-13	6.2	5.7	5.7	7.1	5.1	7.1
30-Sep-13	6.5	3.8	2.9	6.8	4.7	6.7
Average	6.3	6.5	6.0	6.7	8.9	9.2

Mudflat Ecology Monitoring

Sampling Zone

3.6.6 There are two survey areas specified under the updated EM&A Manual for the Contract, namely Tung Chung Bay and San Tau. Tung Chung Bay survey area is divided into three sampling zones (TC1, TC2 and TC3) and there is one sampling zone at San Tau (ST). Survey of horseshoe crabs, seagrass beds and intertidal communities were conducted in each sampling zone. The locations of sampling zones are shown in **Annex I of Appendix O**.

Horseshoe Crabs

3.6.7 An active search method was adopted for horseshoe crab survey at each sampling zone. The survey was undertaken by 2 specialists at each sampling zone. During the search period, any accessible and potential area would be investigated for any horseshoe crab individuals within 2-3 hours in low tide period (tidal level below 1.2 m above Chart Datum (C.D.)). Once a horseshoe crab was found, the species, size and inhabiting substrate, photographic record and respective GPS coordinate were recorded with reference to Li (2008). The horseshoe crab surveys were conducted on 15th (for zones TC3 and ST) and 21st (for zones TC1 and TC2) September 2013 with hot and cloudy weather.

Seagrass Beds

3.6.8 An active search method was adopted for seagrass bed survey at each sampling zone. The survey was undertaken by 2 specialists each spending within 2-3 hours in low tide period. Once seagrass bed was observed, the species, the estimated area (m^2), photographic record and respective GPS coordinate were recorded. The seagrass bed surveys were conducted on 15th (for zones TC3 and ST) and 21st (for zones TC1 and TC2) September 2013 with hot and cloudy weather.

Intertidal Soft Shore Communities

3.6.9 The sandy shore of San Tau and Tung Chung Bay from the uppermost part of the shore and to the water edge was divided into three tidal zones – upper, middle and lower zones, at each sampling zone, TC1, TC2, TC3 and ST. A 100m transect was laid in each of the three tidal zones for fauna sampling.

3.6.10 At each sampling zone, three 100m horizontal transects were laid at 2.0m, 1.5m and 1.0m above C.D. Along each transect, ten random quadrats (0.5 m x 0.5m) were placed. In each quadrat, the epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers/coverage percentages were recorded. One core of 10cm diameter x 20cm depth was also collected within each quadrat. The sediments of the cores were sieved with 2mm mesh-size sieve and the biota inside was identified and counted. All collected fauna were released after recording except some tiny individuals that *in-situ* identification was not feasible. These tiny individuals were collected and were identified in the laboratory. Species and abundance of biota in both cores and quadrats were reported. The intertidal soft shore community surveys were conducted in low tide period on 1st (for ST), 7th (for TC3), 8th (for TC1) and 14th September 2013 (for TC2).

Data Analysis

3.6.11 Data collected from direct search and core sampling was pooled in every quadrat for data analysis. Shannon-Weaver Diversity Index (H') and Pielou's Species Evenness (J) were calculated for every quadrat using the formulae below,

$H' = -\Sigma (Ni / N) \ln (Ni / N)$ (Shannon and Weaver, 1963)
$J = H' / \ln S$, (Pielou, 1966)

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the ith species.

Mudflat Ecology Monitoring Results and Conclusion

Horseshoe Crabs

3.6.12 **Table 3.1 and Figure 3.1 of Appendix O** show the records of horseshoe crab survey at every sampling zone. In general, horseshoe crab Tachypleus tridentatus was found at all sampling zone (TC1: 10 individuals; TC2: 2 individuals; TC3: 7 individuals; ST: 94 individuals). All individuals were found on soft mud, sandy substratum or sandy substratum surrounded by small gravels. Grouping was observed while the group size ranged 2-11 individuals.

3.6.13 Since the commencement of the survey on September 2012, no individual was found at TC2 until the present survey (2 individuals). It showed that TC2 was not a suitable nursery ground for horseshoe crab

3.6.14 According to **Table 3.2 of Appendix O**, the search records of Tachypleus tridentatus were 2.50 individuals hr^{-1} $person^{-1}$ (mean prosomal widths: 31.22 mm), 0.50 individuals hr^{-1} $person^{-1}$ (25.51 mm) and 1.75 individuals hr^{-1} $person^{-1}$ (30.87 mm) at TC1, TC2 and TC3 respectively. Similar to previous surveys, the highest search record of 15.67 individuals hr^{-1} $person^{-1}$ (40.39 mm) was reported at ST. According to Li (2008), the prosomal width of Tachypleus tridentatus recorded ranged 19.33 - 68.01 mm that corresponded to an estimated age of 2.6 – 8.0 years old. It was obvious that ST was an important nursery ground for horseshoe crab especially newly hatched individuals due to larger area of suitable substratum (fine sand or soft mud) and less human disturbance (far from urban district).

