AECOM

Highways Department

Contract No. HY/2007/04

Hong Kong – Shenzhen Western Corridor (Operational Phase)

Final EM&A Summary Report (for the period 1 July 2007 - 30 June 2010)

[08/2010]

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Version:	0	Date:	3 August 2010

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Date: 5 August 2010

By Fax (2761 4864) & Post

Highways Department
Major Works Project Management Office
6th Floor, Ho Man Tin Government Offices,
88 Chung Hau Street, Homantin, Kwoloon

Attention: Mr. Raymond S.K. Yip

Dear Sirs,

Re: Contract No. HY/2007/04
Hong Kong – Shenzhen Western Corridor (Operational Phase)
Final EM&A Summary Report for Operational Phase

Reference is made to ET's e-mail correspondences enclosed with a copy of the Final EM&A Summary Report for Operational Phase for the Shenzhen Western Corridor project. We are pleased to inform that we have no further comment on the captioned Report.

We are pleased to inform you that the captioned Report, which had been certified by the Environmental Team Leader, is verified by IEC in compliance with Condition 1.9 of the Environmental Permit No.EP-162/2003/B and Condition 1.7 of the Environmental Permit No. EP-290/2007 of the Project.

Thank you very much for your kind attention and please do not hesitate to contact the undersigned or our Ms. Vivian Chan if you have any queries.

Yours sincerely,

K.S. Lee
Independent Environmental Checker

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c.c. Mr. Y T Tang ENSR (ET Leader)
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TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

EXECUTIVE SUMMARY

This is the Final Environmental Monitoring and Audit (EM&A) summary report prepared by AECOM Asia Company Limited, the designated Environmental Team (ET), for the operational phase of the Project "Hong Kong-Shenzhen Western Corridor". Permits granted to the Project include the Environmental Permits for the Project (EP-162/2003/B and EP-290/2007). Operation of the Project commenced on 1 July 2007. This report presents the results of EM&A works conducted between 1 July 2007 and 30 June 2010.

Weekly site audits, operational disturbance on intertidal bird communities, bridge lighting scheme and bird collisions, replanted mangroves, operational noise and sedimentation rate monitoring were carried out in the reporting period. Environmental mitigation measures and environmental complaint handling procedures were also implemented.

Environmental Monitoring Works

Noise
Operational noise monitoring was carried out on 23 June 2008 at both SWC-AN1 and SWC-AN2 during the morning and evening peak hours of the expressway.

Although the projected noise level was higher than the EIA predictions, the projected noise level for 2021 was still below the noise standard of 70 dB(A).

Water Quality
6 monitoring of bridge surface runoff from carriageway was carried out in the first monitoring period from September 2007 to November 2007 and another 6 of the monitoring was carried out in the second monitoring period from January 2008 to March 2008.

While elevated nitrate levels, TOC and COD levels were recorded, no action level was triggered and no exceedance was recorded in other parameters in the monitoring periods. The cleaning frequency and method of the bridge deck in the monitoring periods were considered sufficient and effective.

Ecology
Ecological monitoring carried out during operational phase EM&A programme included:

Bridge lighting scheme and bird collisions	37 sessions
Operational disturbance on intertidal bird communities	12 sessions
Replanted Mangroves	8 sessions

No dead bird was spotted on the HK-SWC nor floating on sea surface during the bridge lighting scheme and bird collisions monitoring. No bird mortality was recorded during the operation of HK-SWC across the reporting period.

The results of intertidal bird surveys suggested that the operation, the physical existence and the shade of HK-SWC had no adverse impact on the shorebird communities.

The health condition of the mangrove plantation was good across all three zones during the monitoring period.

Sedimentation Rate Monitoring
Sedimentation rate monitoring was carried out in the period of the 1st year of operational EM&A programme from July 2007 to June 2008. Sedimentation Rate Monitoring for all stations were carried out on a monthly basis.

Referring to the monitoring data in seven monitoring stations, yearly averaged elevations at all stations were lower than the EIA prediction except at station P6. The increased sedimentation at station P6 might due to the nearby reclamation works during the monitoring period.

In general, there was no significant change in the elevation levels of the seabed during the monitoring periods.

Environmental Site Audit
Weekly environmental site audits were carried out in the reporting period. No specific observation was identified.

Environmental Complaints and Prosecution

No complaint related to environmental issues was made against the Project in the reporting period.

1. INTRODUCTION

Background

1.1 AECOM Asia Company Limited (hereinafter called the "ET") was appointed by Highways Department (hereinafter called the "Client") to undertake Environmental Monitoring and Audit for "Hong Kong-Shenzhen Western Corridor" (hereinafter called the "Project") during operational phase. Under the requirements of Section 6 of Environmental Permit EP-162/2003/B and Section 3 of Environmental Permit EP-290/2007, EM&A programme as set out in the EM&A Manuals is required to be implemented. In accordance with the Environmental Permit and the EM&A Manuals, environmental monitoring of operational noise, water quality, ecology and sedimentation rate are required for the Project.

1.2 Operation for the Project commenced on 1 July 2007. This report summarises the environmental monitoring and audit works for the Project between 1 July 2007 and 30 June 2010.

Project Organization

1.3 The structure of the environmental management team is shown in Figure 1.1. Contacts of key environmental staff of the Project are shown in Appendix A.

1.4 A layout plan of the Project is provided in Figure 1.2.

Summary of the EM&A Requirements

1.5 The EM&A programme requires environmental monitoring for operational noise, water quality, ecology and sedimentation rate. The EM&A requirements for each item are described in subsequent sections, including:

- Monitoring parameters;
- Environmental mitigation measures, as recommended in the project EIA final report;
- Environmental requirements in the contract documents.

1.6 Advice on the implementation status of environmental protection and pollution control/mitigation measures are summarised in Section 6 of the Report.

2. OPERATIONAL NOISE MONITORING

Monitoring Requirements

2.1 Noise monitoring is required to monitor the operational noise level at the nearby sensitive receivers during peak traffic hour.

2.2 The measured noise level was compared to the predicted traffic noise levels in the EIA under full provision of the mitigation measures.

Monitoring Parameters, Frequency and Duration

2.3 The traffic noise level should be measured twice within the first year of the road opening. Measurements should be made in terms of the A-weighted L_{10} over three 30-mins periods during the peak traffic hour. Other parameters L_{90} and L_{eq} would be included for reference purpose.

Monitoring Equipment

2.4 The Sound Level Meters used for the monitoring comply with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1). The instrumentation to be used for the noise monitoring is given in Table 2.1.

Table 2.1 Traffic Noise Monitoring Equipment

Manufacturer	Description
Integrating Sound Level Meter	B&K 2238
Calibrator	B&K 4231

2.5 The sound level meter was calibrated using a B&K Sound Level Calibrator Type 4231 for 94dB at 1kHz, prior to and after each set of measurements. Measurement results will be discarded if the calibration before and after does not agree to within 1dB(A) and measurement will be taken until this condition is fulfilled. Also a portable electronic wind speed indicator capable of measuring wind speed in m/s was used to check wind speed.

Monitoring Locations

2.6 Noise monitoring was carried out at NSRs SWC-AN1 and SWC-AN2, which are shown in Figure 2.1. The monitoring locations are summarized in Table 2.2.

Table 2.2 The Noise Monitoring Locations

Monitoring Station	Location	Monitoring Type	Description	Predicted Noise Level, L_{10} dB(A) Façade with angle of view dominant by SWC
SWC-AN1	Village House at Ngau Hom Shek	Façade	G/F	66.0
SWC-AN2	Village House at Ngau Hom Shek	Façade	G/F	64.0

Monitoring Methodology

2.7 The noise measurement point was at a point 1m from the exterior of the sensitive receivers (SWC-AN1 and SWC-AN2) building façade facing the bridge alignment and at the ground level.

2.8 Noise measurements were made in accordance with Section III of the "Calculation of Road Traffic Noise (CRTN), 1998".

2.9 Measurements were made in terms of the A-weighted L_{10} over 3 half hour periods during the peak traffic hour. Statistical results such as L_{eq} and L_{90} were also obtained for reference purpose.

2.10 Road traffic data, including average vehicle speed, number of vehicles and percentage heavy vehicles were recorded at the time of noise measurement.

2.11 The wind speed was frequently checked with a portable wind meter. Observations were recorded when intrusive noise was unavoidable.

Results and Observations

2.12 According to the information provided by the Transport Department, the Deep Bay Link and Shenzhen Western Corridor was the busiest between 09:00 to 10:00 in the morning and from 14:00 to 15:00 in the afternoon. Two sessions of three 30-mins L_{10} measurements were conducted on 23 June 2008 between 09:00 and 10:30 (AM peak) and 13:30 and 15:00 (PM peak).

2.13 The measured noise results are presented in Table 2.3 below.

Table 2.3 Noise Monitoring Results

Monitoring Station	Noise Level, $L_{10\ (1\ hour)}$ dB(A)	
	9:00 – 10:30 (AM Peak)	13:30 – 15:00 (PM Peak)
SWC-AN1	56.8	55.7
SWC-AN2	57.0	56.8

2.14 The measured noise levels were compared with predicted noise levels by application of appropriate corrections to normalise for the predicted traffic conditions of future year, i.e. year 2021. The measured traffic flow and average speed are presented in Table 2.4 and 2.5 and the corresponding correction factors for traffic flow projection and the comparison of the projected operational noise levels with the predicted noise levels are shown in Table 2.6 below.

Table 2.4 Traffic Flow of HK-SWC

	Measured Value				EIA prediction	
Monitoring Period	LV	HV	Total Flow	Percentage of HV	Traffic Flow	Percentage of HV
AM Peak	267	345	612	56.4%	7,600	66.0%
PM Peak	225	363	588	61.7%		

Notes: HV represents Heavy Vehicle
LV represents Light Vehicle

Table 2.5 Traffic Speed Measurement

Monitoring Period	Measured Speed (km/hr)	EIA Predicted Speed (km/hr)
AM Peak	93.8	100.0
PM Peak	94.1	100.0

Table 2.6 Correction Factor for Traffic Flow Projection and Comparison of Predicted Noise Level and Projected Noise Level

Monitoring Station		Noise Level, $L_{10\ (1\ hour)}$ dB(A)		
		Correction Factor*	Projected Noise Level	EIA Predicted Noise Level
SWC-AN1	**AM Peak**	11.8	68.6	66
	PM Peak	11.7	67.4	66
SWC-AN2	**AM Peak**	11.8	68.8	64
	PM Peak	11.7	68.5	64

* Correction Factor = $10Log\left(\frac{Q'}{Q}\right)+33Log\left(\frac{V'+40+500/V'}{V+40+500/V}\right)+10Log\left(\frac{1+5p'/V'}{1+5p/V}\right)$

Where Q' is predicted traffic flow by using the CRTN noise model
V' is predicted traffic speed by using the CRTN noise model
p' is predicted percentage heavy vehicle by using the CRTN noise model
Q is measured traffic flow during the traffic noise monitoring event
V is measured traffic speed during the traffic noise monitoring event
p is measured percentage heavy vehicle during the traffic noise monitoring event

2.15 Comparison of the normalized noise level was made against the EIA prediction for year 2021. The normalized noise level for the year 2021 is higher than the predicted 2021 noise level in the EIA.

2.16 However, the measured noise level was considered to be higher, which might be due to the noise produced by the insects on the nearby trees / plants during the measurement. Such noise was not included in the predicted noise level for 2021. On the other hand, due to the low traffic flow of the expressway, the calculated correction factor was large since the predicted hourly traffic of the expressway in 2021 was 7,600 nos. in both bounds at peak hours, while the highest actual traffic flow was only 612 nos. on 23 June 2008.

2.17 Although the corrected noise level was higher than the EIA predictions, the normalized noise level for 2021 was still below the noise standard of 70 dB(A).

3. WATER QUALITY

Monitoring Requirements

3.1 The monitoring is to determine the characteristics of bridge runoff in particular the first flush from the HK-SWC bridge during rain-storm events and to review the frequency of road cleaning.

3.2 The original method on road surface runoff monitoring involves installation of equipments onto the bridge deck or the parapets on both sides of the expressway. After reviewing by relevant government departments, including the Hong Kong Police Force and Fire Services Department, the installation of equipment was considered causing disturbance to other road users including the fire services and police vehicles during emergency operation and considered relatively unsafe for the ET staff working on the expressway.

3.3 An alternative proposal on the monitoring method using a water tanker to simulate an artificial rainfall by spraying water onto the catchment area of the monitoring gully during bridge closure at night was prepared. The alternative proposal was approved by EPD. A procedural guide was also prepared. The guide was vetted by the IEC and the Engineer and was reviewed by EPD.

3.4 The proposed criteria, action level and actions required are included in Appendix B.

Monitoring Equipment

3.5 A portable automatic sampler of non-contact type, equipped with a suction pipe, was used for sampling. The pump flow rate is adjustable. Table 3.1 summarises the equipment used.

Table 3.1 Road Surface Runoff from Carriageway Monitoring Equipment

Equipment	Model
Variable Speed Sampler (with pump head)	Masterflex Model 7571
Pump Head	Masterflex Model 7518

Monitoring Parameters, Frequency and Duration

3.6 Two periods of monitoring during the first 3 months and after 6 months of the opening of the HK-SWC Bridge would be required. The monitoring should include in total 12 sampling / rainstorm events (12 sets of data) and cover the dry season period. A total of 6 sets of sampling data should be collected during the first 3 months after the opening of the HK-SWC bridge. The other 6 sets of sampling data should be collected in month 7 to month 9 after opening of the HK-SWC Bridge. The minimum interval between two sampling events shall not be less than 4 days.

3.7 The commencement of the road surface runoff monitoring programme was postponed to September 2007 due to the requirement in obtaining consent and relevant permits and licenses from relevant government departments for working on the bridge deck. The first monitoring period of road surface runoff from carriageway was completed on 10 November 2007 and the second monitoring period was completed on 1 March 2008.

3.8 All samples were cooled to 4°C without being frozen and delivered to a HOKLAS laboratory within 24 hours for analysis for the following pollutants in highway runoff:

- Total suspended solids
- Total organic carbon
- Chemical oxygen demand
- Nitrate
- Nitrite
- Total Kjeldahl Nitrogen
- Total phosphorus
- Copper
- Lead
- Zinc

Monitoring Locations

3.9 Water samples were collected from six different road gullies, three on each side of the carriageways.

3.10 The exact monitoring locations were recorded in terms of nearby lighting pole / highways chainage. The exact monitoring locations are shown in Figure 3.1 and are listed in Table 3.2 and Table 3.3 below.

Table 3.2 Locations of Road Surface Runoff Monitoring in the First Monitoring Period

Date	Shenzhen bound	Hong Kong bound
29 September 2007	Lighting Pole BD3776 Chainage 4.2 N	Lighting Pole BD 4568
	Lighting Pole BD3742 Chainage 3.0 N	Lighting Pole BD3610 Chainage 2.0 S
	Lighting Pole BD4638 (Under the speed sign)	Lighting Pole BD3644 Chainage 3.2 S
6 October 2007	Lighting Pole BD3779 (Under the speed sign)	Lighting Pole BD4565
	Lighting Pole BD3742 Chainage 3.0N	Lighting Pole BD3610 Chainage 2.0S
	Lighting Pole BD4643	Lighting Pole BD3655
13 October 2007	Lighting Pole BD3767	Lighting Pole 4555
	Lighting Pole BD3742 Chainage 3.0N	Lighting Pole BD3615 (Under the speed sign)
	Lighting Pole BD4638 (Under the speed sign)	Lighting Pole BD3640
27 October 2007	Lighting Pole BD3748 (Under the speed sign)	Lighting Pole BD4553 (Under the speed sign)
	Lighting Pole BD3720 (Under the instruction sign)	Lighting Pole BD3615 (Under the speed sign)
	Lighting Pole BD4642 (Under the instruction sign)	Lighting Pole BD3638 Chainage 3.0S
3 November 2007	Lighting Pole BD3756	Lighting Pole BD4553 (Under the speed sign)
	Lighting Pole BD3720 (Under the instruction sign)	Lighting Pole BD3615 (Under the speed sign)
	Lighting Pole BD4642	Lighting Pole BD3638 Chainage 3.0S
10 November 2007	Lighting Pole BD3747	Lighting Pole BD4551
	Lighting Pole BD3720 (Under the instruction sign)	Lighting Pole BD3618
	Lighting Pole BD4636	Lighting Pole BD3644 (Under the speed sign)

Table 3.3 Locations of Road Surface Runoff Monitoring in the Second Monitoring Period

Date	Shenzhen bound	Hong Kong bound
5 January 2008	Lighting Pole BD3720	Lighting Pole BD4568
	Lighting Pole BD3701	Lighting Pole BD3614
	Lighting Pole BD4626	Lighting Pole BD3652
12 January 2008	Lighting Pole BD3764	Lighting Pole BD4553
	Lighting Pole BD3742 (Chainage 3.0N)	Lighting Pole BD3615 (Under the speed sign)
	Lighting Pole BD4638 (Under the speed sign)	Lighting Pole BD3645 (Under the speed sign)
19 January 2008	Lighting Pole BD3748 (Under the speed sign)	Lighting Pole BD4562
	Lighting Pole BD3713 (Chainage 2.0N)	Lighting Pole BD3610 (Chainage 2.0S)
	Lighting Pole BD4634	Lighting Pole BD3639 (Chainage 3.0S)
16 February 2008	Lighting Pole BD3742	Lighting Pole BD4568
	Lighting Pole BD3721	Lighting Pole BD2650
	Lighting Pole BD4647	Lighting Pole BD3624
23 February 2008	Lighting Pole BD3748	Lighting Pole BD4574
	Lighting Pole BD3728	Lighting Pole BD3610
	Lighting Pole BD4642	Lighting Pole BD3627
1 March 2008	Lighting Pole BD3771 (Chainage 4.0N)	Lighting Pole BD4555
	Lighting Pole BD3731	Lighting Pole BD3615 (Under the Speed Sign)
	Lighting Pole BD4640	Lighting Pole BD3654

Monitoring Methodology

3.11 A water tanker with sprinklers was deployed to spray water on the road surface around the catchment area of the monitoring gully. It simulated an artificial rain and provided a washing effect on the road surface under rainstorm event.

3.12 At each monitoring location, the water tanker stopped on the left lane near the monitoring gully and spray water to the right lane within the catchment area. The water would drain from the right lane to hard shoulder, and then the monitoring gully. The position of the tanker and spraying angle of the sprinkler were adjusted to achieve the best washing effect.

3.13 A portable automatic sampler was used for sampling. The suction tube inlet was placed at the mid level of the sedimentation pond inside the monitoring gully. The sampling works was started once bridge runoff discharge was observed from the gully to the connected down pipe.