3.6.15 **Figure 3.2 of Appendix O** shows the changes of number of individuals, mean prosomal width and search record of horseshoe crab *Tachypleus tridentatus* at the every sampling zone along the sampling months. Both number of individuals and search records declined generally during dry season (from September to December 201) at TC1, TC2 and ST. The horseshoe crabs were inactive and burrowed in the sediments during cold weather (<15 ºC). Similar results of low search record in dry seasons were reported in a previous territory-wide survey of horseshoe crab. For example, the search records at Tung Chung Wan were 0.17 individuals hr^{-1} $person^{-1}$ and 0 individual hr^{-1} $person^{-1}$ in wet season and dry season respectively (details see Li, 2008). From December 2012 to September 2013 (present survey), both values increased with the warmer climate at the three sampling zones.

3.6.16 At ST, sharp increase of number of individuals was recorded from 15 individuals in March 2013, 59 individuals in June 2013 to 94 individuals in September 2013). A personal conversation was conducted with Prof. K.S. Shin (Department of Biology and Chemistry, The City University of Hong Kong (CityU) who was running a conservation programme of horseshoe crab in Hong Kong. His monitoring team had recorded similar increase of horseshoe crab population during wet season this year. It was believed the suitable ambient temperature increased its conspicuousness.

3.6.17 **Figure 3.3** of **Appendix O** shows the changes of prosomal width of horseshoe crab Tachypleus tridentatus at ST. It was believed that most of individuals (50% records between upper and lower quartile), recorded in the dry season, had grown to a size of double in June 2013 (prosomal width increase from 10-20 mm to 30-50 mm). The individuals remained similar in size in present survey. It indicated the major moulting period occurring between March and June. At the same time, tiny individuals (10-15 mm) were found (outliers of low value) that seasonal spawning was believed occurring at ST.

3.6.18 Besides, 18 labeled individuals of *Tachypleus tridentatus* (prosomal width: 28.76-56.00 mm) were recorded in the present survey (Table 3.1 and Figure 3.1). All of them were released through a conservation programme conducted by Dr. Shin (CityU). It was a re-introduction trial of artificial bred and marked horseshoe crab juvenile at selected sites. So that the horseshoe crabs population might be restored in the natural habitat. Through a personal conversation with Dr Shin, about 100 individuals were released to ST on 20 June 2013. All these labeled individuals were not included in the results of present monitoring programme.

3.6.19 Another less common species *Carcinoscorpius rotundicauda* was not found during the whole survey period except the survey conducted in December 2012 at ST (4 individuals). This species was believed present in ST at very low number while encounter was very rare

3.6.20 The present survey was the fourth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project could not be detected on horseshoe crabs considering the factor of natural, seasonal variation, In case, abnormal phenomenon (e.g. very few numbers of horseshoe individuals in warm weather) is observed, it would be reported as soon as possible.

Seagrass Beds

Table 3.3 and Figure 3.4 of **Appendix O** show the records of seagrass beds survey at every sampling zone. Seagrass was recorded in ST only while the largest patch was *Halophila ovalis* located nearby the mangrove vegetation on sandy substratum at tidal level 2 m above C.D.. The estimated total area was 758.9 m^2 with estimated coverage ranged 85-90%. It was a long seagrass strand merged by the growth of 2 to 3 smaller patches recorded in previous surveys from September 2012 to June 2013. Moreover, six small patches of *H. ovalis* were recorded on soft mud at tidal level between 1.0 m and 1.5 m above C.D.. The estimated total area of each patch ranged 1.2 - 8.0 m^2 with estimated coverage ranging 15-70%. These small patches were yet recorded in previous surveys and were distant from the largest strand. Seasonal recruitment of *H. ovalis* was believed occurred between June and September. One small patch of *Zostera japonica* was found within the long strand of *Halophila ovalis*. The estimated area was 3.7 m^2 while the estimated coverage was about 95%.

3.6.21 **Figure 3.5 of Appendix O** shows the changes of estimated total area of seagrass beds at ST along the sampling months. For seagrass *Halophila ovalis*, the total area and estimated coverage increased gradually. It showed that the seagrass was in scattered patches during dry season then grew and merged into single patch during wet season. Seasonal recruitment during wet season further increased the total area of seagrass. However it was doubt that the newly recruited patches of seagrass would survive the natural heat stress, predation and wave action. For seagrass *Zostera japonica,* it was not reported in the surveys of September and December 2012. Seasonal recruitment of few patches was reported between December and March. Then the patch size increased and merged gradually with the warmer climate. However the patch size decreased sharply in the present survey. The patch might not overcome the high heat stress exerted on shore between June and September 2013.

3.6.22 The present survey was the fourth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project could not be detected on seagrass. The seagrass area of *Halophila ovalis* was increasing steadily due to natural growth and seasonal recruitment. Although that of *Zostera japonica* decreased in the present survey, it would be the cause of natural heat stress. In case, abnormal phenomenon (e.g. rapid reduction of seagrass patch size) was observed, it would be reported as soon as possible.

Intertidal Soft Shore Communities

3.6.23 **Table 3.4 and Figure 3.5** of **Appendix O** show the types of substratum along the horizontal transect at every tidal level of every sampling zone. The relative distribution of different substrata was estimated by investigating the substratum types (Gravels & Boulders / Sands / Soft mud) of the ten random quadrats along the horizontal transect.

3.6.24 The distribution of substratum types varied among tidal levels and sampling zones. At TC1, higher percentage of 'Sands' was recorded (60%) while the rest was 'Gravels and Boulders' (40%) at high tidal level. High percentage of 'Gravels and Boulders' (80%) was recorded at mid tidal level. Even distribution of 'Soft mud' (40%) and 'Sands' (40%) was recorded at low tidal level. At TC2, high percentage of 'Sands' (60%) was recorded while the rest was 'Soft mud' (40%) at high tidal level. But higher percentages of 'Soft mud' (50-70%) and lower percentage of 'Sands' (30%) were recorded at mid and low tidal levels. At TC3, high percentages of 'Sands' (80-100%) were recorded at high and mid tidal levels. 'Gravels and Boulders' was the major

substratum (60%) at low tidal level followed by 'Sands' (30%). At ST, 'Gravels and Boulders' (100%) was recorded only at high tidal level. Even distribution of 'Gravels and Boulders' (50%) and 'Sands' (50%) was recorded at mid tidal level. At low tidal level, high percentage of 'Soft mud' (80%) was recorded at low tidal level followed by 'Gravels and Boulders' (20%).

3.6.25 There was neither consistent vertical nor horizontal zonation pattern of substratum type in the study site. Such heterogeneous variation should be caused by different hydrology (e.g. wave in different direction and intensity) received by the four sampling zones.

3.6.26 **Table 3.5 of Appendix O** lists the total abundance, density and number of taxon of every phylum in the present survey. A total of 19329 individuals were recorded. Mollusks were significantly the most abundant phylum (total individuals 18738, density 625 individuals m^{-2}, relative abundance 96.9%). The second abundant group was arthropod (total individuals: 421, density 14 individuals m^{-2}, 2.2%) respectively. Relatively other phyla were very low in abundance ($\leq$0.6%). Similarly, the most diverse phylum were mollusks (37 taxa) followed by arthropods (13 taxa) and annelids (8 taxa). The taxa of other phyla were relatively less ($\leq$1 taxon). The complete list of collected specimens is provided in **Annex III of Appendix O**.

3.6.27 **Table 3.6 of Appendix O** shows the number of individual, relative abundance and density of each phylum at every sampling zone. The results were similar among the four sampling zones. In general, mollusks were the most dominant phylum (no. of individuals: 3119-7510 individuals, relative abundance 93.7-98.8%). Arthropods were the second abundant phylum (no. of individuals: 49-185 individuals, 0.6-4.6%) although the number of individuals was significantly lower than that of mollusks. Relatively, other phyla were very low in abundance across the four sampling zones (< 1%) except the annelids at TC2 (no. of individuals: 57 individuals, relative abundance 1.4%).

3.6.28 **Table 3.7 of Appendix O** lists the abundant species (relative abundance >10%) at every sampling zone. At TC1, gastropod *Batillaria multiformis* was clearly the dominant species (403-406 individuals m^{-2}, relative abundance 51-64%) at high and mid tidal levels. It was also in moderate abundance at low tidal level (32 individuals m^{-2}, 10%). Gastropod *Cerithidea djadjariensis* (98-111 individuals m^{-2}, 18-29%) was also abundant at high and low tidal levels. Gastropod *Monodonta labio* (135 individuals. m^{-2}, 17%) was the second abundant at mid tidal level. Rock oyster *Saccostrea cucullata* was at moderate abundance at mid and low tidal levels (61-96 individuals m^{-2}, 12-18%).