3.14 Each water sample collected was of 1L in volume and 24 individual samples were collected in each monitoring event. Four composite samples, each of 6L, were prepared from the 24 individual water samples for laboratory analysis. The first composite sample was a mix of the first water sample collected from each monitoring gully. Similar preparation procedure applied to the remaining three composite samples.

3.15 Upon mixing, the composite samples were filled into suitable containers (preserved / non-preserved) based on the testing parameters before delivery.

3.16 An additional composite sample was prepared by mixing the samples taken from the water tanker before and after the monitoring. This sample was collected to understand the quality of spraying water and for reference purpose.

3.17 The samples were cooled to 4°C without being frozen. The samples were delivered to the ALS Techichem (HK) Pty Ltd, a HOKLAS laboratory, within 24 hours for analysis.

QA/QC Procedure and Detection Limits

3.18 The testing methods adopted by *ALS Technichem Pty. Ltd.* are amended from the testing procedures as provided in the procedural guide. Nonetheless, all of them are accredited by HOKLAS. The updated testing methods and detection limits are provided in Table 3.4.

Table 3.4 Detection Limit for Monitoring Parameters

Parameter	Recommended Method	Detection Limit (mg/L)
Total suspended solids	APHA 2540D (20th edition)	2
Total organic carbon	APHA 5310 B (20th edition)	1
Chemical oxygen demand	APHA 5220 C&D (20th edition)	2
Nitrate	APHA 4500-NO_3^- FNO_2:B (20th edition)	0.01
Nitrite	APHA 4500-NO_2:B (20th edition)	0.01
Total Kjeidahl Nitrogen	APHA 4500 Norg:B (20th edition)	0.1
Total phosphorus	APHA 4500-P:B4,F (20th edition)	0.1
Copper	USEPA6020	0.001
Lead	USEPA6020	0.01
Zinc	USEPA6020	0.01

Results and Observations

3.19 6 road surface runoff monitoring events were respectively carried out in the first and the second monitoring periods.

3.20 All monitoring results are provided in Appendix C.

First Monitoring Period

3.21 The average flow rate of water spraying by the water tanker was about 4.0 L/s. Collection of each of the 1L sample was completed within 2 – 3 minutes.

Total Suspended Solids (TSS)

3.22 The TSS levels in six monitorings were generally low. The highest concentration of TSS was 20 mg/L and the lowest concentration was below the detection limit (i.e. <2 mg/L).

3.23 There was no TSS exceedance recorded in the first monitoring period.

Nitrate and Nitrite (NO_3^-+NO_2^-)

3.24 In comparison with the reference criteria, a relatively high nitrite and nitrate concentration was recorded and it was mainly attributable to high nitrate content since the nitrite concentration was generally below 0.01 mg/L in all monitoring results. In fact, nitrate concentration in the reference sample taken from the water tanker was around 1.08 – 1.66 mg/L and was already above the reference criterion of 0.72 mg/L. The water used for surface runoff monitoring was tap water from the Water Supplies Department (WSD). According to the "Drinking Water Quality for the Period April 2006 – March 2007" issued by WSD, the range of nitrate concentration in the water supply is <2.5 to 9.9 mg/L with an average of 3.6 mg/L. Nevertheless, the nitrate concentration of this level, i.e. 1.08 – 1.66 mg/L, is still within WSD requirements for potable use.

3.25 Regarding the elevated nitrate levels recorded on 27 October 2007, the increments of the two composite samples over the reference sample ranged from 0.93 – 1.74 mg/L and exceeded the reference criterion of 0.72 mg/L. In general, the measured concentrations of all parameters were similar

for all 4 composite samples.

3.26 According to the observations during the monitoring, there was no adverse observation / condition, which would contribute to high level of pollutants, identified on the bridge deck. On the other hand, the accumulated water inside the gully may increase the pollutant levels in the first or even the second sample. Currently, water sample was collected at the mid level of the gully once runoff is observed discharged from the gully to the downpipe. The existing pollutant inside the gully may also be a factor of elevating pollutant level.

3.27 From the results of Deep Bay Water Quality Monitoring by EPD from 2005 – 2006 at stations DM1 to DM5, the range of the nitrate concentration was 0.08 – 2.00 mg/L. All monitoring results in the reporting period lied within the normal range of nitrate concentration in the Deep Bay Water; the maximum increment of the nitrate concentration in the reporting period was 1.74 mg/L. This indicated that under normal rainfall condition, the nitrate input from the bridge runoff water would not have an adverse impact on the environment and ecology in the Deep Bay Water.

3.28 Furthermore, the associated environmental impact was considered minimal due to the relatively small volume of runoff water as compared to the whole Deep Bay area and the low concentration of the pollutants in the runoff water.

3.29 Temperature, humidity, wind direction and background air quality, are also factors that would affect the measured concentration of nitrate and nitrite. Different humidity indicates different amount of water particles / water content in the atmosphere. Air pollutants, including NOx, tend to affiliate with water particles and some would dissolve in water. The concentration of NOx in the Shenzhen Bay area is relatively high and the water content in the air around HK-SWC is considered to be high due to the close proximity to the water body of the bridge. Small amount of pollutants from the air might be contributed to the measured value.

3.30 According to the air quality monitoring data from Environmental Protection Department, the hourly concentration of nitrogen oxides (NOx) between the period 1 August 2006 and 31 July 2007 ranged from 5 $\mu g/m^3$ to 597 $\mu g/m^3$ with an average of 106.26 $\mu g/m^3$ at Yuen Long air quality monitoring station. Hourly concentration of nitrogen oxides (NOx) between the period 1 August 2006 and 31 July 2007 at Tap Mun air quality monitoring stations ranged from 0 $\mu g/m^3$ to 171 $\mu g/m^3$ with an average of 18.28 $\mu g/m^3$ and at Mong Kok roadside air quality monitoring station ranged from 61 $\mu g/m^3$ to 1451 $\mu g/m^3$ with an average of 337.63 $\mu g/m^3$ were also provided for reference.

3.31 Besides the abovementioned exceedances recorded on 27 October 2007, there was no exceedance recorded in nitrate and nitrite concentration in the reporting period.

3.32 There was no action level exceedance triggered in the reporting period since there was no 3 consecutive monitoring in nitrate and nitrite concentration exceeded the reference criteria.

Total Kjeldahl Nitrogen (TKN)

3.33 The TKN concentrations in all the samples were low. The highest concentration of TKN measured was 1.5 mg/L.

3.34 All TKN monitoring results complied with the reference criteria.

Total Phosphorus (TP)

3.35 The total phosphorus concentration of all monitoring samples were below detection limit (i.e. <0.1 mg/L). There was no exceedance in total phosphorus recorded in the first monitoring period.

Total Organic Carbon (TOC)

3.36 The TOC concentrations in all 6 samples were generally low. There was a slight increase in the TOC concentration on 27 October 2007, which was still below the reference criteria, was considered to be affected by the pollutants accumulated inside the gullies prior to the monitoring event.

3.37 The highest measured TOC concentration was 24 mg/L. There was no exceedance in TOC recorded in the first monitoring period.

Chemical Oxygen Demand (COD)

3.38 The measured COD concentrations in the monitoring samples were generally low. All measured COD concentration were below the reference criteria except for the 1st composite sample taken on 27 October 2007, which the increment was still within the reference criterion and it was not considered as an exceedance.

3.39 There was no exceedance recorded in the first monitoring period.

Copper (Cu), Lead (Pb) and Zinc (Zn)

3.40 The concentration of copper and zinc was slightly increased in the samples taken on 27 October 2007. It was considered that the increased amount of copper and zinc was due to the pollutants accumulated inside the gullies prior to the monitoring. Copper deposited onto the carriageway could be generated from the brake pads / other metallic parts of the vehicles, while zinc could be deposited from tyres of vehicles.

3.41 Lead is considered to be one of the most toxic / acute pollutants in water. The concentrations of lead in all monitoring samples were below detection limit (i.e. <0.01 mg/L). It could be due to the restriction of use of leaded petrol / fuel in vehicles.

3.42 The concentration of copper, lead and zinc in all samples were within the reference criteria.

Summary for the First Monitoring Period

3.43 All monitoring results complied with the reference criteria except nitrite and nitrate level on 27 October 2007. The increments of the two samples ranged from 0.93 – 1.74 mg/L against the reference criterion of 0.72mg/L. The impact from the elevated nitrate and nitrite concentration to the environment was considered minimal.

3.44 Since no 3 consecutive monitoring with the same parameter exceed the criteria, no action level exceedance was recorded in the first monitoring period.

3.45 The cleaning frequency and method of the bridge deck was considered sufficient and effective.

Second Monitoring Period

3.46 The average flow rate of water spraying by the water tanker was about 4.0 L/s. Collection of each of the 1L sample was completed within 2 – 3 minutes.

Total Suspended Solids (TSS)

3.47 The TSS levels in six monitorings were generally low. The highest concentration of TSS was 40 mg/L and the lowest concentration was below the detection limit (i.e. <2 mg/L).

3.48 There was no TSS exceedance recorded in the second monitoring period.

Nitrate and Nitrite (NO_3^-+NO_2^-)

3.49 It was recorded that high nitrite and nitrate concentration was found in the reference sample taken from the water tanker, ranging from 1.32 – 1.80 mg/L, The magnitude is relatively high in comparison with other parameters. In order to determine the nitrate and nitrate concentration due to bridge runoff water only, the concentration of pollutant of the reference sample was subtracted from the raw monitoring data to derive the increment due to bridge runoff.

3.50 To make the results comparative with the reference criterion, presented as median even mean concentrations (EMCs) by Driscoll in Table EM4.6 of EM&A Manual, median EMCs values were calculated. The calculation is provided in Appendix D. The EMCs for Nitrite & Nitrate were derived from the average concentration for each of the events monitored.

3.51 The median EMCs for monitoring was found to be 0.41 mg/L. Median EMCs for monitoring was compared with the reference criterion.

Total Kjeldahl Nitrogen (TKN)

3.52 The TKN concentrations in all the samples were low. The highest concentration of TKN measured is 1.4 mg/L.

3.53 All TKN monitoring results complied with the reference criterion.

Total Phosphorus (TP)

3.54 The total phosphorus concentration of all monitoring samples were below detection limit (i.e. <0.1 mg/L). There was no exceedance in total phosphorus recorded in the second monitoring period.

Total Organic Carbon (TOC)

3.55 The measured TOC concentration in the first composite sample on 5 January 2008 exceeded the reference criterion. The increased TOC level was considered due to the existing pesticides residue / stagnant water inside the gully prior to the monitoring event. However, since the measured COD level in the composite sample was far below the reference criteria, it is believed that the adverse impact from oxygen depletion by decomposing of organic matter was insignificant.

3.56 The highest measured TOC concentration was 33 mg/L. Besides the elevated TOC concentration recorded on 5 January 2008, there was no other exceedance in TOC recorded in the reporting period. No action level was triggered.

Chemical Oxygen Demand (COD)

3.57 The measured COD concentrations in the monitoring samples were generally low. All measured COD concentrations were below the reference criterion except for the 1st composite sample taken on 19 January 2008.

3.58 The elevated COD concentration in the first composite sample on 19 January 2008 was considered due to the slight increase in suspended solids, total organic carbon and dissolved metals. The increment of the concentration was 96 mg/L, exceeded the reference criterion of 90 mg/L.

3.59 No action level exceedance in COD was recorded in the second monitoring period.

Copper (Cu), Lead (Pb) and Zinc (Zn)

3.60 The concentrations of copper, lead and zinc were generally low throughout the reporting period.

3.61 The highest concentration of copper was 0.018 mg/L and highest concentration of zinc was 0.20 mg/L.

3.62 The concentrations of lead in most of the monitoring samples were below detection limit (i.e. <0.01 mg/L), while the maximum concentration was 0.02 mg/L. The low concentration could be due to the restriction of use of leaded petrol / fuel in vehicles.

3.63 The concentrations of copper, lead and zinc in all samples were within the reference criteria.

Summary for the Second Monitoring Period

3.64 All monitoring results complied with the reference criteria except TOC level on 5 January 2008 and COD

level on 19 January 2008. After investigation, the elevated TOC level was considered due to the stagnant water inside the gullies, which may contain pesticides residue. Monitoring data was reviewed and the elevated COD level was considered relevant to the slight increase in suspended solids, total organic carbon and dissolved metals. Since the concentrations of suspended solids, total organic carbon and dissolved metals were complied with the reference criteria, the environmental impact from the runoff was considered minimal.

3.65 Since no 3 consecutive monitoring with the same parameter exceed the criteria, no action level exceedance was recorded in the second monitoring period.

3.66 The cleaning frequency and method of the bridge deck was considered sufficient and effective.

4. ECOLOGY

Monitoring Requirements

4.1 As required under Clause 6.7, 6.9 and 6.10 of the Environmental Permit EP-162/2003/B, Clause 3.4 of the Environmental Permit EP-290/2007 and Section 6.3.2 – 6.3.4 of the EM&A Manual, operational disturbance on intertidal bird communities, bridge lighting scheme and bird collisions, and replanted mangroves have to be monitored bi-monthly (for 2 years), monthly (for 3 years) and quarterly (for 2 years) respectively.

4.2 The trigger and action levels for bird density for the monitoring on intertidal bird communities are provided in Appendix B.

Operational Disturbance on Intertidal Bird Communities

Monitoring Equipment

4.3 Equipment used for monitoring included a 20-60x telescope, 10x42 binoculars, and a hand-held GPS.

Monitoring Locations

4.4 Two monitoring locations were selected: Ngau Hom Shek (NHS) and Sheung Pak Nai (SPN). The NHS site locates adjacent to the Hong Kong - Shenzhen Western Corridor (HK-SWC), and provides information for potential operational phase disturbance. The SPN site was used as a control site during the monitoring process in construction phase. In this Project, the SPN site was also used as a control site to maintain consistency. It is located approximately 950m to the southwest of NHS.

Monitoring Methodology

Intertidal Mudflat Monitoring

4.5 The abundance and diversity of bird species within a 100m x 100m quadrat (10,000m^2) of exposed mudflat were recorded. The monitoring was carried out during low tide when at least 100m of mudflat was exposed. Data was recorded at both NHS and SPN sites.

4.6 The density and diversity of bird species were then compared with the baseline data recorded from September 2001 to May 2002, as presented in the Shenzhen Western Corridor EIA Report (EIA).

Tideline Monitoring

4.7 A survey was conducted along a 10m wide belt transect centred along the tideline at NHS and SPN. The survey was conducted during low tide when at least 100m of mudflat was exposed. The transect at NHS extended 250m from the alignment of the HK-SWC towards both sides (Figure 4.1). The transect was divided into 10 sections of 50m.

Total area of a transect = 10m x 500m = 5,000m^2

4.8 Telescope and binoculars were used to scan from one end to the other end of the transect. 1.5 minutes were spent in each section. The number and species of birds were recorded in each section. The same method was used at the SPN site, except that there was no bridge alignment and the transect was set on a random section along the tideline.

4.9 The density of birds within the tideline transects at NHS and SPN were then tested for their significance of difference using parametric t-test, or non-parametric Mann-Whitney test, where:

Null Hypothesis = No difference in bird densities along the tidelines at NHS and SPN

4.10 Additionally, bird abundance and species composition were being compared with the baseline data recorded from September 2001 to May 2002, as presented in the EIA.

Monitoring of Effects of Shade

4.11 In order to monitor the effects of the shade of the HK-SWC to birds, the density and composition of bird species were recorded on the mudflat underneath the HK-SWC in 3 strips that lie parallel to it: 1) the strip of mudflat right under the bridge (recommended by the EM&A Manual); 2) the strip of mudflat within the shade; and 3) the strip of mudflat outside the shade and bridge. The strips extended from the shore towards the sea. Monitoring was carried out during low tide when at least 250m of mudflat was exposed. Each strip was 250m in length, 40m in width (width of HK-SWC) and was divided into 5 sections of 50m.

$$\text{Total area of a strip} = 250 \times 40 = 10{,}000\text{m}^2$$

4.12 Since the sun does not always shine at the 12 o'clock position, the shade of the bridge rarely lies right under the bridge. It is therefore recommended to follow the shade of the bridge and collect information there, in addition to collecting information from right under the bridge as recommended by the EM&A Manual.

4.13 The collected information from the 3 strips of mudflat were being tested for their significance of difference using the parametric t-test, or non-parametric Mann-Whitney test, where:

Null Hypothesis = No difference in bird densities on different strips of mudflat

Results and observation

4.14 Bi-monthly intertidal bird communities monitoring was conducted for the first 2 years of operation. A total of 12 monitoring were carried out.

4.15 The graphical plots of the intertidal bird communities monitoring results are given in Appendix E.

Intertidal Mudflat Monitoring

4.16 The density and abundance of shorebirds recorded during winter months were often higher than those recorded in other months, as a large population of passage migrants and winter visitors had arrived in Deep Bay.

4.17 The intertidal mudflat quadrats at the NHS impact site and SPN control site recorded approximately the same abundance and diversity of shorebirds, indicating that shorebird communities were not adversely affected by the operation of the HK-SWC.

4.18 The shorebird density and diversity at NHS and SPN recorded during the surveys were mostly higher than the numbers recording during EIA. The results of this survey suggested that the operation of HK-SWC had no adverse effect on the shorebird communities.

Tideline Monitoring

4.19 Lower abundance of shorebirds was often recorded in summer periods in the surveys. The decrease was possibly due to the transition from winter period, when large amount of shorebirds aggregated in Deep Bay, to summer period, when all the winter visitors were gone.

4.20 The tideline transects at the NHS impact site and SPN control site generally recorded the same diversity of shorebirds, while the NHS site recorded a higher density/abundance. The results indicated that the shorebird communities were not adversely affected by the operation of the HK-SWC during the survey.

4.21 Parametric t-tests suggested that there were generally no statistically significant difference between the bird abundance along the tidelines at NHS and SPN in the surveys, except in two months when the NHS impact site had even higher shorebird abundance than the SPN control site. Therefore it is considered that the operation of HK-SWC had no impact on the shorebird communities at NHS during the survey.

4.22 The shorebird density and diversity at both of the NHS and SPN sites recorded in the survey were often higher than that recorded during the previous EIA, indicating that the operation of HK-SWC had no adverse effect on the shorebird communities during the surveys.

Monitoring of Effects of Shade

4.23 During the surveys, three sets of data, 'In Shade', 'Under Bridge' and 'On Exposed Mudflat', were collected.

4.24 No data for "In Shade" could be recorded for several sessions of the monitoring under overcast weather when there was no shade of HK-SWC on the mudflat.

4.25 The monitoring surveys showed that shorebird abundance on the surveyed area "Under Bridge" and "In Shade" were slightly lower than that on "Exposed Mudflat", suggesting that the operation of the HK-SWC may have potential impacts on the distribution of shorebird community.

4.26 Statistical analysis results generally suggested that no statistically significant difference between the bird abundance within the mudflats 'In shade', 'Under Bridge' and 'On Exposed Mudflat', except in November 2007 and January 2009. Moreover, distribution of shorebirds may be affected by a number of abiotic or biotic factors apart from the operation of the HK-SWC:

- Early-staged establishment of benthos communities in the mudflat under bridge after the construction phase provide less food resource for shorebirds, which may account for the lower number of shorebirds recorded under the bridge. However, benthos communities in mudflat under the bridge are expected to build up gradually in long-term and such factor should be diminished in the future.
- The curve-shaped tideline at some locations may provide less feeding area and feeding opportunities for shorebirds, which may affect their distribution at NHS.
- The uneven and patchy distribution of shorebirds in nature means that it may cause bias in statistical analysis.
- A succession of oyster farms was found located on the mudflat approximately 50m away from both sides of the alignment of HK-SWC. The oyster areas were observed to be a popular feeding ground for shorebirds and were frequently visited. The abundant food resource in these areas may have a positive effect on the abundance and diversity of intertidal shorebirds on the strip of exposed mudflat at NHS.

4.27 It was therefore considered that the physical existence of the HK-SWC and its shade had no significant adverse impact on the shorebird communities at NHS during the survey.

Bridge Lighting Scheme and Bird Collisions

Monitoring Equipment

4.28 A camera and a pair of binoculars were required during the monitoring process.

Monitoring Locations

4.29 The monitoring of bird collisions took place along the Hong Kong-Shenzhen Western Corridor (HK-SWC), which is approximately 5.5km long and 40m wide.

Monitoring Methodology

4.30 A survey was conducted to assess the impacts of different lighting schemes on bird mortality as caused by collision with the bridge and associated structures. In order to monitor the bird's mortality, a survey was carried out along the HK-SWC at both sides of the carriageway covering both the Hong Kong and Shenzhen sections. Attention was paid to the road surface while attempts were made to spot dead birds. Sea surface was also scanned for any floating dead birds.

4.31 The four lighting schemes are listed as follows:

- ***Scheme 1*** – Monday to Thursday and Sunday, 19.30-22.00. Architectural lighting for the tower.
- ***Scheme 2*** – Friday, Saturday and general festival, 19.30-22.00. Architectural lighting for the tower and side faces of the deck.
- ***Scheme 3*** – Special festival and events, 19.30-22.00. Architectural lighting for the tower, stay cables and the side faces of the deck.
- ***Scheme 4*** – During inclement weather, turn off the architectural lighting.

Results and observation

4.32 Monthly bridge lighting scheme and bird collisions monitoring was conducted for the first 3 years of the operation. A total of 37 monitoring were carried out in the reporting period.

4.33 A summary of the results, including the types and schemes of illumination used on the bridge, the weather conditions and records of bird mortalities by species, number, location and estimated cause of death, is provided in Appendix E.

4.34 No dead bird was found on the bridge nor floating on water surface during the surveys. There was no significant evidence to suggest adverse impacts from the HK-SWC on bird collision.

Replanted Mangroves

Monitoring Equipment

4.35 A retractable metallic measuring tape, a soft measuring tape (over 4m) and a camera were used to monitor the growth of mangrove seedlings.

Monitoring Locations

4.36 The monitoring of the survival and growth of the compensatory mangrove plantation took place right below the HK-SWC on the mudflat near the shore at NHS (Figure 4.2). The total area of the plantation was 2,010.9m^2. It was composed of 7,736 *Kandelia obovata* droppers.

Monitoring Methodology

4.37 A survey should monitor the density, growth and health condition of the compensatory mangrove plantation that was being established on 9 February 2007, after the clearance for the construction of the SWC.

4.38 The mangrove plantation was being divided equally into three zones, where Zone 1 was the closest to the shore and Zone 3 was the furthest. Within each zone, three quadrats, which were one square meter in size, were being chosen at random. The number of mangrove planting was counted within each quadrat and the heights of three representative individuals were measured. The heights of the tallest and the shortest individual, and the trunk diameter of the most representative individual were also measured. The health condition of the plantings was also assessed in the scale of good, fair and poor.

Results and observation

4.39 Quarterly monitoring of replanted mangroves was conducted for the first 2 years of the operation. A total of 8 monitoring were carried out.

4.40 The graphical plots of the replanted mangroves monitoring results are given in the in Appendix E.

4.41 There was no obvious change in density of plantings during the monitoring period (July 2007 – April 2009) at all 3 zones since they were first planted.

4.42 Active growth of mangrove plantings was recorded at all three zones, as the average height of the plantings recorded increased at all three zones across the monitoring period.

4.43 The trunk diameter of the plantings showed a considerable increase in the survey in July 2008 at Zone 2 and Zone 3, and in October 2008 at Zone 1. While the recorded trunk diameter of the plantings at the 3 zones decreased slightly in 2009, the recorded diameters were significantly larger in the last survey in April 2009 than that in the initial surveys in July and October 2007.

4.44 Environmental factors including substrate composition, salinity, tidal influence and human disturbance could affect the growth pattern of mangrove stands.

4.45 In general, the health condition of the mangrove plantation was good across all three zones during the monitoring period.

5. SEDIMENTATION RATE MONITORING

Monitoring Requirements

5.1 As required under Clause 6.2 of the Environmental Permit EP-162/2003/B, monitoring on the sedimentation rate in Deep Bay would be required on a monthly basis.

Monitoring Parameters, Frequency and Duration

5.2 The monitoring work took place every month starting from the construction phase and up to one year after the project has commenced the operation. Additional work may be needed subject to the weather condition.

Monitoring Locations

5.3 Seven monitoring stations as specified in Sedimentation Rate Monitoring Plan (Rev. 1) at Tsim Bei Tsui, Mai Po mudflat and Sha Kiu Tsuen were monitored. The monitoring locations are shown in Figure 5.1 and the coordinates of the seven monitoring points are listed in Table 5.1.

Table 5.1 Locations of Sedimentation Rate Monitoring Stations

Station	Proposed Northing (m)	Proposed Easting (m)
P1	838615.950	819251.410
P2	838598.730	819415.000
P3	838959.120	820630.770
P4	839526.710	820880.830
P5	840299.490	821115.070
P6	838895.080	817938.940
P7	838919.960	817923.090

Monitoring Equipment and Methodology

5.4 The hydrographic field survey was carried out to measure the seabed levels of the Mai Po and Inner Deep Bay intertidal mudflat at the specified sampling points.

5.5 The survey mainly applied RTK GPS surveying technology. The RTK technology used real time differential GPS technology to survey 3D coordinates (X,Y,Z) of a survey point. When real time differential signal was not available due to surveying and environmental conditions, static GPS surveying would be carried out with equivalent or better accuracy but of longer operation time.

5.6 The base station was a survey control point directly derived or established from Lands Department, HKSAR. The main survey control point was selected at a stable location on the rooftop of a police station within Mai Po area. A minor survey control point was established at the concrete jetty of Tsim Bei Tsui. The rover GPS instrument was used for surveying as standard DGPS operation. If there is any problem in using RTK GPS and using the proposed surveying control point, higher precision but longer surveying time static GPS surveying technology with nearby survey control point would be employed. As static GPS using much more observation to increase the observation result, the precision is higher than RTK GPS surveying but it takes much longer time to finish one point. It was a costly approach in

term of time when comparing the RTK GPS. Sometimes, both digital data logging and written records were collected in the field. Both readings were checked twice after surveying to ensure no error was in data booking.

5.7 The base station was setup with double-checking procedure to ensure the coordinates derived or provided by Lands Department was correctly input into the base station. The antenna height of the base station was also double-checked for the essential input of the base station. The height of antenna of the rover was measured and entered into the system with double-checking procedure. The rover was used to measure known points such as benchmark of Lands Department to check the accuracy of the whole system during the measurement in surveying days. On top of this procedure, more than one survey record was measured at each required location and the mean of at least three records was taken for the final survey result.

5.8 The survey was also calibrated in the field at the base station and the nearby predefined checkpoint before and after the survey. This was to eliminate any systematic error during the survey at particular environment and particular date under international surveying methodology.

5.9 All survey point was approached by using real-time GPS measurement to the nearest 5m. If the RTK signal is available, the surveying team will get to the nearest point using stake out procedure. If the RTK signal is not available, the surveying team will approach to the nearest position using non-RTK GPS approach within 30m. Should RTK or non-RTK GPS signal is not available within specific surveying month, levelling, which has higher accuracy and precision, will be used if nearby known benchmark is available.

Results and Observations

5.10 Due to the completion of the reclamation and construction of the HK-SWC, the average sedimentation rate should compare with the EIA predicted rate (Scenario 3). The predicted average sedimentation rates in EIA report for the operational scenario (with the latest SWC reclamation and with SWC bridge) with the circular viaduct section (as Scenario 3 in the EIA report) are provided in Table 5.2.

Table 5.2 Predicted Average Sedimentation Rates in the EIA

Indicator Point	Scenario 3 (mm/yr)
Tsim Bei Tsui SSSI	11.6
Ramsar Site (North)	28.5
Ramsar Site (South)	13.5

5.11 The SRM locations P1, P2, P6 and P7 were located near Tsim Bei Tsui SSSI, stations P4 and P5 were located near Ramsar Site (North) while station P3 was located near Ramsar Site (South). The SRM results obtained during the operational phase should, therefore, compare with the indicator points Tsim Bei Tsui, Ramsar Site (North) and Ramsar Site (South).

5.12 The monitoring results of the 12 monitoring events carried out in the first year of operation of the expressway are presented in Table 5.3 and graphical presentation is provided in Appendix F.

Table 5.3 Monitoring Results (elevation) (mPD) during Operational Phase

Point	Jul 2007	Aug 2007	Sep 2007	Oct 2007	Nov 2007	Dec 2007	Jan 2008	Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008
P1	0.981	0.931	0.958	0.938	0.932	0.945	0.924	0.945	0.920	0.915	0.944	0.927
P2	1.053	1.019	0.994	0.963	0.946	0.976	0.963	0.99	0.986	0.962	0.962	0.948
P3	1.608	1.605	1.603	1.604	1.615	1.586	1.565	1.571	1.572	1.604	1.581	1.590
P4	1.814	1.807	1.809	1.818	1.802	1.787	1.806	1.805	1.788	1.826	1.794	1.775
P5	1.535	1.558	1.569	1.598	1.596	1.567	1.569	1.556	1.571	1.567	1.573	1.563
P6	1.204	1.253	1.264	1.263	1.263	1.259	1.256	1.251	1.259	1.254	1.250	1.260
P7	1.243	1.27	1.263	1.252	1.247	1.256	1.245	1.249	1.255	1.257	1.253	1.260

5.13 The average sedimentation rates at each station were calculated from the 12 monitoring results and are tabulated in Table 5.4.

Table 5.4 Monitored and EIA Predicted Sedimentation Rates after Operation of HK-SWC

Monitoring Stations	Average Monitored Sedimentation Rate (mm/yr)	EIA Predicted Sedimentation Rate (mm/yr)
P1	-35.66	11.6
P2	-69.57	11.6
P3	-30.21	13.5
P4	-23.04	28.5
P5	7.38	28.5
P6	19.30	11.6
P7	0.08	11.6

5.14 The monitored sedimentation rates at Station P1 to P4 were negative. All the monitored sedimentation rate were below the EIA predicted values, except for station P6. The monitored value at P6 was 19.30 mm/yr, while the EIA prediction was 11.6 mm/yr. At P6, it was noted that the measured elevation at station P6 was low in July 2007 and showed an increase after July 2007. From months August 2007 to June 2008, the fluctuation of the sedimentation rate is similar. During recent monitoring, it was noted that at the north-east of station P6, reclamation was observed and a bund was formed at that area. This may cause the reduction in the flushing capacity of the nearby mudflat; and the sedimentation rate at P6 & 7 might have increased.

Summary of Sedimentation Rate Monitoring

5.15 All the monitored values are lower than the predicted value in EIA except for station P6. The increase of sedimentation rate at P6 might be due to the nearby reclamation works during the monitoring period.

5.16 The presence of HK-SWC bridge piers does not induce any significant adverse impacts in the sedimentation rate in the Deep Bay.

6. ENVIRONMENTAL AUDIT

Status of Environmental Licensing and Permitting

6.1 All permits/licences/notifications obtained as of the reporting period are summarised in Table 6.1

Table 6.1 Summary of Environmental Notification, Licensing and Permit Status

Permit No.	Valid Period		Description	Status
	From	To		
Environmental Permit				
EP-162/2003/B	19 Jan. 04	-	1. Construction and operation of a 3.2 km dual 3-lane carriageway elevated structure of the Shenzhen Western Corridor spanning across Deep Bay from Ngau Hom Shek to the section of the Shenzhen Western Corridor within the boundary within the Mainland. 2. Construction and operation of a 340 m dual 3-lane carriageway of the Deep Bay Link connecting to the Shenzhen Western Corridor at Ngau Hom Shek.	Valid
EP-290/2007	20 Nov. 07	-	1. Operation of a 2.0km dual 3-lane carriageway elevated structure of the Shenzhen Bay Bridge spanning across Deep Bay from Shenzhen Bay Bridge – Hong Kong Section to Shenzhen Bay Port, Hong Kong Port Area at Dongjiaotou.	Valid

Site Environmental Audit

6.2 Site audits were carried out on a weekly basis for the first 3 years of operation to monitor environmental issues on the site to confirm that all mitigation measures were implemented properly. A total of 155 site audits were conducted in the period.

Implementation Status of Environmental Mitigation Measures

6.3 No specific finding was identified in the reporting period.

Environmental Mitigation Implementation Schedule (EMIS)

6.4 According to the Environmental Permit (EP-162/2003/B), the mitigation measures detailed in the permits are required to be implemented. An updated summary of the EMIS is presented in Appendix G.

Summary of Exceedances of Environmental Quality Performance Limit

6.5 No action / limit level exceedance was recorded in the reporting period.

Implementation Status of Environmental Complaint Handling Procedures

6.6 Appendix H presents the environmental complaint flow diagram of the Project.

6.7 No complaint, summon or prosecution related to environmental issues was received or made against the Project in the reporting period.

7. COMPARISON OF EM&A DATA WITH EIA PREDICTION

Operational Noise Monitoring

7.1 The normalized noise levels for the year 2021 at both monitoring stations were higher than the predicted 2021 noise level in the EIA. It might due to the noise produced by the insects on the nearby trees / plants during the measurement. Such noise was not included in the predicted noise level for 2021. On the other hand, due to the low traffic flow on the expressway during the monitoring period, the calculated correction factor was large since the predicted hourly traffic of the expressway in 2021 was 7,600 nos. in both bounds at peak hours, while the highest actual traffic flow was only 612 nos. on 23 June 2008.

7.2 Although the corrected noise level was higher than the EIA predictions, the normalized noise level for 2021 was still below the noise standard of 70 dB(A).

Water Quality

7.3 In the reporting periods (Sep – Nov 2007 and Jan – Mar 2008), one elevation in nitrate and nitrite concentration, one TOC concentration and one COD concentration were recorded in the monitoring events on 27 October 2007, 5 January 2008 and 19 January 2008 respectively.

7.4 In view of the road cleaning practices and frequency, the elevation in nitrite and nitrate concentration recorded on 27 October 2007 was unlikely attributed to inadequate road cleaning. Rather, such elevation was considered in relation to the existing pollutants inside the gully, relatively high NOx content in the ambient air in the region and the application of mean or median value of data obtained from overseas journals in establishing the criteria, which are discussed in Section 8.3 and 8.4.

7.5 The elevated TOC level was considered due to the stagnant water inside the gullies, which may contain pesticides residue and the elevated COD level was considered relevant to the slight increase in suspended solids, total organic carbon and dissolved metals. Since the concentrations of suspended solids, total organic carbon and dissolved metals were complied with the reference criteria, the environmental impact from the runoff was considered minimal.

7.6 Other than that, no elevation of other parameters was recorded.

7.7 As no 3 consecutive monitoring with the same parameter exceeded the reference criteria, no action level was triggered in both periods.

7.8 The cleaning frequency and method of the bridge deck in the reporting periods were considered sufficient and effective.

Ecology

7.9 The intertidal mudflat quadrats at the NHS impact site and SPN control site recorded approximately the same abundance and diversity of shorebirds. The tideline transects at the NHS impact site and SPN control site generally recorded the same diversity of shorebirds, while the NHS site recorded a higher density/abundance. The shorebird density and diversity at NHS and SPN recorded during both surveys were mostly higher than the numbers recording during the EIA. The results of these surveys suggested that the operation of HK-SWC had no adverse effect on the shorebird communities and are in line with the EIA predictions.

7.10 Statistical analysis for the results of shade effect monitoring generally suggested that no statistically significant difference between the bird abundance within the mudflats 'In shade', 'Under Bridge' and 'On Exposed Mudflat', except in November 2007 and January 2009. Distribution of shorebirds may be affected by a number of abiotic or biotic factors apart from the operation of the HK-SWC. The factors are discussed in Section 4.26 and in the Monthly EM&A Report for November 2007. It was therefore considered that the physical existence of the HK-SWC and its shade had no significant adverse impact

on the shorebird communities at NHS during the survey. The result is in line with the EIA prediction.

7.11 No bird carcasses was found on the bridge nor floating on water surface during the monthly bridge lighting scheme and bird collisions surveys, as well as during the weekly site audits. There was no evidence to suggest adverse impacts from the HK-SWC and its lighting on bird collision. The result is in line with the EIA predictions that the SWC bridge and its lighting would have little or insignificant impact upon bird mortality.

Sedimentation Rate

7.12 All the monitored values of the sedimentation rate monitoring are lower than the predicted value in EIA except for station P6. The increase of sedimentation rate at P6 might be due to the nearby reclamation works during the monitoring period.

7.13 The presence of HK-SWC bridge piers does not induce any significant adverse impacts in the sedimentation rate in the Deep Bay.

8. REVIEW OF ENVIRONMENTAL MONITORING METHODOLOGY AND EM&A PROGRAMME

8.1 The environmental monitoring methodologies and procedures were regularly reviewed by the ET.

8.2 Modification to the bridge surface runoff monitoring methodology was made during the operation period for sake of safety.

8.3 Other than the surface runoff monitoring, the EM&A programme was adequately conducted and the mitigation measures were successfully implemented during the operation period, as evident by the minor monitoring exceedances, no action/limit level triggered and no complaint, summons and prosecutions.