3.6.29 At TC2, gastropod *Cerithidea cingulata* was the most abundant at high tidal level (412 individuals m^{-2}, relative abundance 50%) but was less in abundance at mid tidal level (61 individuals m^{-2}, 13%). All three tidal levels were dominated by gastropod *Cerithidea djadjariensis* (167-271 individuals. m^{-2}, 33-52%). At mid tidal level, rock oyster *Saccostrea cucullata* (72 individuals m^{-2}, 15%) was the second abundant species. At low tidal level, gastropod *Batillaria zonalis* (42 individuals m^{-2}, 13%) was common-occurring species.

3.6.30 At TC3, the high and mid tidal levels were mainly dominated by gastropods *Batillaria multiformis* (526-857 individuals m^{-2}, relative abundance 49-63%), *Cerithidea djadjariensis* (244-310 individuals m^{-2}, 18-29%) and *Cerithidea cingulata* (191-206 individuals m^{-2}, 14-19%). At low tidal level, the abundant species were gastropod *Monodonta labio* (196 individuals m^{-2}, 33%), rock oyster *Saccostrea cucullata* (158 individuals m^{-2}, 27%) followed by gastropod *Batillaria multiformis* (91 individuals m^{-2}, 15%).

3.6.31 At ST, gastropod *Batillaria multiformis* was highly abundant (329 individuals m^{-2}, relative abundance 55%) at high tidal level followed by gastropod *Monodonta labio* (108 individuals. m^{-2}, 18%). Relatively the abundant species were similar but lower in abundances at mid tidal level such as gastropods *Cerithidea djadjariensis* (88 individuals m^{-2}, 18%), *Batillaria multiformis* (58 individuals m^{-2}, 12%), *Cerithidea cingulata* (58 individuals m^{-2}, 12%), *Lunella coronata* (56 individuals m^{-2}, 12%) and rock oyster *Saccostrea cucullata* (88 individuals m^{-2}, 18%). At low tidal level, the abundant species gastropod *Cerithidea djadjariensis* (95 individuals m^{-2}, 44%) and *Batillaria zonalis* (24 individuals m^{-2}, 11%) were also low in abundances.

3.6.32 There was no consistent zonation pattern of species distribution observed across sampling zones and tidal levels in Tung Chung Wan and San Tau. The species distribution should be determined by the type of substratum primarily. In general, gastropods *Batillaria multiformis* (7058 individuals, 37%), *Cerithidea djadjariensis* (4207 individuals, 22%), *Cerithidea cingulata* (2701 individuals, 14%) were the most common occurring species on sandy substratum mainly among the four sampling zones. Moreover gastropod *Monodonta labio* (1360 individuals, 7%) and rock oyster *Saccostrea cucullata* (1520 individuals, 8%), were common occurring species inhabiting gravel and boulders substratum.

3.6.33 **Table 3.8 of Appendix O** shows the mean values of number of species, density, *H'* and *J* of soft shore communities at every tidal level and sampling zone. Among the sampling zones, the mean number of species was generally similar among TC1, TC2 and TC3 (7-13 spp. 0.25 m^{-2}) while ST had relatively higher value (8-15 spp. 0.25 m^{-2}). The mean densities of TC3 (590-1371 individuals m^{-2}) was generally higher than that of TC1 (332-800 individuals m^{-2}) and TC2 (320-827 individuals m^{-2}) followed by ST (218-602 individuals m^{-2}). The mean biodiversity index and species evenness were similar that ranged 1.22-1.56 and 0.58-0.66 respectively.

3.6.34 Across the tidal levels, there was no difference of the mean number of species. Higher mean densities were observed at high and mid tidal levels. Usually higher mean biodiversity index and species evenness were observed at mid and low tidal levels.

3.6.35 **Figure 3.6 of Appendix O** shows the temporal changes of number of species, density, *H'* and *J* at every tidal level and sampling zone since the baseline monitoring survey (Sep 2012). No significant temporal change of any biological parameters was observed at all sampling zones. Although declined densities were reported at sampling zones TC2 (mid and low tidal levels) and TC3 (high and mid tidal levels) in dry season on December 2012, it was believed a natural, seasonal variation due to higher mortality and lower activity rate of intertidal fauna during cold, dry season. The densities of both sampling zones had increased along with the hot, wet season. At the same time, steady increases of number of species and biodiversity index were observed at ST (mid and low tidal levels).

3.6.36 The present survey was the fourth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project were not detected on intertidal soft shore community.