Modifications and Recommendations to the Surface Runoff Monitoring

8.4 After reviewing the monitoring method stated in the EM&A manual, it is not guaranteed that sufficient rainfall events would happen within the monitoring months and due to the safety concern on working on the bridge deck, an alternative methodology, which includes using a water tanker to simulate an artificial rainfall, for bridge runoff monitoring was adopted.

8.5 Since the bridge runoff monitoring at HK-SWC was the first bridge runoff monitoring established in Hong Kong and there was no background information and data available before the first monitoring period, no review of the reference criteria was carried out.

8.6 Since Deep Bay is an area of ecological importance, particularly to shorebirds, any input of pollutants to the Deep Bay water should be minimized. The most concerned pollutants would be heavy metals. The measured concentrations of heavy metals (copper, lead and zinc) were low and were well below the reference criteria. Impacts from heavy metals in road runoff water are considered small. Besides heavy metals, input of nutrients, including organic carbon, nitrogen-containing chemicals and phosphorus-containing chemicals, would be another concern, since these nutrients can lead to extensive growth of algae in the Deep Bay. Yet, the concentrations of these pollutants are low, the impact to the Deep Bay environment is considered small.

8.7 The Deep Bay catchment area is about 535km^2, which is much larger as compared to the surface area of the bridge deck. As the concentration of pollutants are low and the volume of runoff from the bridge deck is small (due to the relatively small surface area), the impact to water quality and ecology was considered insignificant.

8.8 It was recommended that samples should be collected from storm drain inlet of the gutter, i.e. before runoff entering into gullies, to prevent the monitoring data affecting by the stagnant water inside the gullies which contain certain amount of pollutants. Referring to the methodology in the study by Barrett et al. (1998), the runoff samples were collected from a single storm-drain inlet located along the gutter of a curbed section of the highway.

8.9 Use of EMC is a general and appropriate method to evaluate the effects of storm water runoff on receiving waters. Obtaining local event mean concentration for the area of concern was suggested to have accurate estimation, determination of reference criteria and monitoring programme as well. Whereas obtaining local event mean concentration is not feasible, applying literature event mean concentration could be used as a guideline.

9. ENVIRONMENTAL ACCEPTABILITY OF THE PROJECT

9.1 Although the normalized operational noise levels for the year 2021 at both monitoring stations were higher than the predicted 2021 noise level in the EIA, considered due to the noise produced by the insects on the nearby trees / plants during the measurement, they are still below the traffic noise standard of 70 dB(A).

9.2 The increase of sedimentation rate at P6 station could be attributed to the nearby reclamation works during the monitoring period. It was concluded that the presence of HK-SWC bridge piers does not induce any significant adverse impacts in the sedimentation rate in the Deep Bay.

9.3 Besides, while elevated nitrate levels, TOC and COD levels were recorded for the bridge surface runoff monitoring, no action level was triggered. The impact from the bridge runoff pollutants was considered minimal, provided the cleaning frequency and method of the bridge deck are maintained.

9.4 Apart from that, no other monitoring exceedance, complaint, summons or prosecution related to environmental issues was recorded, received or made against the Project in the reporting period. This indicates that the EIA recommended mitigation measures were effectively implemented and demonstrates the operation of SWC in general was environmentally acceptable.

10. CONCLUSIONS

10.1 Environmental impact monitoring was performed between 1 July 2007 and 30 June 2010. All monitoring results in the reporting period were checked and reviewed.

10.2 Operational noise monitoring was carried out at both SWC-AN1 and SWC-AN2. Although the projected noise level was higher than the EIA predictions, the projected noise level for 2021 was still below the noise standard of 70 dB(A).

10.3 Elevated nitrate levels, TOC and COD levels were recorded during the bridge surface runoff from carriageway monitoring. However, no action level was triggered and no exceedance was recorded in other parameters in the reporting periods. The cleaning frequency and method of the bridge deck in the reporting periods were considered sufficient and effective.

10.4 No bird mortality was recorded during the bridge lighting scheme and bird collisions survey in the reporting period.

10.5 The results of intertidal bird surveys suggested that the operation, the physical existence and the shade of HK-SWC had no adverse impact on the shorebird communities.

10.6 The health condition of the mangrove plantation was good across all three zones during the monitoring period.

10.7 All the recorded values in the sedimentation rate monitoring are lower than the predicted value in EIA except for station P6. The increase of sedimentation rate at P6 might be due to the nearby reclamation works during the monitoring period. The presence of HK-SWC bridge piers does not induce any significant adverse impacts in the sedimentation rate in the Deep Bay.

10.8 No specific observation was identified during the site audits in the reporting period.

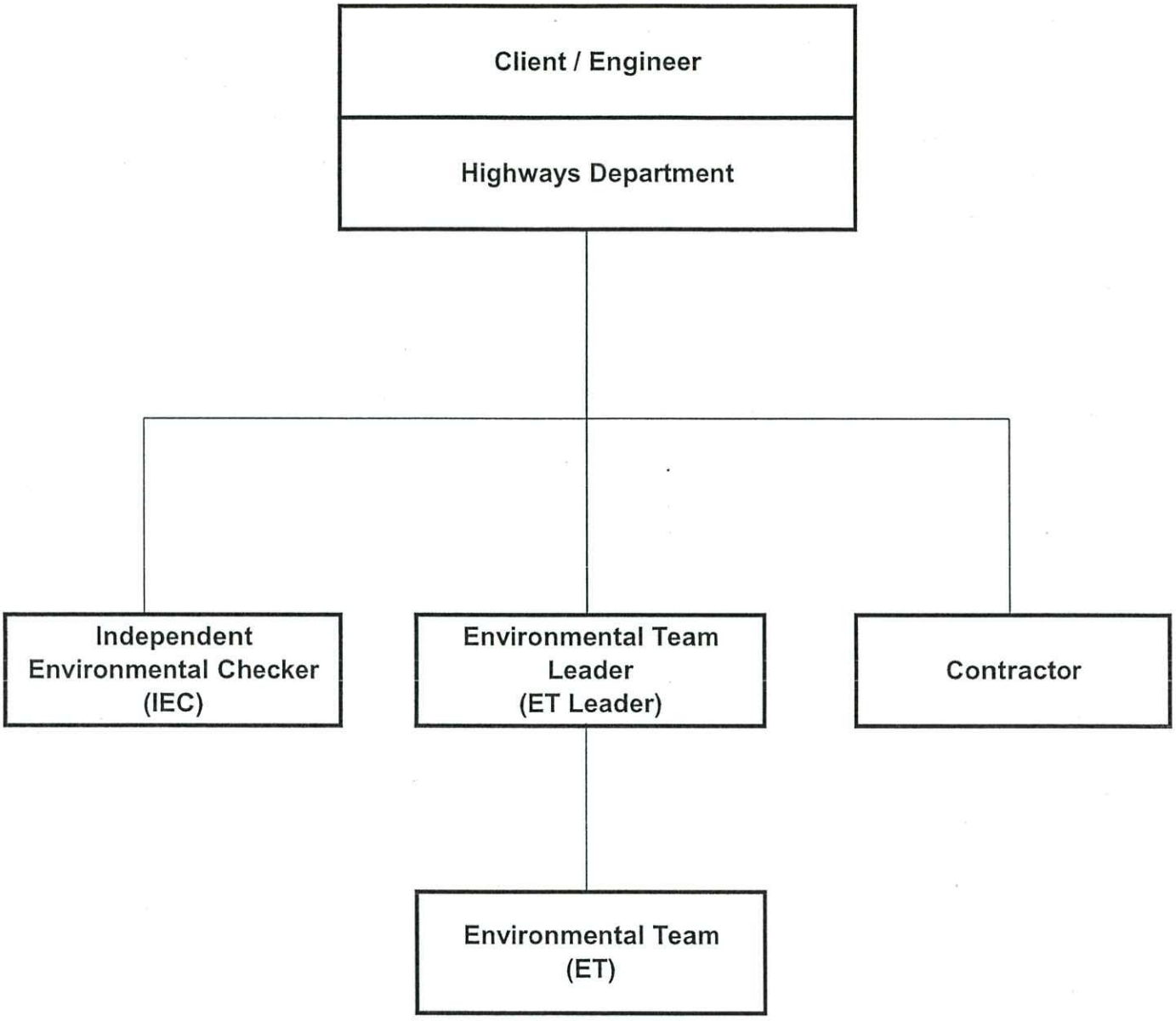
10.9 No complaint, notification of summons or prosecution related to environmental issues was made against the Project in the reporting period.

10.10 Assessment and analysis of the monitoring results of the Project had demonstrated the environmental acceptability of the Project.

11. REFERENCE

Barrett M. E., Irish L. B., Malina J. F. and Charbeneau R. J. (1998) Characterization of Highway Runoff in Austin, Texas, Area. *Journal of Environmental Engineering, 124, 131–137.*

FIGURES



AECOM	Contract No. HY/2007/04	SCALE	N.T.S.	DATE	2007
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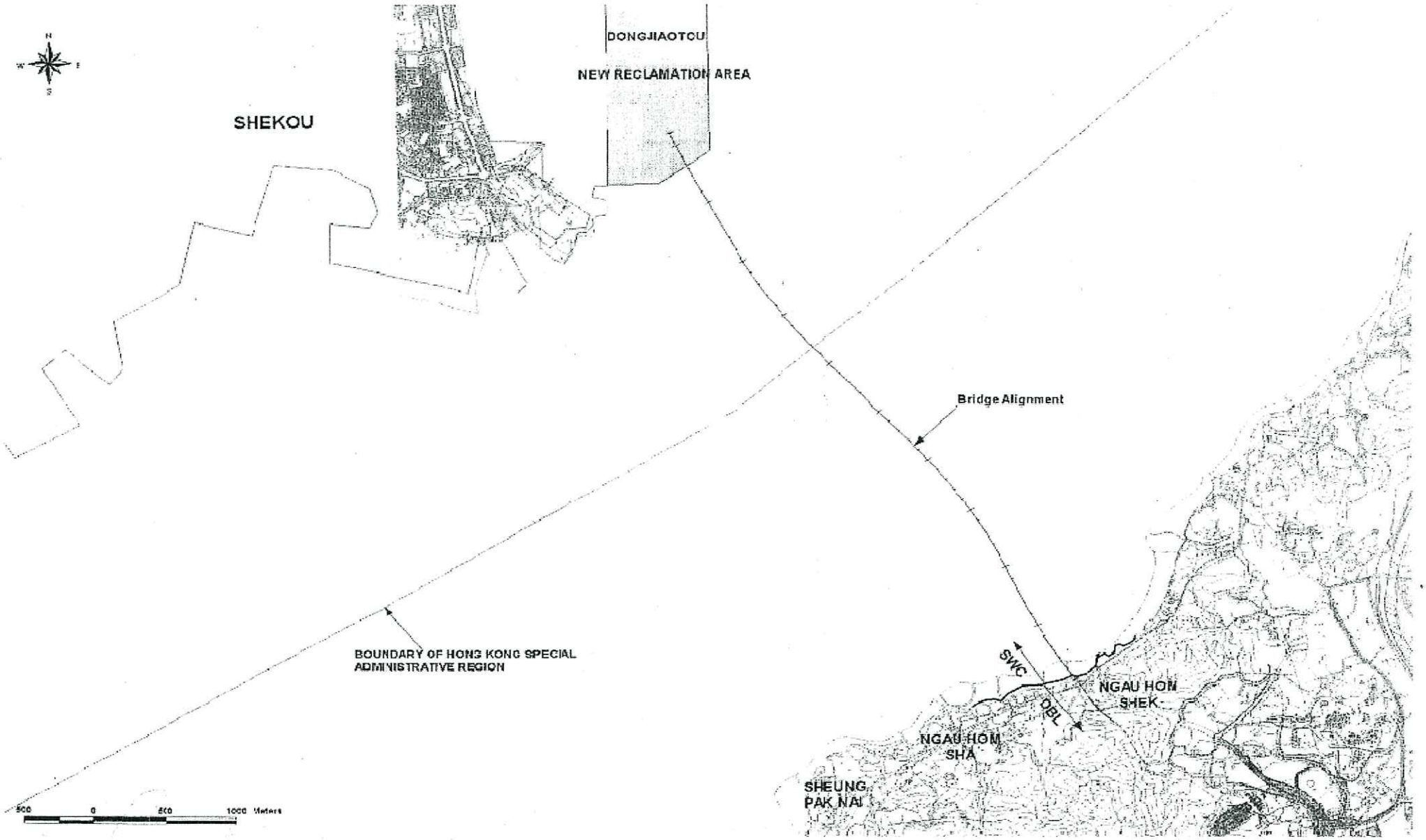
	Project Organization	JOB NO.	60025836	FIGURE 1.1	Rev 1



AECOM

Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Site Layout

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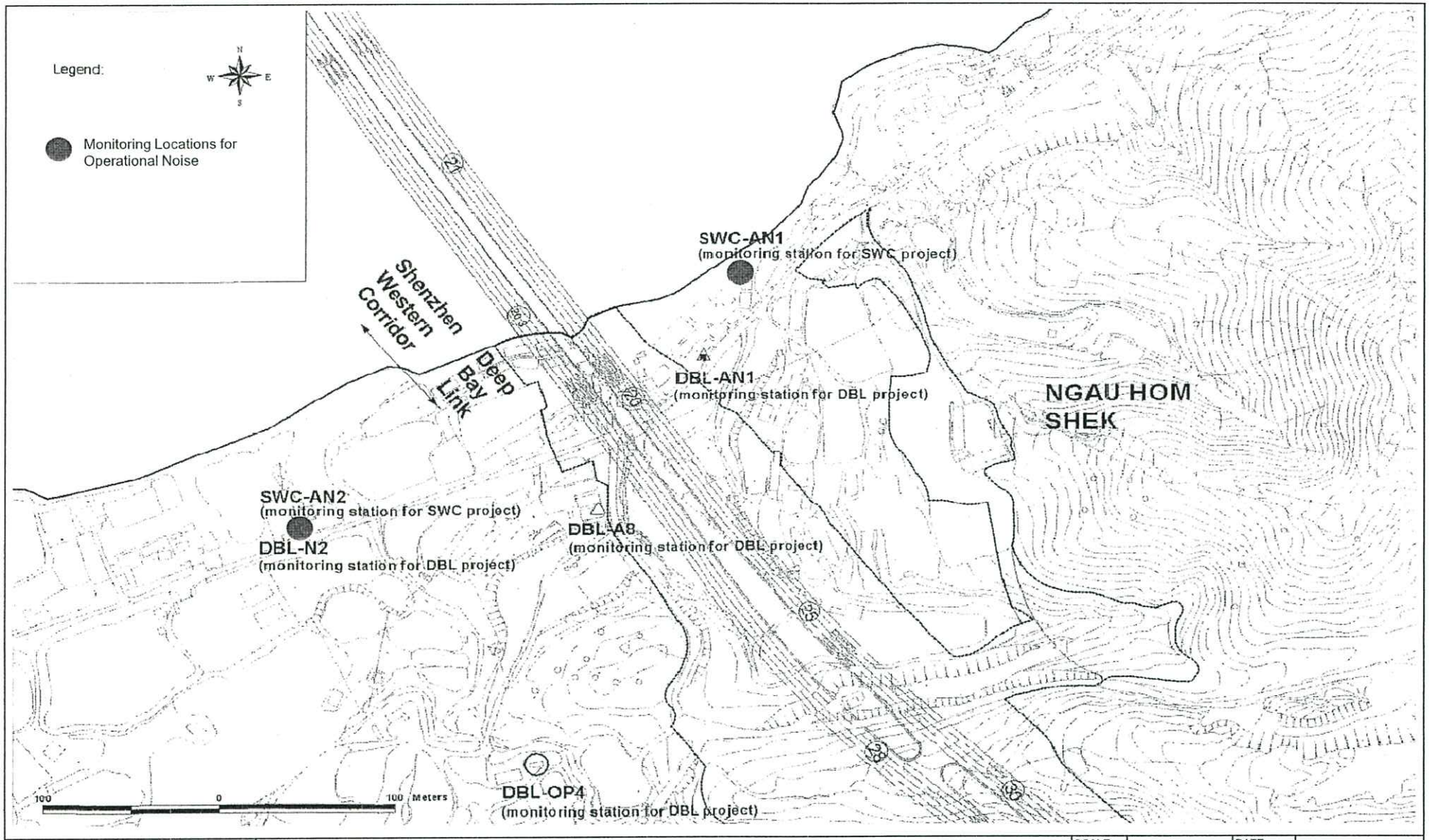
JOB NO.	60025836	FIGURE	1.2
		Rev	-



AECOM

Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Location for Operational Noise Monitoring

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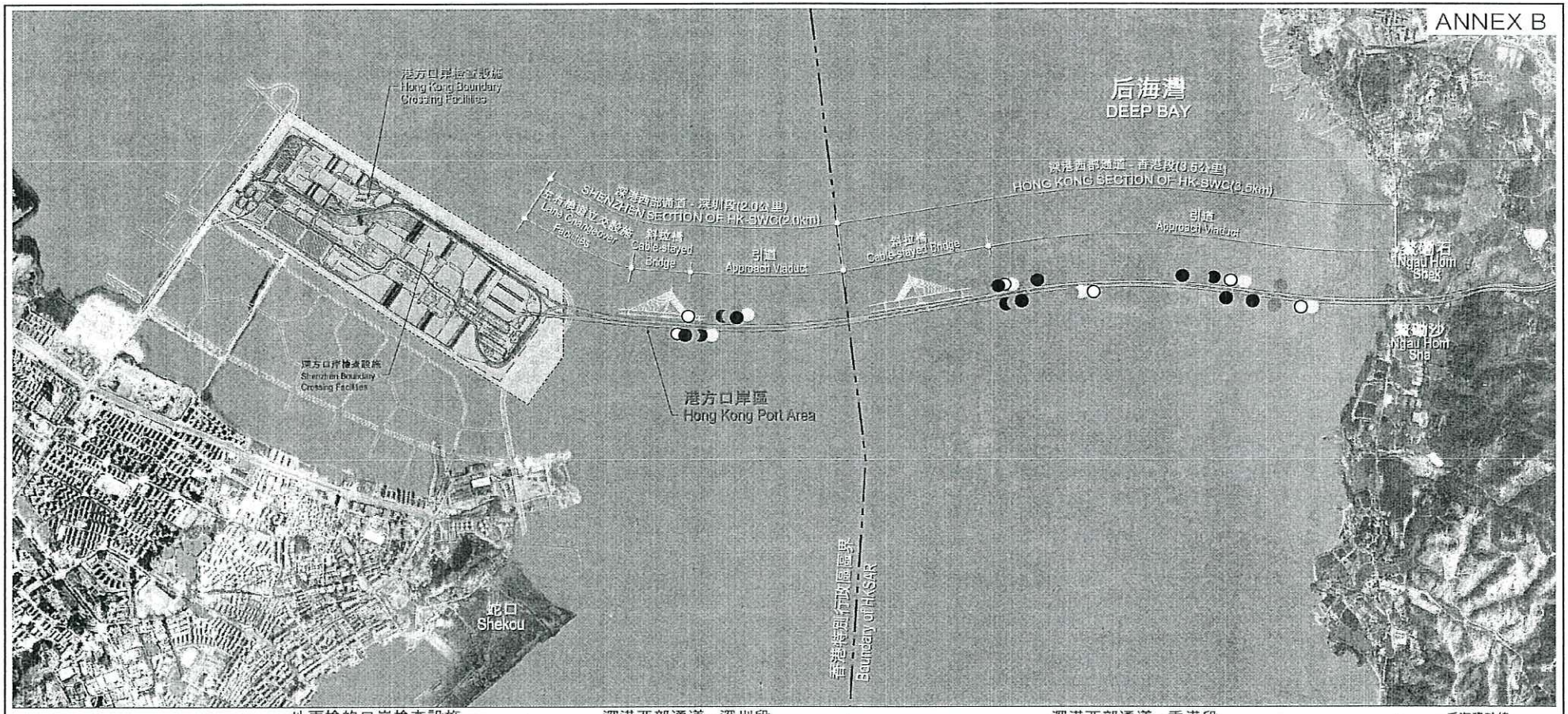
CHECK	FLWY	DRAWN	FLWY
JOB NO.	60025836	FIGURE	2.1
		Rev	-

ANNEX B



Legend:

- ○ Monitoring Location on 27 Sep 07
- Monitoring Location on 6 Oct 07
- Monitoring Location on 13 Oct 07
- ● Monitoring Location on 27 Oct 07
- Monitoring Location on 3 Nov 07
- ● Monitoring Location on 10 Nov 07

AECOM

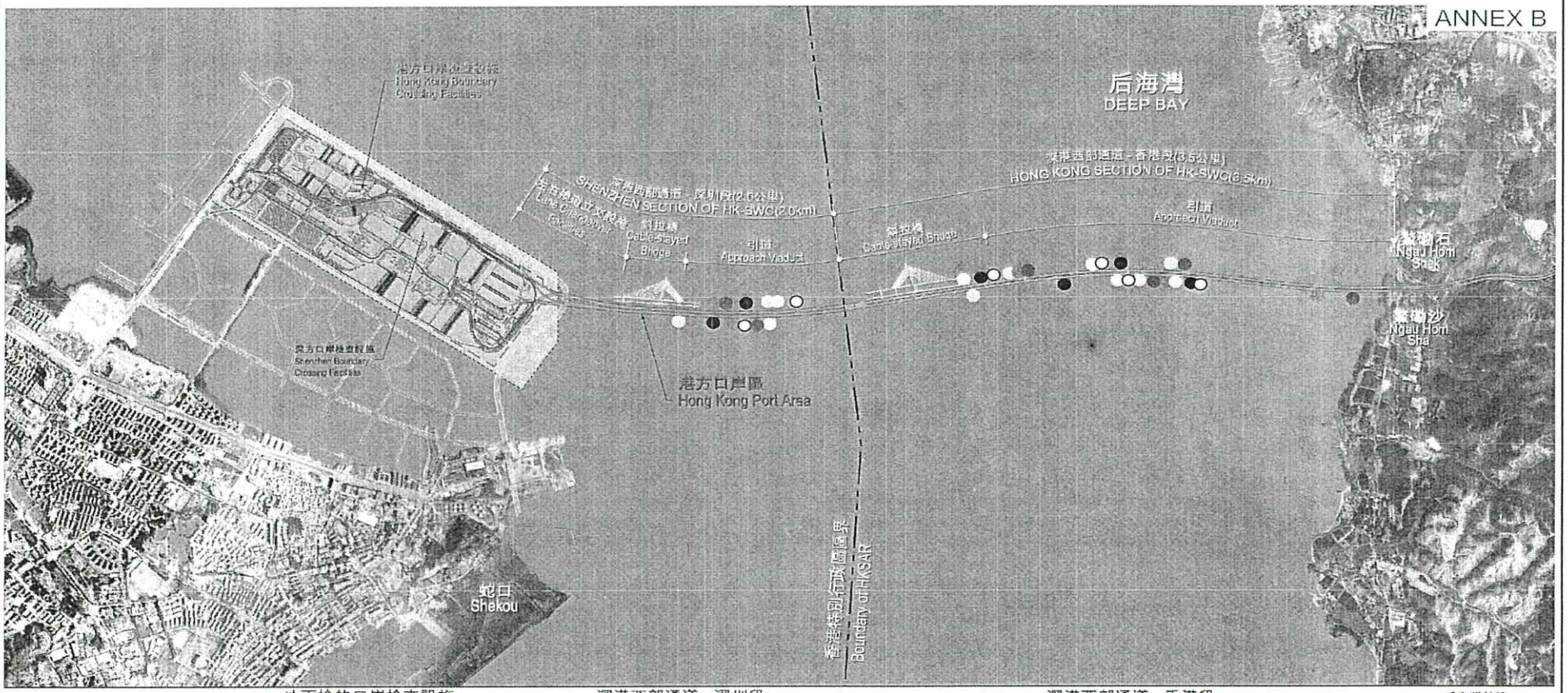
Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Road Surface Runoff from Carriageway Monitoring Locations (First Monitoring Period)

SCALE	N.T.S.	DATE	2007
CHECK	EWNY	DRAWN	FLWY
JOB NO.	60025836	FIGURE 3.1	Rev -

ANNEX B



一地兩檢的口岸檢查設施 COLOCATED BOUNDARY CROSSING FACILITIES | 深港西部通道 - 深圳段 SHENZHEN SECTION OF HK-SWC (SSWC) | 深港西部通道 - 香港段 HONG KONG SECTION OF HK-SWC | 后海灣幹線 DEEP BAY LINK

Legend:
- Monitoring Location on 5 Jan 08
- Monitoring Location on 12 Jan 08
- Monitoring Location on 19 Jan 08
- Monitoring Location on 16 Feb 08
- Monitoring Location on 23 Feb 08
- Monitoring Location on 1 Mar 08

AECOM

Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Road Surface Runoff from Carriageway Monitoring Locations (Second Monitoring Period)

SCALE	N.T.S.	DATE	Mar 2008
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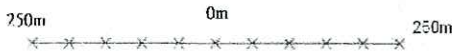
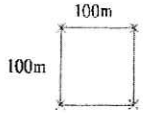
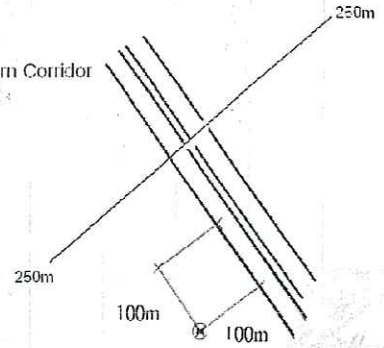
JOB NO.	60025836	FIGURE	3.1
		Rev	-





SHEUNG PAI NAI

(CONTROL SITE)



Representitive location of the transect and quadrat (Drawing NOT TO SCALE)

NGAU HOM SHEK

(POTENTIAL ECOLOGICAL IMPACT MONITORING SITE)

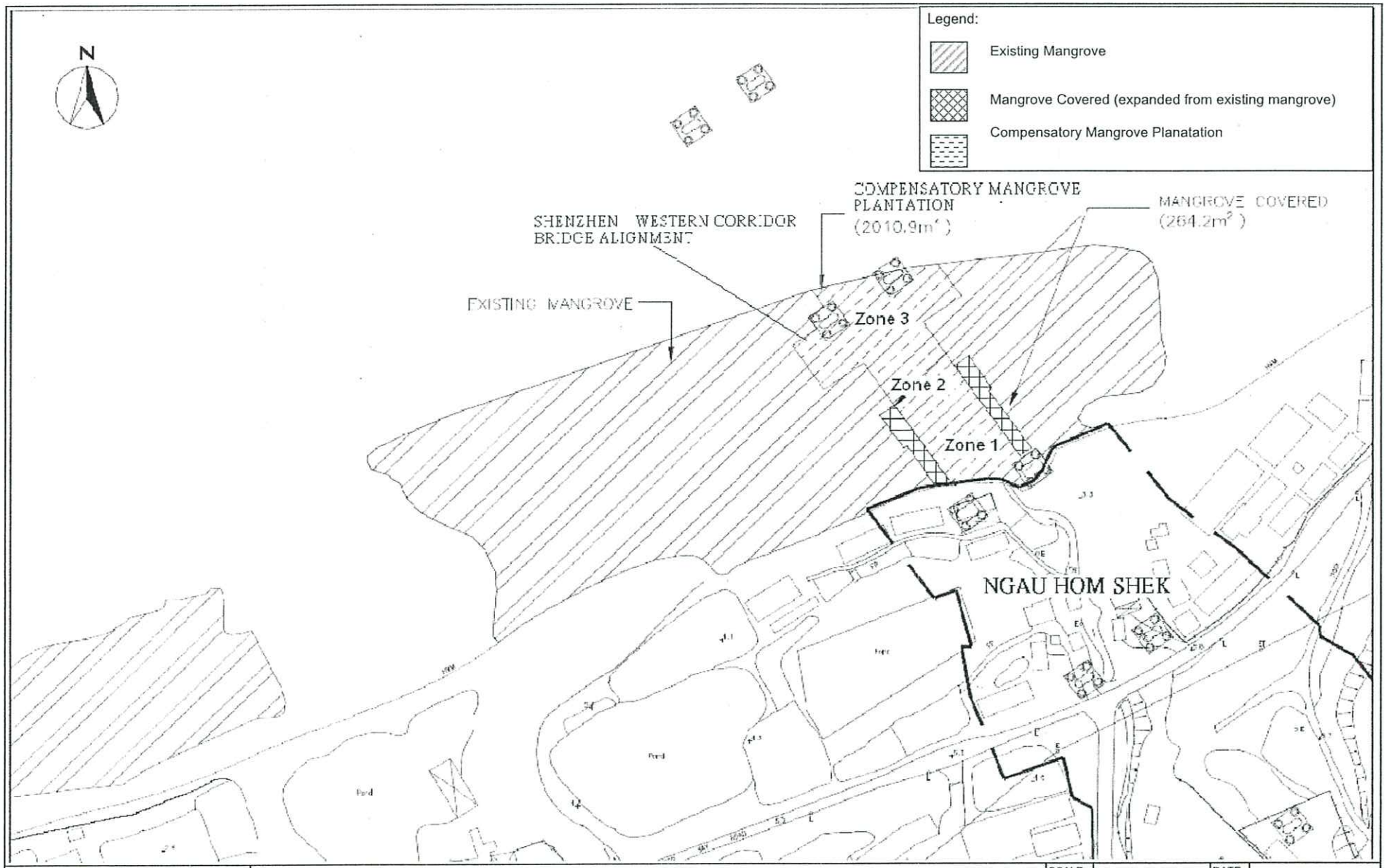
AECOM

Contract no. HY/2007/04

Hong Kong - Shenzhen Western Corridor

Location of the Monitoring Sites for Inter-tidal Bird Communities

SCALE	N.T.S.	DATE	Jan 2009
CHECK	CWHY	DRAWI	KCYJ
JOB NO.	60025836	FIGURE 4.1	Rev -



AECOM

Contract no. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

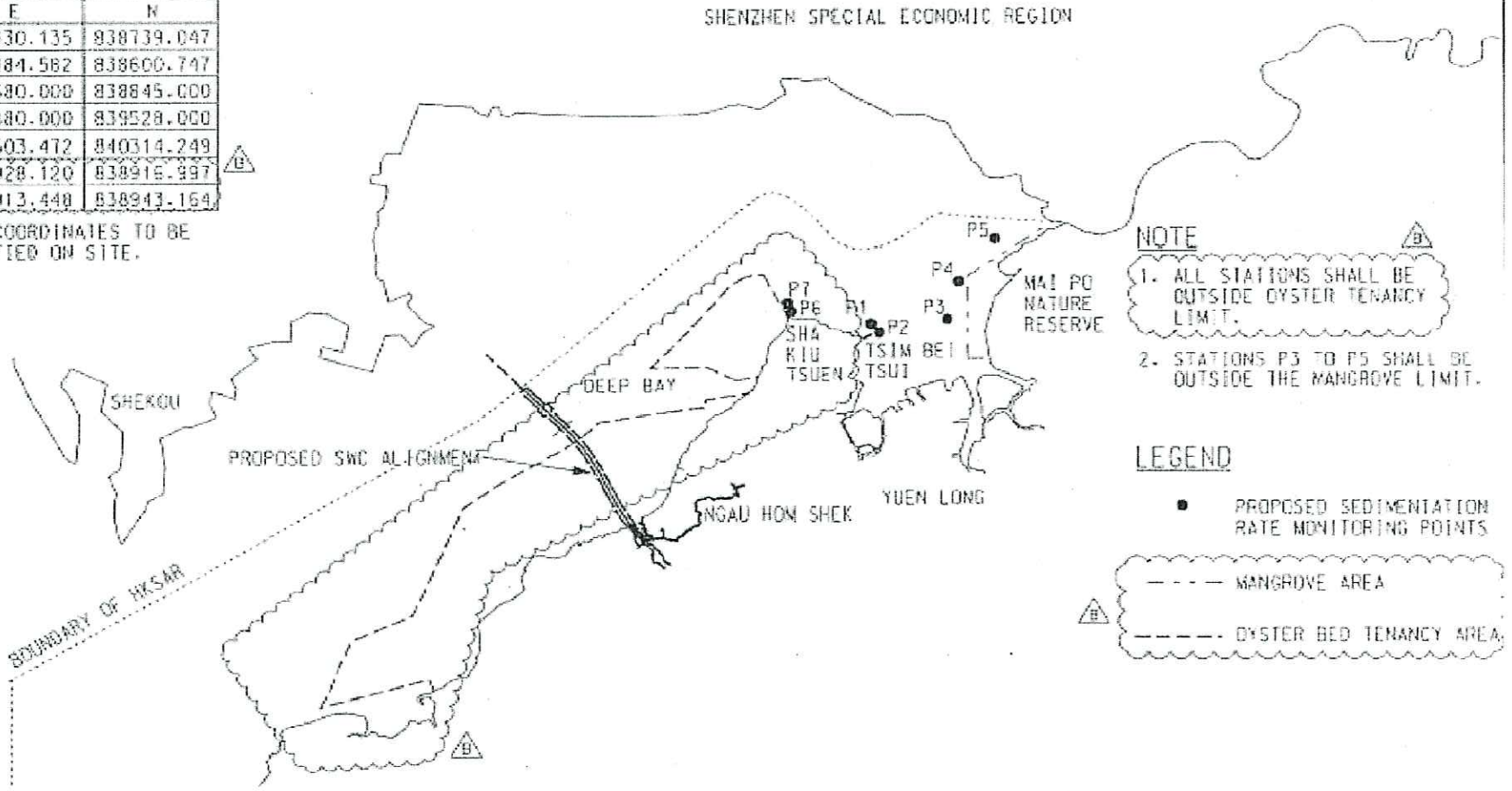
Location of Mangrove Plantation

SCALE	N.T.S.	DATE	Jan 2009
CHECK	CWHY	DRAWN	KCYJ
JOB NO.	60025836	FIGURE	4.2
		Rev	-

SETTING OUT COORDINATES OF MONITORING STATIONS

POINT	E	N
P1	819330.135	838739.047
P2	819484.582	838600.747
P3	820680.000	838845.000
P4	820880.000	839528.000
P5	821503.472	840314.249
P6	817928.120	838916.997
P7	817913.448	838943.164

NOTE: ALL COORDINATES TO BE VERIFIED ON SITE.



AECOM

Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Location of Sedimentation Rate Monitoring

SCALE	N.T.S.	DATE	2007
CHECK	CWHY	DRAWN	FLWY
JOB NO.	60025836	FIGURE 5.1	Rev -

APPENDIX A
CONTACTS OF KEY ENVIRONMENTAL PERSONNEL

Contacts of Key Environmental Staff

	Name	Telephone	Fax
EPD			
Environmental Protection Officer	Ms. M. Y. Choi	2411 9622	2611 9149
Highways Department (Major Works)			
Senior Engineer	Mr. William Chiang	2762 3522	2761 4864
Engineer	Ms. Jackei Yin	2762 3647	2761 4864
Highways Department (New Territories Region)			
Engineer	Mr. Kevin C K Yu	2762 3526	2714 5228
Engineer	Mr. Gary T W Mok	2482 0230	2714 5228
IEC			
CH2M HILL Hong Kong Limited			
Independent Environmental Checker	Mr. K S Lee	2507 2203	2507 2293
Assistant to IEC	Ms. Vivian Chan	2507 2203	2507 2293
ET			
AECOM Asia Co. Ltd.			
Environmental Team Leader	Mr. Y T.Tang	2893 1551	2891 0305
Senior Environmental Consultant	Ms. Edith Ng	2893 1551	2891 0305
Maintenance Contractor			
Chiu Hing Construction & Transportation Co. Ltd.			
Site Agent	Mr. K L Liu	2771 9197	2782 1075

APPENDIX B
EVENT AND ACTION PLANS DURING OPERATION PHASE

Appendix B Event and Action Plans during the Operation Phase

Bridge Surface Runoff from Carriageway

Proposed Criteria to be Used for Determination of Cleaning Frequency, Action Level and Action