3.7 Solid and Liquid Waste Management Status

3.7.1 The Contractor registered with EPD as a Chemical Waste Producer on 12 July 2012 for the Contract. Sufficient numbers of receptacles were available for general refuse collection and sorting.

3.7.2 The summary of waste flow table is detailed in **Appendix K**.

3.7.3 The Contractor was reminded that chemical waste containers should be properly treated and stored temporarily in designated chemical waste storage area on site in accordance with the Code of Practise on the Packaging, Labelling and Storage of Chemical Wastes.

3.8 Environmental Licenses and Permits

3.8.1 The valid environmental licenses and permits during the reporting period are summarized in **Appendix L.**

4 Environmental Complaint and Non-compliance

4.1 Environmental Exceedances

4.1.1 The detailed air quality, noise, water quality and dolphin exceedances are provided in **Appendix M**. Also, the summaries of the environmental exceedances are presented as followed:

Air Quality

4.1.2 There were no Action and Limit Level exceedances for 1-hr TSP or 24-hr TSP recorded air quality were recorded during the reporting period.

Noise

4.1.3 No Action and Limit Level exceedances for noise were recorded during this reporting period.

Water Quality

4.1.4 During the reporting period, there were 10 Action Level exceedances and 3 Limit Level exceedances of suspended solids level. No exceedances of turbidity level were recorded. No exceedances of dissolved oxygen level. There were no specific activities recorded during the monitoring period that would cause any significant impacts on monitoring results and no leakage of turbid water or any abnormity or malpractice was observed during the sampling exercise. Therefore, all exceedances were considered as non-contract related. The detailed numbers of exceedances recorded during the reporting period at each impact station are summarised in **Table 4.1.**

Dolphin

4.1.5 There was one Action Level exceedances of dolphin monitoring for the quarterly monitoring data (September – November 2013). According to the contractor's information, the marine activities undertaken for HKLR03 during the two quarterly periods (June to August 2013 and September to November 2013) included stone platform construction, reclamation, stone column installation, band drain installation and excavation of stone platform. During the quarterly period of September to November 2013, geotextile laying activities were also carried out.

4.1.6 There is no evidence showing the current AL non-compliance directly related to the construction works of HKLR03. It should also be noted that reclamation work under HKLR03 (adjoining the Airport Island) situates in waters which has rarely been used by dolphins in the past, and the working vessels under HKLR03 have been travelling from source to destination in accordance with the Marine Travel Route to minimize impacts on Chinese White Dolphin. In addition, the contractor will implement proactive mitigation measures such as avoiding anchoring at Marine Department's designated anchorage site – Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

4.1.7 All dolphin protective measures are fully and properly implemented in accordance with the EM&A Manual. In order to minimise disturbance to the Brother's Island, the Contractor provide training to skippers to ensure that their working vessels travel from source to destination to minimize impacts on Chinese White Dolphin and avoid anchoring at Marine Department's designated anchorage site - Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

Table 4.1 Summary of Water Quality Exceedances

Station	Exceedance Level	DO (S&M)		DO (Bottom)		Turbidity		SS		Total Number of Exceedances	
		Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
IS5	Action Level	--	--	--	--	--	--	--	22-11-2013	0	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS(Mf)6	Action Level	--	--	--	--	--	--	16-09-2013 11-11-2013	11-11-2013	2	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS7	Action Level	--	--	--	--	--	--	--	18-10-2013	0	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS8	Action Level	--	--	--	--		--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS(Mf)9	Action Level	--	--	--	--	--	--	--	06-09-2013	0	1
	Limit Level	--	--	--	--	--	--	--	16-10-2013	0	1
IS10	Action Level	--	--	--	--	--	--	--	06-11-2013	0	1
	Limit Level	--	--	--	--	--	--	--	25-10-2013	0	1
SR3	Action Level	--	--	--	--	--	--	--	22-11-2013	0	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR4	Action Level	--	--	--	--		--	--	18-09-2013	0	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR5	Action Level	--	--	--	--	--	--	--	06-11-2013	0	1
	Limit Level	--	--	--	--	--	--	--	25-10-2013	0	1
SR10A	Action Level	--	--	--	--	--	--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR10B	Action Level	--	--	--	--	--	--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
Total	**Action**	0	0	0	0	0	0	2	8	10**	
	Limit	0	0	0	0	0	0	0	3	3**	

Notes:
S: Surface;
M: Mid-depth;
* The total exceedances.