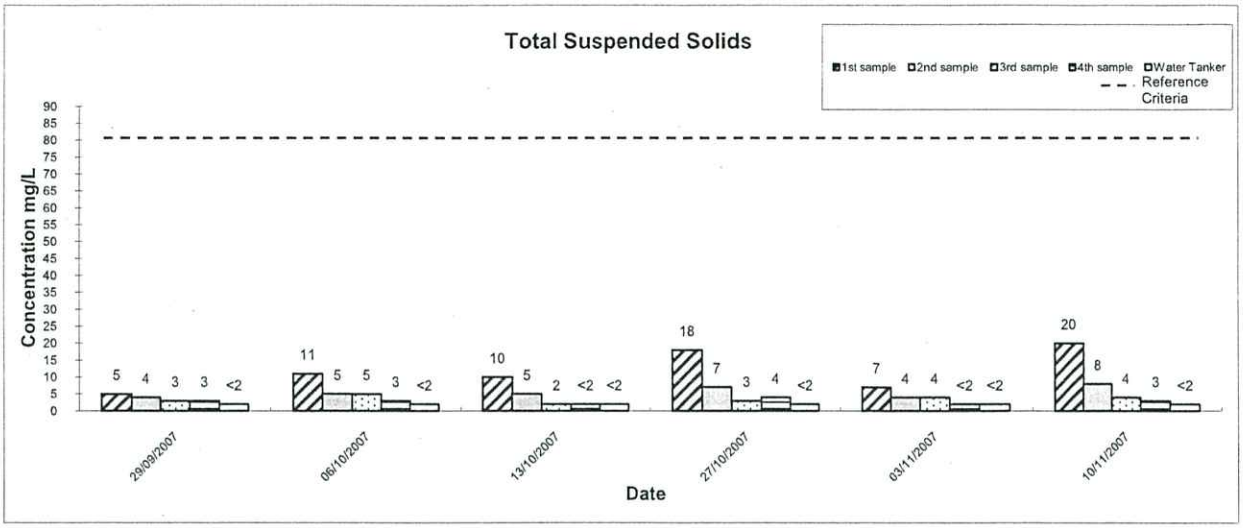
Parameter	Reference Criteria for Determination of Cleaning Frequency	Action Level	Action
Total suspended solids (mg/L)	81	3 consecutive monitoring with the same parameter (1 or more than 1 parameter) exceeded the criteria	Increase 1 cleaning event per week
Total organic carbon (mg/L)	25		
Chemical oxygen demand (mg/L)	90		
Nitrite and nitrate (mg/L)	0.72		
Total Kjeldahl Nitrogen (mg/L)	6.4		
Total phoshorus (mg/L)	0.95		
Copper (mg/L)	0.174		
Lead (mg/L)	0.31		
Zinc (mg/L)	0.94		

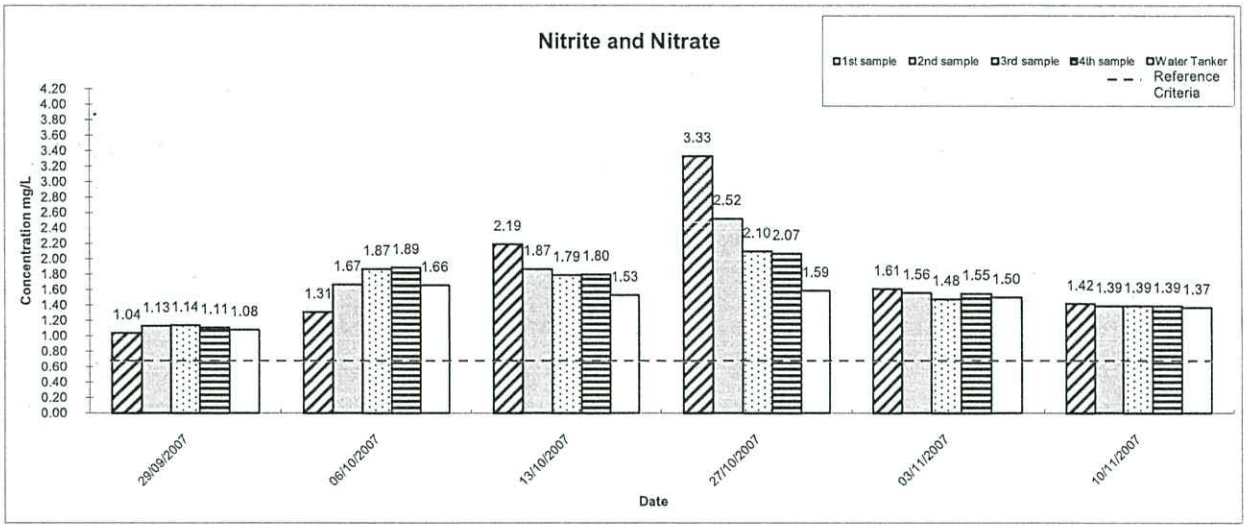
Ecological Monitoring

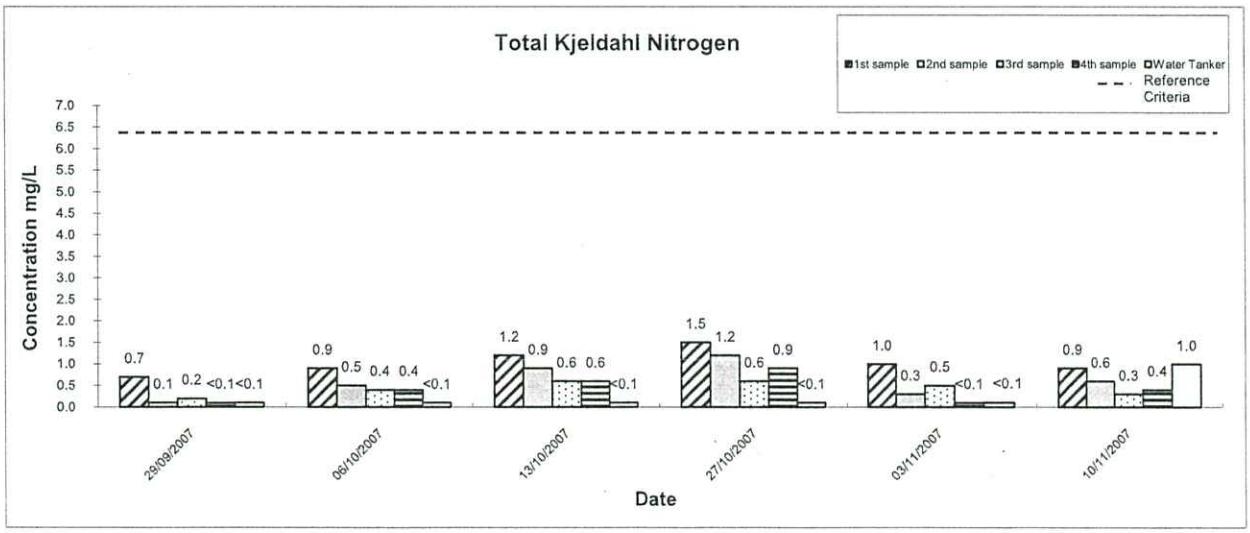
Trigger and Action levels for Intertidal Bird Communities

Parameters	Trigger level	Action	Action level	Action
Bird density (No./ha)	30% net reduction of bird density in the bridge in comparison with baseline data of the bridge location from EIA field surveys (**Table 3.10** & **3.11** in **Appendix 9A** of the EIA report) and the change of bird density in control site.	Increase the monitoring frequency to weekly.	50% net reduction of bird density in the bridge in comparison with baseline data of the bridge location from EIA field surveys (**Table 3.10** & **3.11** in **Appendix 9A** of the EIA report) and the change of bird density in control site.	Explore locations and measures to enhance bird feeding resources.

APPENDIX C
GRAPHICAL PRESENTATIONS OF BRIDGE SURFACE RUNOFF FROM CARRIAGEWAY MONITORING RESULTS

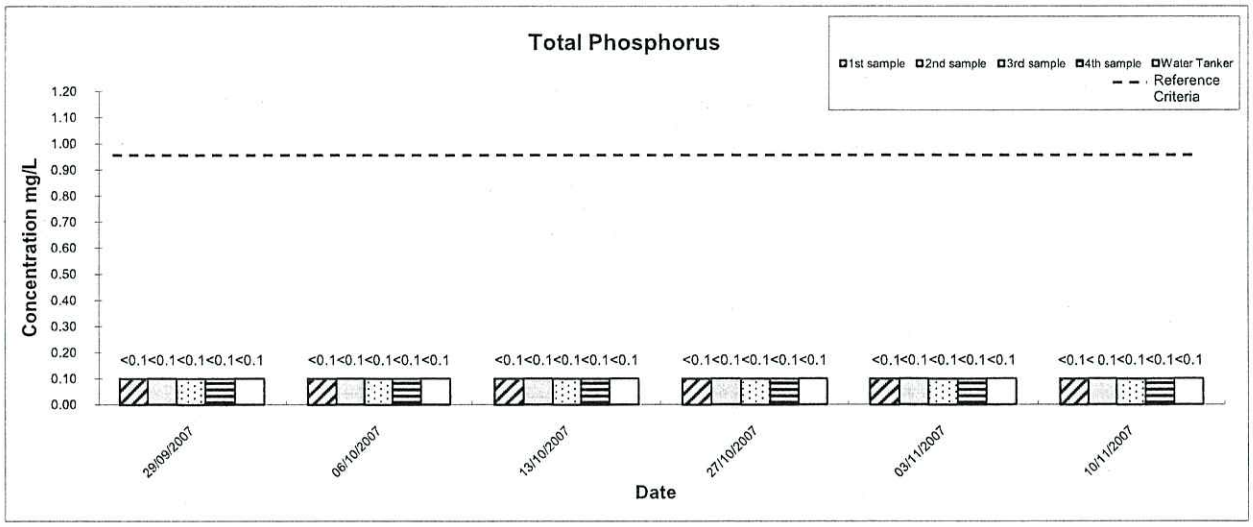


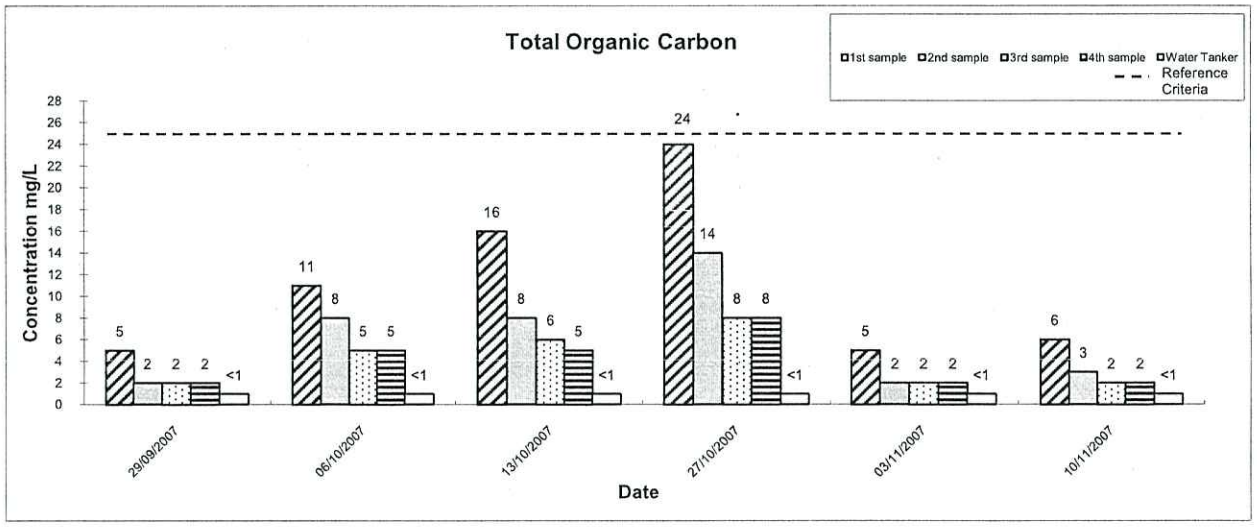


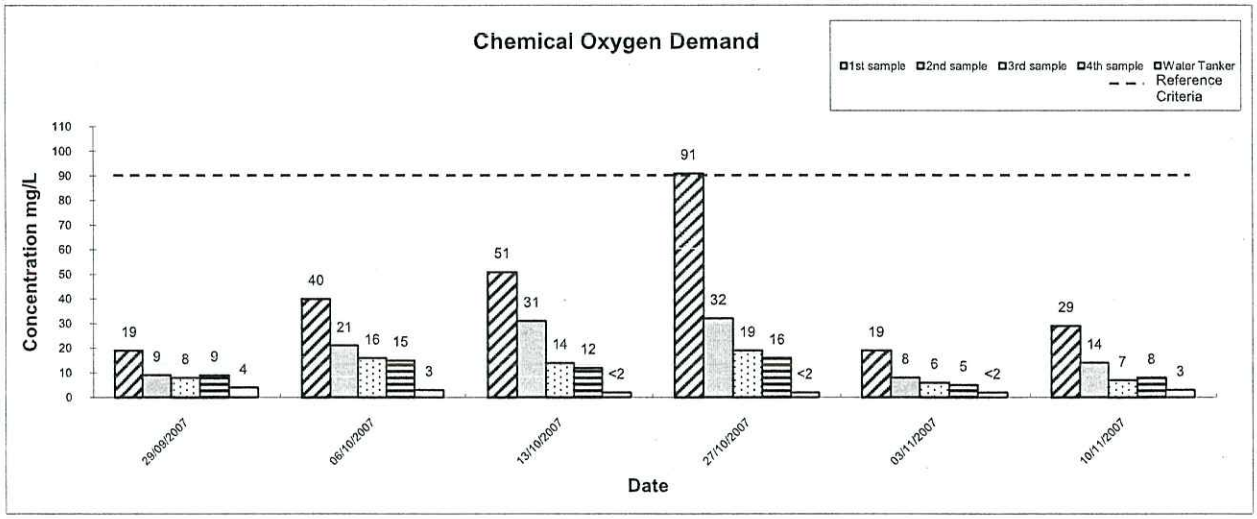


** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.
Data presented in the graphs are raw data from the laboratory.

AECOM	HY/2007/04 Hong Kong - Shenzhen Western Corridor (Operational Phase) **Graphical Presentation of the 1st Road Surface Runoff from Carriageway Monitoring Results**	SCALE	N.T.S.	DATE	2007
		CHECK	EWNY	DRAWN	FLWY
		JOB NO.	60025836	APPENDIX	C
				Rev	-

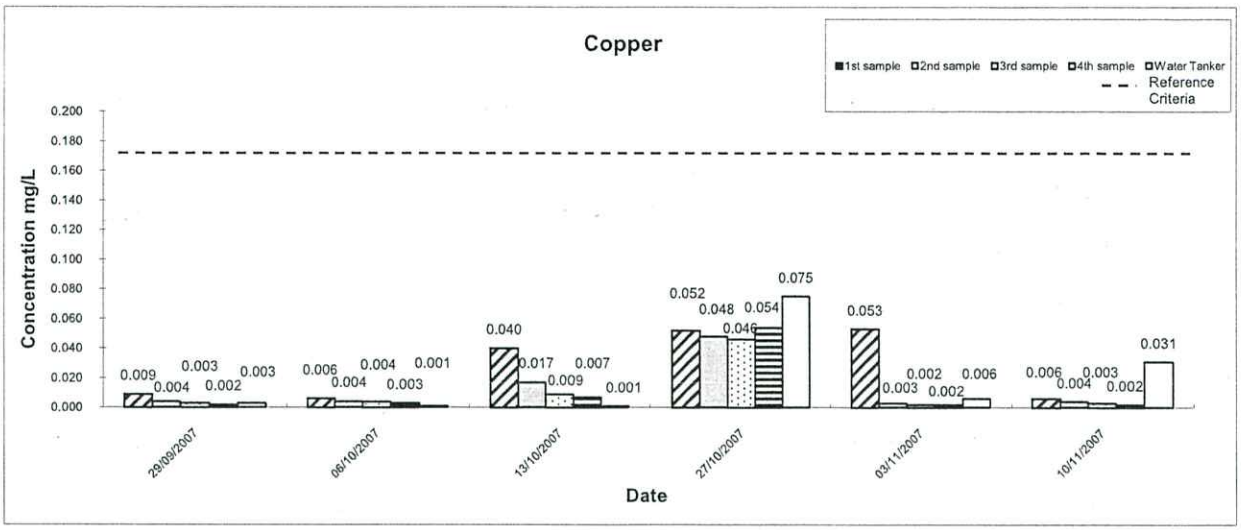


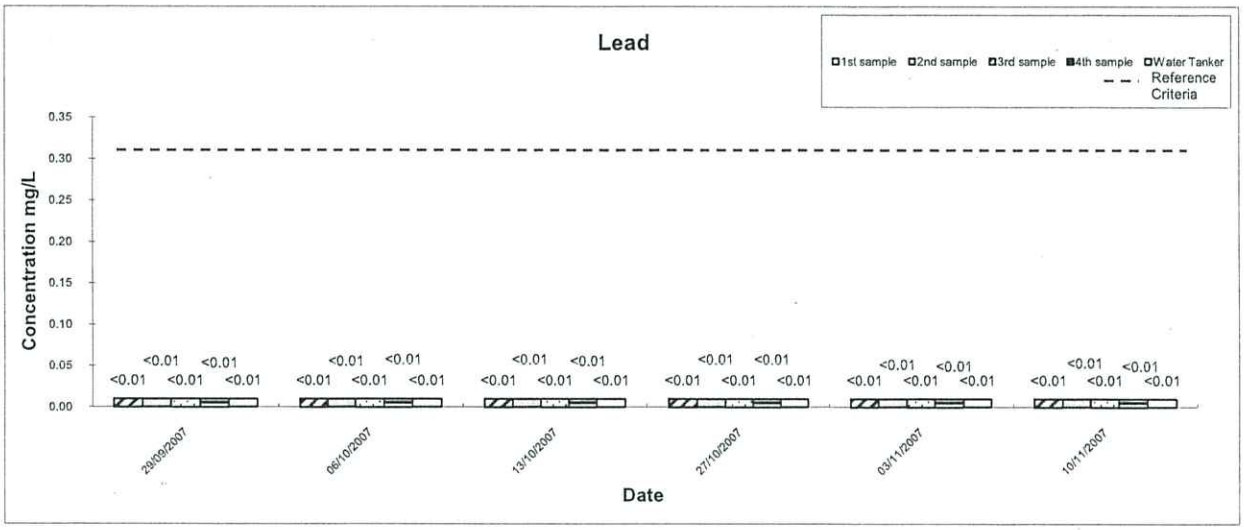


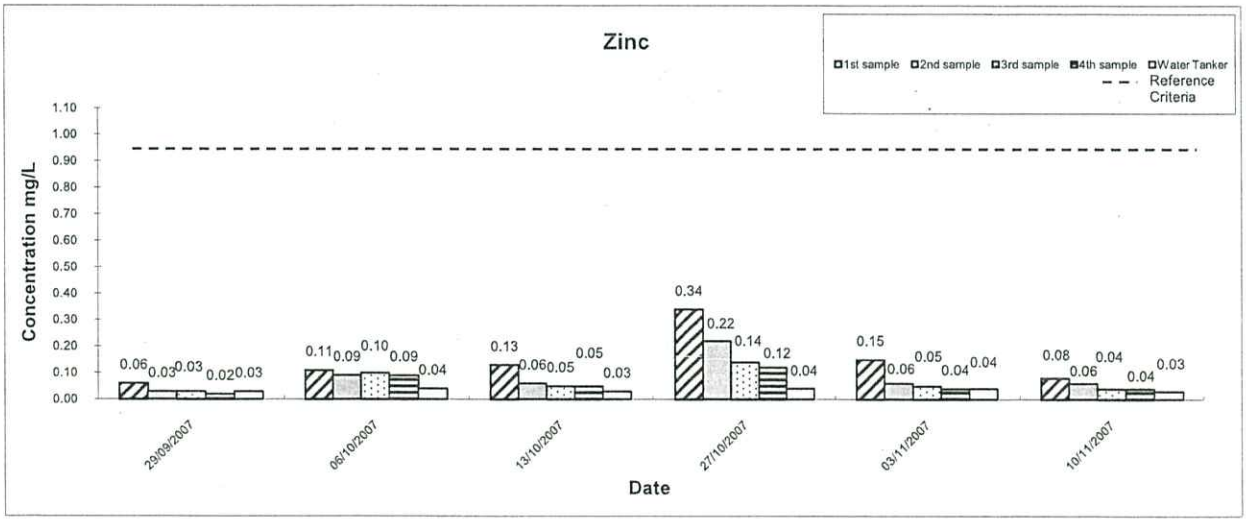


** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.
Data presented in the graphs are raw data from the laboratory.

AECOM	HY/2007/04 Hong Kong - Shenzhen Western Corridor (Operational Phase) **Graphical Presentation of the 1st Road Surface Runoff from Carriageway Monitoring Results**	SCALE	N.T.S.	DATE	2007
		CHECK	EWNY	DRAWN	FLWY
		JOB NO.	60025836	APPENDIX C	Rev -







** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.
Data presented in the graphs are raw data from the laboratory.

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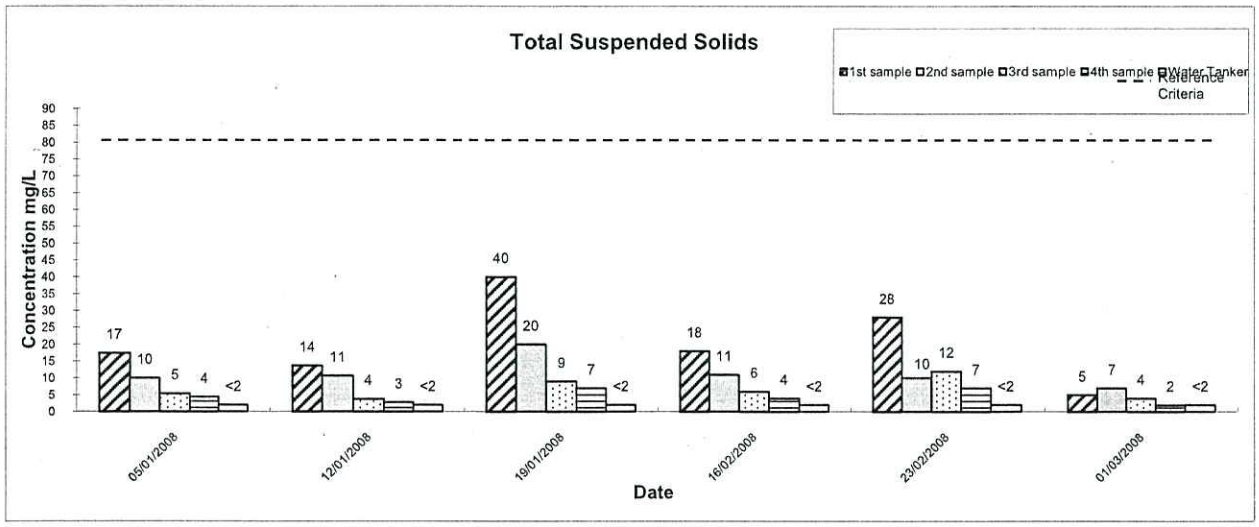
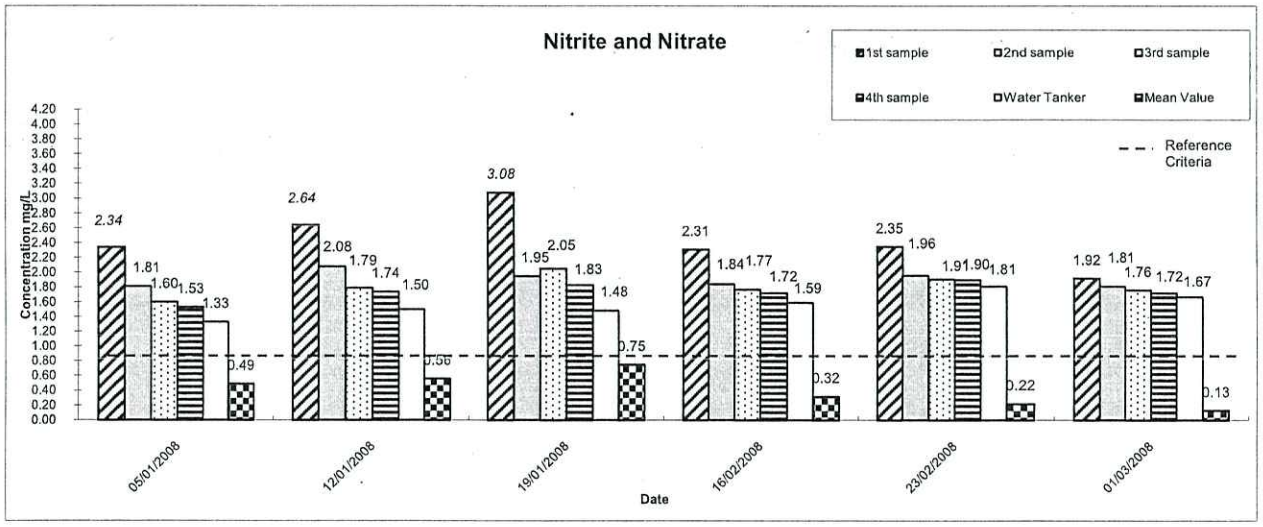
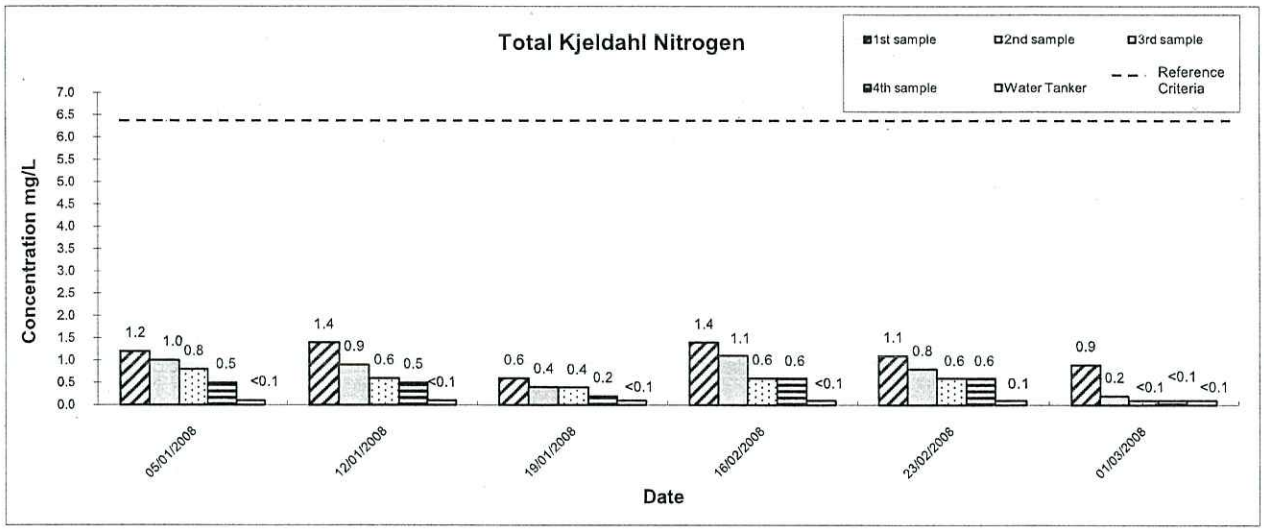
	Graphical Presentation of the 1st Road Surface Runoff from Carriageway Monitoring Results	JOB NO.	60025836	APPENDIX	C
					Rev -







** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.

Data presented in the graphs are raw data from the laboratory. Elevated concentration against the reference criteria are shown in italic.

AECOM	HY/2007/04 Hong Kong - Shenzhen Western Corridor (Operational Phase) **Graphical Presentation of the 2nd Road Surface Runoff from Carriageway Monitoring Results**	SCALE	N.T.S.	DATE	2008
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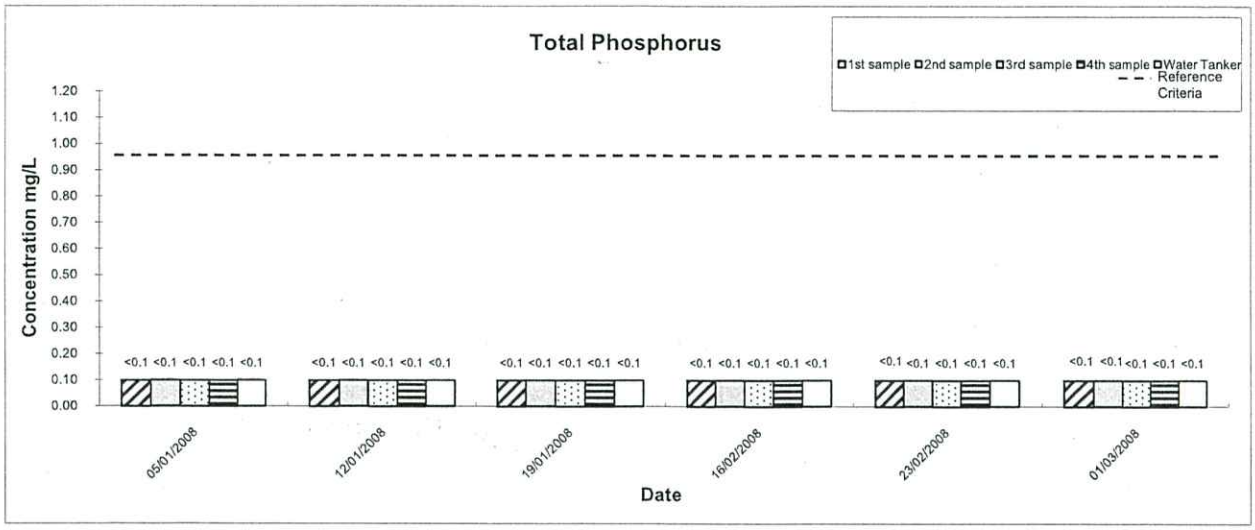
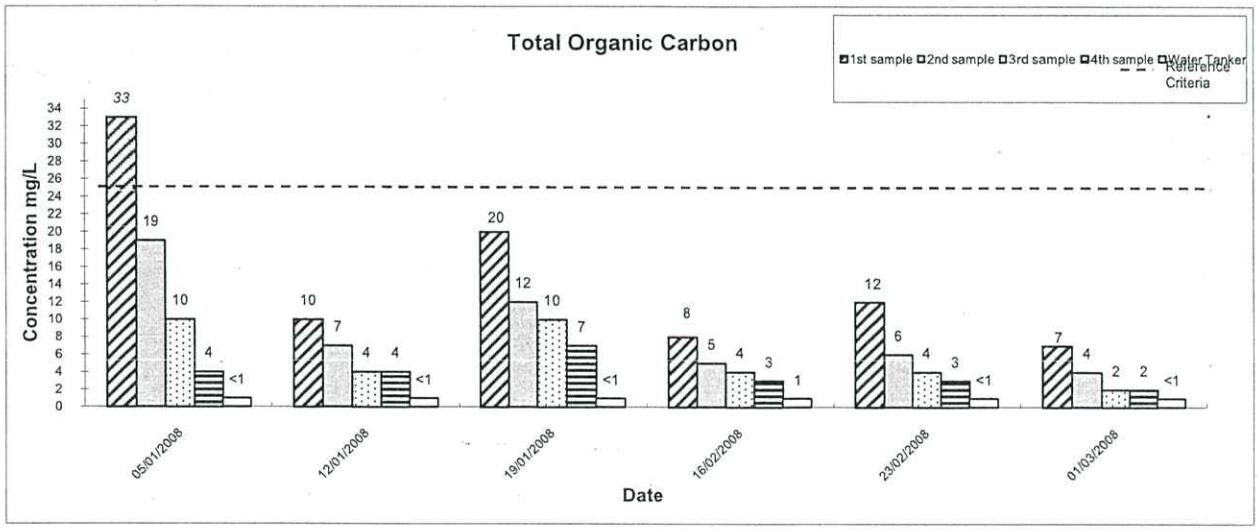
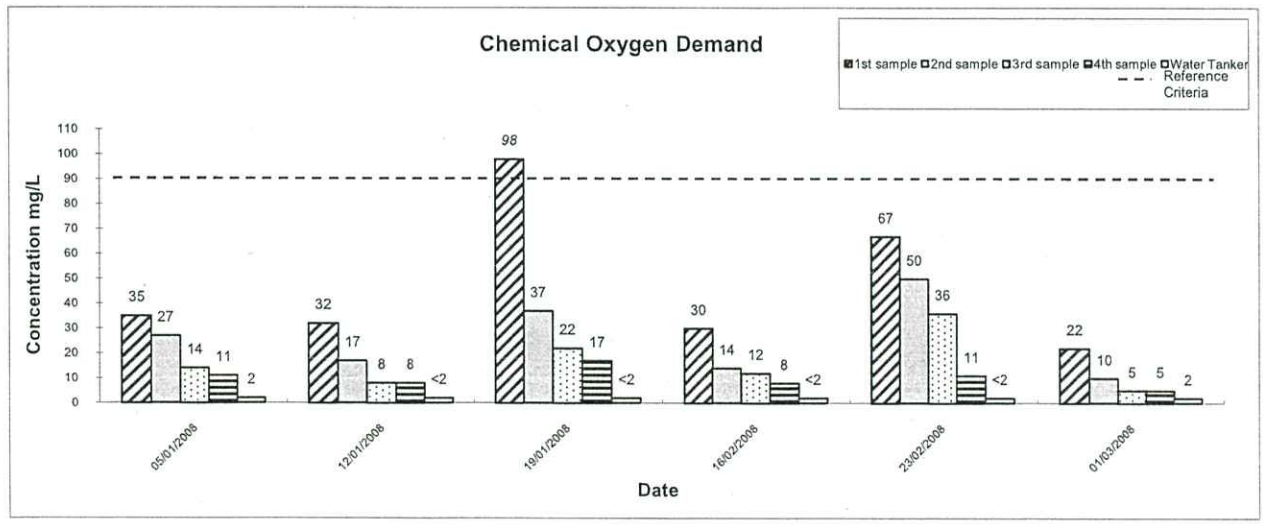
		JOB NO.	60025836	APPENDIX	C
				Rev	-







** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.

Data presented in the graphs are raw data from the laboratory. Elevated concentration against the reference criteria are shown in italic.

AECOM	HY/2007/04 Hong Kong - Shenzhen Western Corridor (Operational Phase) **Graphical Presentation of the 2nd Road Surface Runoff from Carriageway Monitoring Results**	SCALE	N.T.S.	DATE	2008
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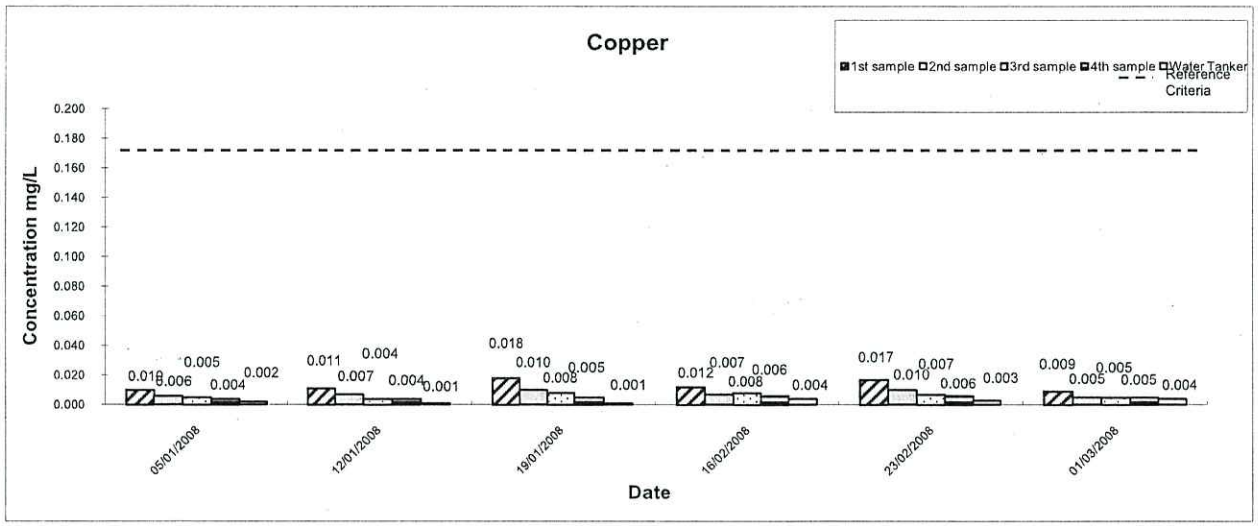
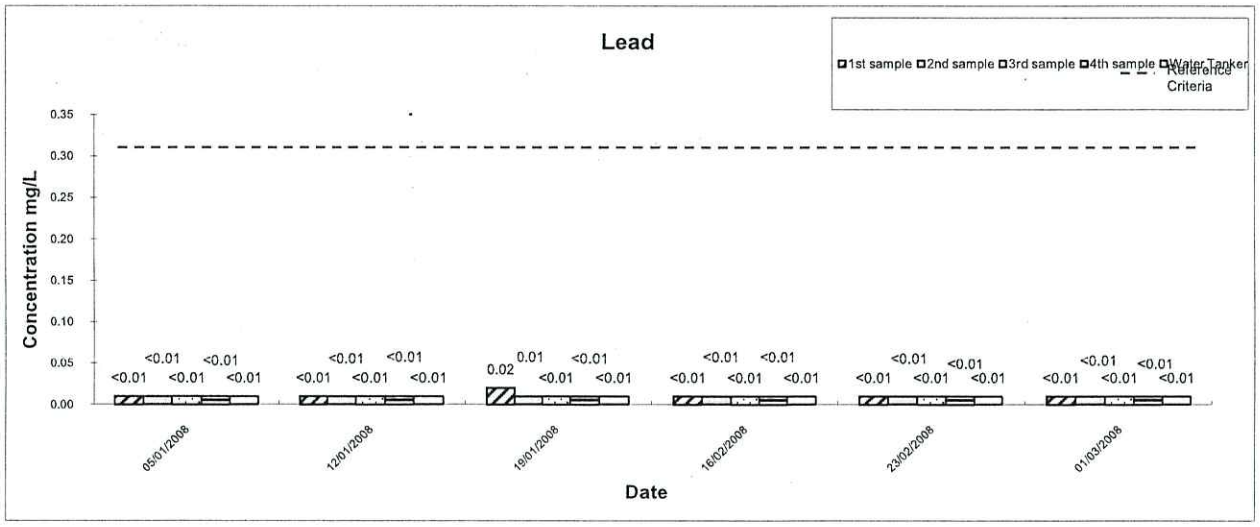
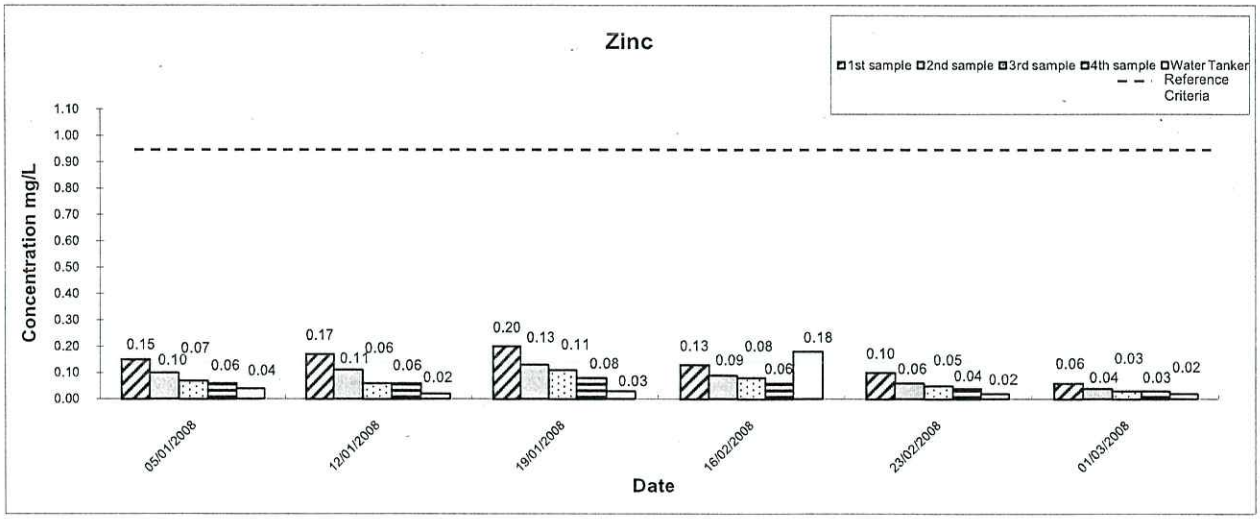
		JOB NO.	60025836	APPENDIX	C
				Rev	-