4.2 Summary of Environmental Complaint, Notification of Summons and Successful Prosecution

4.2.1 There were five environmental complaints received during this reporting period. All investigation reports for exceedances of the Contract have been submitted to ENPO/IEC for comments and/or follow up to identify whether the exceedances occurred related to other HZMB contracts. The summary of environmental complaints is presented in **Table 4.2**. The details of environmental complaints are presented in **Appendix N**.

Table 4.2 Summary of Environmental Complaints for the Reporting Period

Environmental Complaint No.	Date of Complaint Received	Description of Environmental Complaints
COM-2013-033	13 September 2013	Noise
COM-2013-034	17 September 2013	Noise
COM-2013-037	8, 9 and 16 October 2013	Noise
COM-2013-041	31 October 2013	Noise
COM-2013-043	11 November 2013	Noise

4.2.2 No notification of summons and prosecution was received during the reporting period.

4.2.3 Statistics on notifications of summons and successful prosecutions are summarized in **Appendix M**.

5 COMMENTS, RECOMMENDATIONS AND CONCLUSION

5.1 Comments

5.1.1 According to the environmental site inspections undertaken during the reporting period, the following recommendations were provided:

- The Contractor was reminded to tense the slit curtain at Portion X.
- The Contractor was reminded to clean up the plastic boxes at Portion X.
- The Contractor was reminded to provide drip trays for the chemical containers at Sand Pump Barge.
- The Contractor was reminded to clean up the muddy water on public road at S11.
- The Contractor was reminded to clean up the stagnant water inside the drip tray at West Portal.
- The Contractor was reminded to clean up the stagnant water inside the I-beams at West Portal.
- The Contractor was reminded to clean up the passageway of Yao Chun 138.
- The Contractor was reminded to provide a drip tray for the chemical container at Sand Pump Barge.
- The Contractor was reminded to clean up the footprints (sand) on public road area at S11.
- The Contractor was reminded to provide a drip tray for the compressor at West Portal.
- The Contractor was reminded to clean up the passageway of LT 30.
- The Contractor was reminded to provide sand bags around the sand stockpile to prevent muddy water discharge onto the road at WA04.
- The Contractor was reminded to provide water spraying on the unpaved road regularly at N13.
- The Contractor was reminded to provide water spraying on the unpaved area regularly at S16.
- The Contractor was reminded to clean up the oil inside the drip tray at West Portal.
- The Contractor was reminded to clean up the stagnant water inside the drip tray at West Portal.
- The Contractor was reminded to provide sufficient dust mitigation measures at work area of West Portal.
- The Contractor was reminded to replace the Sand bags on Sand Pump Barge.
- The Contractor was reminded to place the sand bags beside the road at S7.
- The Contractor was reminded to provide drip trays for oil container at West Portal.
- The Contractor was reminded to provide drip trays for chemical containers at N4.
- The Contractor was reminded to provide drip trays for oil containers at S8.
- The Contractor was reminded to provide drip trays for oil containers at N13.
- The Contractor was reminded to spray water regularly on the public road at S8.
- The Contractor was reminded to clean up oil stain on the deck of YC138.
- The Contractor was reminded to clean up the excess fill materials at the barge edge of CM83.

- The Contractor was reminded to place the sand bags along the road at S7 and clean up the rocks and debris next to the sea front.
- The Contractor was reminded to provide drip trays for chemical container at S9.
- The Contractor was reminded to display the Environmental Permit at the major site exit of WA4.
- The Contractor was reminded to clean all the vehicles before leaving the construction site at WA4.
- The Contractor was reminded to clean up the stagnant water inside the I-Beams at West Portal.
- The Contractor was reminded to provide regular maintenance for silt curtains at Portion X.
- The Contractor was reminded to spray water regularly for the unpaved area at WA03.
- The Contractor was reminded to provide enough drip trays for the chemical containers at N4.
- The Contractor was reminded to clean up the sand inside the drip tray at S8.
- The Contractor was reminded to clean up the sand on the passage way at Kin Yip.
- The Contractor was reminded to provide regular maintenance for the operating machine at S9.
- The Contractor was reminded to extend the length of the blue cover for the percussive piling works at S9.
- The Contractor was reminded to provide water sprayed regularly on the unpaved area at S11.
- The Contractor was reminded to provide fence around the tree and remove the construction materials.
- The Contractor was reminded to provide drip tray for the chemical containers at N13
- The Contractor was reminded to clean up the sand on barge edge of Chung Tin.
- The Contractor was reminded to provide water spray regularly to avoid the dust emission at West Portal.
- The contractor was reminded to strengthen dust control measures at West Portal.

5.2 Recommendations

5.2.1 The impact monitoring programme for air quality, noise, water quality and dolphin ensured that any deterioration in environmental condition was readily detected and timely actions taken to rectify any non-compliance. Assessment and analysis of monitoring results collected demonstrated the environmental impacts of the contract. With implementation of the recommended environmental mitigation measures, the contract's environmental impacts were considered environmentally acceptable. The weekly environmental site inspections ensured that all the environmental mitigation measures recommended were effectively implemented.

5.2.2 The recommended environmental mitigation measures, as included in the EM&A programme, effectively minimize the potential environmental impacts from the contract. Also, the EM&A programme effectively monitored the environmental impacts from the construction activities and ensure the proper implementation of mitigation measures. No particular recommendation was advised for the improvement of the programme.

5.3 Conclusions

5.3.1 The construction phase and EM&A programme of the Contract commenced on 17 October 2012 and this is the fifth Quarterly EM&A Report summarises the monitoring results and audit findings of the EM&A programme during the reporting period from 1 September 2013 to 30 November 2013.

Air Quality

5.3.2 For air quality, there were no Action and Limit Level exceedances for 1-hr TSP or 24-hr TSP recorded during this reporting period.

Noise

5.3.3 For construction noise, there was no Action Level and Limit Level exceedances for noise were recorded at the monitoring station during the reporting period.

Water Quality

5.3.4 During the reporting period, there were 10 Action Level exceedances and 3 Limit Level exceedances of suspended solids level.

Dolphin

5.3.5 There were one Action Level exceedances of dolphin monitoring for the quarterly monitoring data (September – November 2013).

5.3.6 During this quarter of dolphin monitoring, no adverse impact from the activities of this construction project on Chinese White Dolphins was noticeable from general observations.

5.3.7 Although the dolphins rarely occurred in the area of HKLR03 construction in the past, during the baseline monitoring period and throughout the five quarters of impact monitoring period, it is apparent that dolphin usage has been significantly reduced in NEL, and many individuals have shifted away from the important habitat around the Brothers Islands.

5.3.8 It is critical to monitor the dolphin usage in North Lantau region in the upcoming months, to determine whether the dolphins are continuously affected by the various construction activities in relation to the HZMB works, and whether suitable mitigation measure can be applied to revert the situation.

Mudflat -Sedimentation Rate

5.3.9 For sedimentation rate monitoring of mudflat, was generally and relatively higher than the baseline measurement at S1 and S4. The mudflat level is continuously increased. For S2 and S3 showed that the level has increased within tolerance and their sea bed depth would not be considered as significant change. For S1 and S4, the mudflat level has been continuously increased. The increased surface level for S1, S2, S3 and S4 is 0.072, 0.052, 0.052 and 0.088 mPD when compared to the baseline monitoring results.

5.3.10 Impact water quality monitoring in San Tau (monitoring station SR3) was conducted in September 2013. The monitoring parameters included dissolved oxygen, turbidity and suspended solids.

Mudflat - Ecology

5.3.11 An active search method was adopted for horseshoe crab survey at each sampling zone. In general, horseshoe crab *Tachypleus tridentatus* was found at TC1 (10 individuals), TC2 (2 individuals), TC3 (7 individuals) and ST (94 individuals). All individuals were found on soft mud, sandy substratum or sandy substratum surrounded by small gravels. Grouping was observed while the group size ranged 2-11 individuals. Since the commencement of the survey (Sep. 2012), no individual was found at TC2. It showed that TC2 was not a suitable nursery ground for horseshoes crab. In the September 2013 survey, the search records of *Tachypleus tridentatus* were 2.50 individuals hr^{-1} $person^{-1}$ (mean prosomal widths: 31.22 mm), 0.50 individuals hr^{-1} $person^{-1}$ (25.51 mm) and 1.75 individuals hr^{-1} $person^{-1}$ (30.87 mm) at TC,

TC2 and TC3 respectively. Similar to previous surveys, the highest search record of 15.67 individuals hr^{-1} $person^{-1}$ (40.39 mm) was reported at ST. According to Li (2008), the prosomal width of Tachypleus tridentatus recorded ranged 19.33 - 68.01 mm that corresponded to an estimated age of 2.6 – 8.0 years old. It was obvious that ST was an important nursery ground for horseshoe crab especially newly hatched individuals due to larger area of suitable substratum (fine sand or soft mud) and less human disturbance (far from urban district).

5.3.12 Another less common species *Carcinoscorpius rotundicauda* was not found during the whole survey period except the survey conducted in December 2012 at ST (4 individuals). This species was believed present in ST at very low number while encounter was very rare.

5.3.13 An active search method was adopted for seagrass bed survey at each sampling zone. Seagrass was recorded in ST only while the largest patch was *Halophila ovalis* located nearby the mangrove vegetation on sandy substratum at tidal level 2 m above C.D.. The estimated total area was 758.9 m^2 with estimated coverage ranged 85-90%. It was a long seagrass strand merged by the growth of 2 to 3 smaller patches recorded in previous surveys from September 2012 to June 2013. Moreover, six small patches of *H. ovalis* were recorded on soft mud at tidal level between 1.0 m and 1.5 m above C.D.. The estimated total area of each patch ranged 1.2 - 8.0 m^2 with estimated coverage ranging 15-70%. These small patches were yet recorded in previous surveys and were distant from the largest strand. Seasonal recruitment of *H. ovalis* was believed occurred between June and September. One small patch of *Zostera japonica* was found within the long strand of *Halophila ovalis*. The estimated area was 3.7 m^2 while the estimated coverage was about 95%. For seagrass *Halophila ovalis*, the total area and estimated coverage increased gradually. It showed that the seagrass was in scattered patches during dry season then grew and merged into single patch during wet season. Seasonal recruitment during wet season further increased the total area of seagrass. However it was doubt that the newly recruited patches of seagrass would survive the natural heat stress, predation and wave action. For seagrass *Zostera japonica,* it was not reported in the surveys of September and December 2012. Seasonal recruitment of few patches was reported between December and March. Then the patch size increased and merged gradually with the warmer climate. However the patch size decreased sharply in the present survey. The patch might not overcome the high heat stress exerted on shore between June and September 2013.

5.3.14 The intertidal soft shore community surveys were conducted in low tide period on 1st (for ST), 7th (for TC3), 8th (for TC1) and 14th September 2013 (for TC2). A total of 19329 individuals were recorded. Mollusks were significantly the most abundant phylum (total individuals 18738, density 625 individuals m^{-2}, relative abundance 96.9%). The second abundant group was arthropod (total individuals: 421, density 14 individuals m^{-2}, 2.2%) respectively. Relatively other phyla were very low in abundance ($\leq$0.6%). Similarly, the most diverse phylum were mollusks (37 taxa) followed by arthropods (13 taxa) and annelids (8 taxa). The taxa of other phyla were relatively less ($\leq$1 taxon).

5.3.15 The present survey was the fourth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project were not detected on intertidal soft shore community. In case, abnormal phenomenon (e.g. rapid reduction of seagrass patch size) was observed, it would be reported as soon as possible.

5.3.16 There was no consistent zonation pattern of species distribution observed across sampling zones and tidal levels in Tung Chung Wan and San Tau. The species distribution should be determined by the type of substratum primarily. In general, gastropods *Batillaria multiformis* (6055 individuals, 35%), *Cerithidea djadjariensis* (3721 individuals, 21%), rock oyster *Saccostrea cucullata* (1829 individuals, 11%), gastropods *Monodonta labio* (1489 individuals, 9%) and *Cerithidea cingulata* (1031 individuals, 6%) were the most common occurring species among the four sampling zones.

5.3.17 The September 2013 survey results indicate that the impacts of the HKLR project could not be detected on horseshoe crabs, seagrass and intertidal soft shore community.

Environmental Site inspection and Audit

5.3.18 Environmental site inspection was carried out on 3, 10, 18 and 27 September 2013, 2, 9, 16, 22 and 29 October 2013, and 6, 13, 20 and 29 November 2013. Recommendations on remedial actions were given to the Contractors for the deficiencies identified during the site inspections.

5.3.19 There were five environmental complaints received during this reporting period.

5.3.20 No notification of summons and prosecution was received during the reporting period.

FIGURES

APPENDIX A

Environmental Management Structure

APPENDIX B

Construction Programme

APPENDIX C

Location of Works Areas

APPENDIX D

Event and Action Plan

APPENDIX E

Implementation Schedule of Environmental Mitigation Measures

APPENDIX F

Site Audit Findings and Corrective Actions

APPENDIX G

Air Quality Monitoring Data and Graphical Plots

APPENDIX H

Noise Monitoring Data and Graphical Plots

APPENDIX I

Water Quality Monitoring Data and Graphical Plots

APPENDIX J

Dolphin Monitoring Results

APPENDIX K

Waste Flow Table

APPENDIX L

Summary of Environmental Licenses and Permits

APPENDIX M

Record of "Notification of Environmental Quality Limit Exceedances

APPENDIX N

Cumulative Statistic on Complaints

APPENDIX O

Mudflat Monitoring Results