** Remarks: Results below the lowest detection limit are shown as the value of detection limit in the above graphs.

Data presented in the graphs are raw data from the laboratory. Elevated concentration against the reference criteria are shown in italic.

AECOM	HY/2007/04 Hong Kong - Shenzhen Western Corridor (Operational Phase) **Graphical Presentation of the 2nd Road Surface Runoff from Carriageway Monitoring Results**	SCALE	N.T.S.	DATE	2008
		CHECK	CWHY	DRAWN	FLWY
		JOB NO.	60025836	APPENDIX C	Rev -

APPENDIX D
CALCULATION FOR NITRITE AND NITRATE DUE TO ROAD CLEANING

APPENDIX D: Calculation for Nitrite and Nitrate due to Road Cleaning

Date and Time of Sampling: 05/01/2008 01:00 - 03:07 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	2.34	1.81	1.60	1.53	1.33
Nitrite & Nitrate due to road cleaning (mg/L)#	1.01	0.48	0.27	0.20	
Mean Value of Nitrite & Nitrate (mg/L)	0.49				

Date and Time of Sampling: 12/01/2008 01:00 - 03:45 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	2.64	2.08	1.79	1.74	1.50
Nitrite & Nitrate due to road cleaning (mg/L)#	1.14	0.58	0.29	0.24	
Mean Value of Nitrite & Nitrate (mg/L)	0.56				

Date and Time of Sampling: 19/01/2008 01:00 - 02:37 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	3.08	1.95	2.05	1.83	1.48
Nitrite & Nitrate due to road cleaning (mg/L)#	1.60	0.47	0.57	0.35	
Mean Value of Nitrite & Nitrate (mg/L)	0.75				

APPENDIX D: Calculation for Nitrite and Nitrate due to Road Cleaning

Date and Time of Sampling: 16/02/2008 01:15 - 03:00 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	2.31	1.84	1.77	1.72	1.59
Nitrite & Nitrate due to road cleaning (mg/L)#	0.72	0.25	0.18	0.13	
Mean Value of Nitrite & Nitrate (mg/L)	0.32				

Date and Time of Sampling: 23/02/2008 01:00 - 02:10 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	2.35	1.96	1.91	1.90	1.81
Nitrite & Nitrate due to road cleaning (mg/L)#	0.54	0.15	0.10	0.09	
Mean Value of Nitrite & Nitrate (mg/L)	0.22				

Date and Time of Sampling: 01/03/2008 01:06 - 02:39 Weather Condition: Fine

Parameter \ Composite	1st	2nd	3rd	4th	Water Truck (Reference)
Nitrite & Nitrate (mg/L)	1.92	1.81	1.76	1.72	1.67
Nitrite & Nitrate due to road cleaning (mg/L)#	0.25	0.14	0.09	0.05	
Mean Value of Nitrite & Nitrate (mg/L)	0.13				

Median Even Mean Concentration (EMCs) of Nitrate & Nitrate due to Road Cleaning := **0.41** **mg/L**

Remark: # assign the value as zero if negative value resulted after subtraction

APPENDIX E
GRAPHICAL PRESENTATIONS OF ECOLOGICAL MONITORING RESULTS

Appendix E

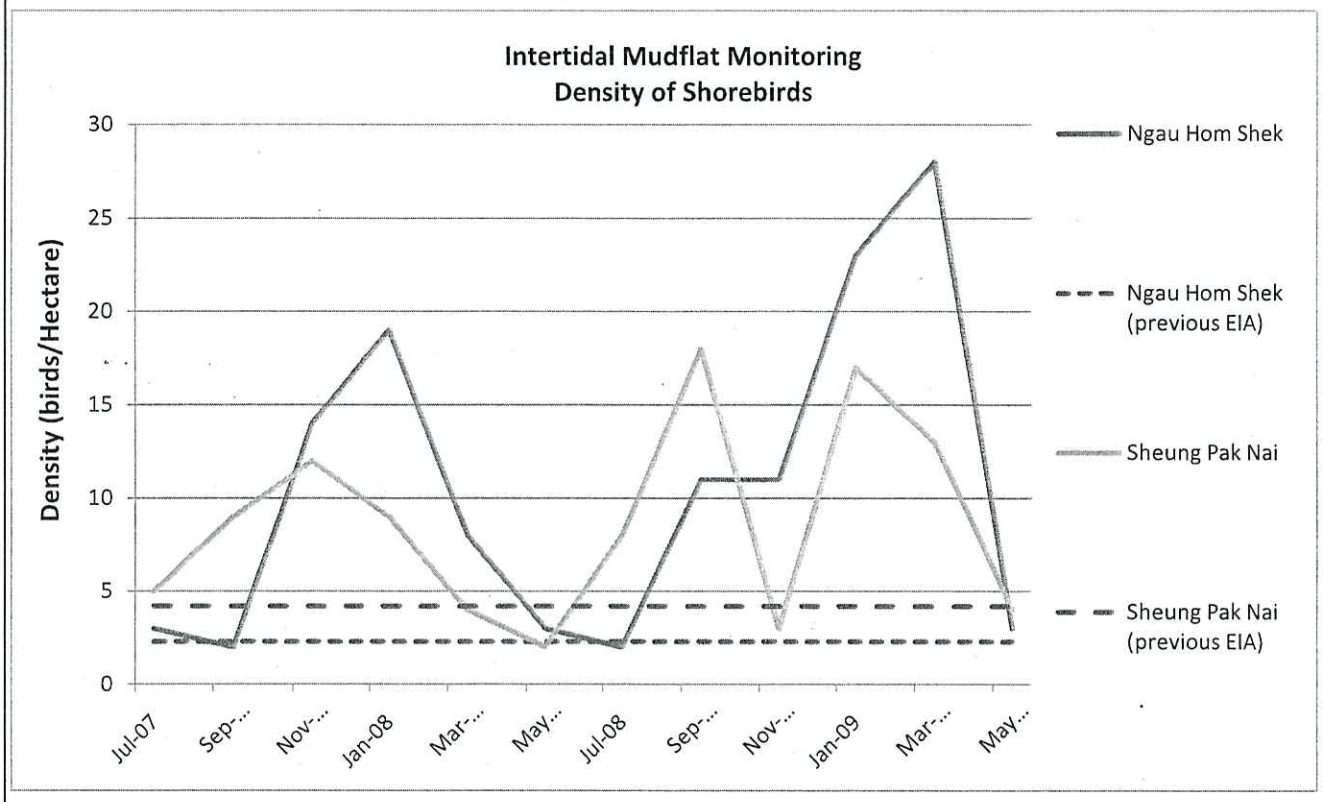
Summary of Bridge Lighting Scheme and Bird Collisions Monitoring Results

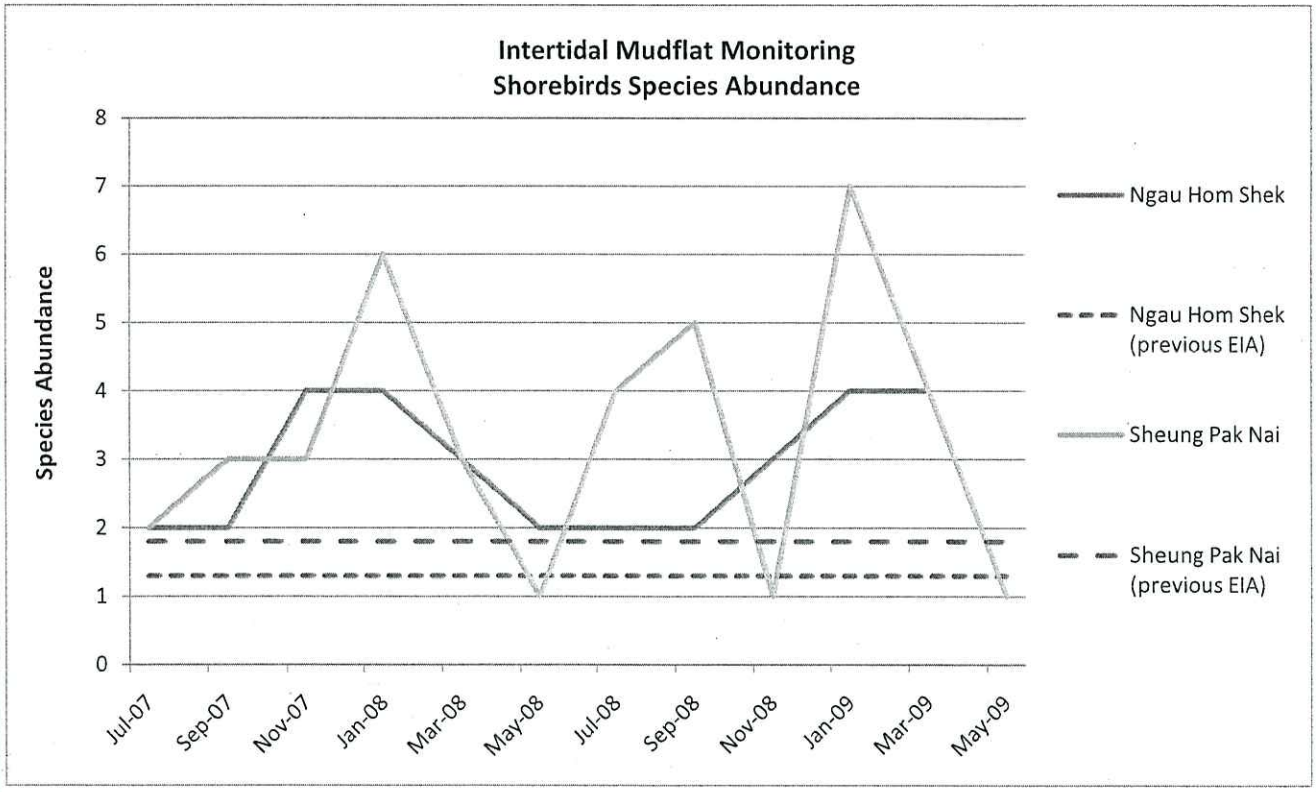
From July 2007 to June 2010

Date	Time	Lighting Scheme	Weather Condition	Records of Bird Mortality				Remarks
				Species	No.	Location	Estimated Cause of Death	
26 Jul 2007 (Thu)	8.15pm	Scheme 1	Fine with clear sky	-	0	-	-	No record of dead bird.
9 Aug 2007 (Thu)	15.00pm	Scheme 4	Windy and rainy.	-	0	-	-	Typhoon signal 3 was hoisted. No record of dead bird.
24 Aug 2007 (Fri)	8.20pm	Scheme 2	Fine but cloudy. Humidity 79%.	-	0	-	-	No record of dead bird
10 Sept 2007 (Mon)	8.05pm	Scheme 1	Fine but cloudy.	-	0	-	-	No record of dead bird
3 Oct 2007 (Wed)	7.30pm	Scheme 3	Fine, light breeze, 90% humidity	-	0	-	-	No record of dead bird. National Day Golden Week of China.
5 Nov 2007 (Mon)	7.30pm	Scheme 1	Fine clear sky, 22°C, 68% humidity	-	0	-	-	No record of dead bird.
4 Dec 2007 (Tue)	8.20pm	Scheme 1	Fine weather, 22°C, calm wind.	-	0	-	-	No record of dead bird
14 Jan 2008 (Mon)	7.30pm	Scheme 1	Fine, light breeze.	-	0	-	-	No record of dead bird.
12 Feb 2008 (Tue)	7.35pm	Scheme 1	10°C, 50% humidity, hazy vision	-	0	-	-	No record of dead bird.
7 Mar 2008 (Fri)	7.15pm	Scheme 2	Fine weather, a bit cloudy. 22°C, light breeze.	-	0	-	-	No record of dead bird
8 Apr 2008 (Tue)	7.30pm	Scheme 1	26 °C, 80% humidity.	-	0	-	-	No record of dead bird.
6 May 2008 (Tue)	7.35pm	Scheme 3 (Labour Day Week)	25°C, 81% humidity, rained during daytime.	-	0	-	-	No record of dead bird.
13 Jun 2008 (Fri)	7.30pm	Scheme 2	25°C, 87% humidity.	-	0	-	-	No record of dead bird

17 July 2008 (Thur)	7.45pm	Scheme 1	25-32 °C, 67-89% humidity.	-	0	-	-	No record of dead bird.
15 Aug 2008 (Fri)	7.30pm	Scheme 2	26-32 °C, 65-85% humidity.	-	0	-	-	No record of dead bird.
25 Sept 2008 (Thur)	8.00pm	Scheme 1	26-32 °C, 74-91 % humidity.	-	0	-	-	No record of dead bird
6 Oct 2008 (Mon)	7.45pm	Scheme 3	22.3-25.7 °C, 65-87% humidity.	-	0	-	-	Scheme 3 was on from 1st to 7th October 2008 for National Day. No record of dead bird.
14 Nov 2008 (Fri)	7.35pm	Scheme 2	19.4-28.1 °C, 58-82% humidity.	-	0	-	-	No record of dead bird.
15 Dec 2008 (Mon)	7.30pm	Scheme 1	11.7-19.2 °C, 57-72 % humidity.	-	0	-	-	No record of dead bird
30 Jan 09 (Mon)	7.45pm	Scheme 3	22.3-25.7°C, 65-87% humidity.	-	0	-	-	Scheme 3 was on from 25 January 2009 to 1 February 2009 for Lunar New Year Eve and Lunar New Year. No record of dead bird.
11 Feb 09 (Wed)	7.30pm	Scheme 1	15.3-23.2°C, 50-88% humidity.	-	0	-	-	No record of dead bird.
13 Mar 09 (Fri)	7.35pm	Scheme 2	14.4-24.8°C, 60-96 % humidity.	-	0	-	-	No record of dead bird
24 Apr 09 (Fri)	7.30pm	Scheme 2	21.7-24.5°C, 85-93% humidity.	-	0	-	-	No record of dead bird.
26 May 09 (Tue)	8pm	Scheme 1	23.6-26.5°C, 89-97% humidity.	-	0	-	-	No record of dead bird.
15 Jun 09 (Mon)	7.30pm	Scheme 1	25.2-30°C, 81-96 % humidity.	-	0	-	-	No record of dead bird
24 July 09 (Fri)	7.30pm	Scheme 2	27.9-31°C, 72-90% humidity	-	0	-	-	No record of dead bird.
25 August 09 (Tue)	7.30pm	Scheme 1	28.3-33.3°C, 69-83% humidity	-	0	-	-	No record of dead bird.
28 September 09 (Mon)	7.30pm	Scheme 1	24.5-29.3°C, 70-96% humidity	-	0	-	-	No record of dead bird
7 October 09 (Wed)	7.30pm	Scheme 3	24.6-31°C, 49-94% humidity	-	0	-	-	No record of dead bird.

30 November 2009 (Mon)	7.30pm	Scheme 1	17.8-22.1°C, 61-80% humidity	-	0	-	-	No record of dead bird.
29 December 2009 (Tue)	7.30pm	Scheme 1	13.8-16.9°C, 85-96% humidity	-	0	-	-	Foggy. No record of dead bird.
15 January 10 (Fri)	7.30pm	Scheme 2	13.8-18.4°C, 47-82% humidity	-	0	-	-	No record of dead bird.
18 February 2010 (Thur)	7.30pm	Scheme 3	8.2-10.5°C, 77-92% humidity	-	0	-	-	Lunar New Year week. No record of dead bird.
18 March 2010 (Thur)	7.30pm	Scheme 1	18.7-24.4°C, 68-87% humidity	-	0	-	-	No record of dead bird.
22 Apr 2010 (Thu)	7.30pm	Scheme 1	21.1-28.4°C, 77-95% humidity.	-	0	-	-	No record of dead bird.
6 May 2010 (Thu)	7.30pm	Scheme 3	26-28.7°C, 80-93% humidity.	-	0	-	-	Scheme 3 due to Labour Day. No record of dead bird.
18 June 2010 (Fri)	7.30pm	Scheme 2	28.7-31.4°C, 71-83% humidity.	-	0	-	-	No record of dead bird.





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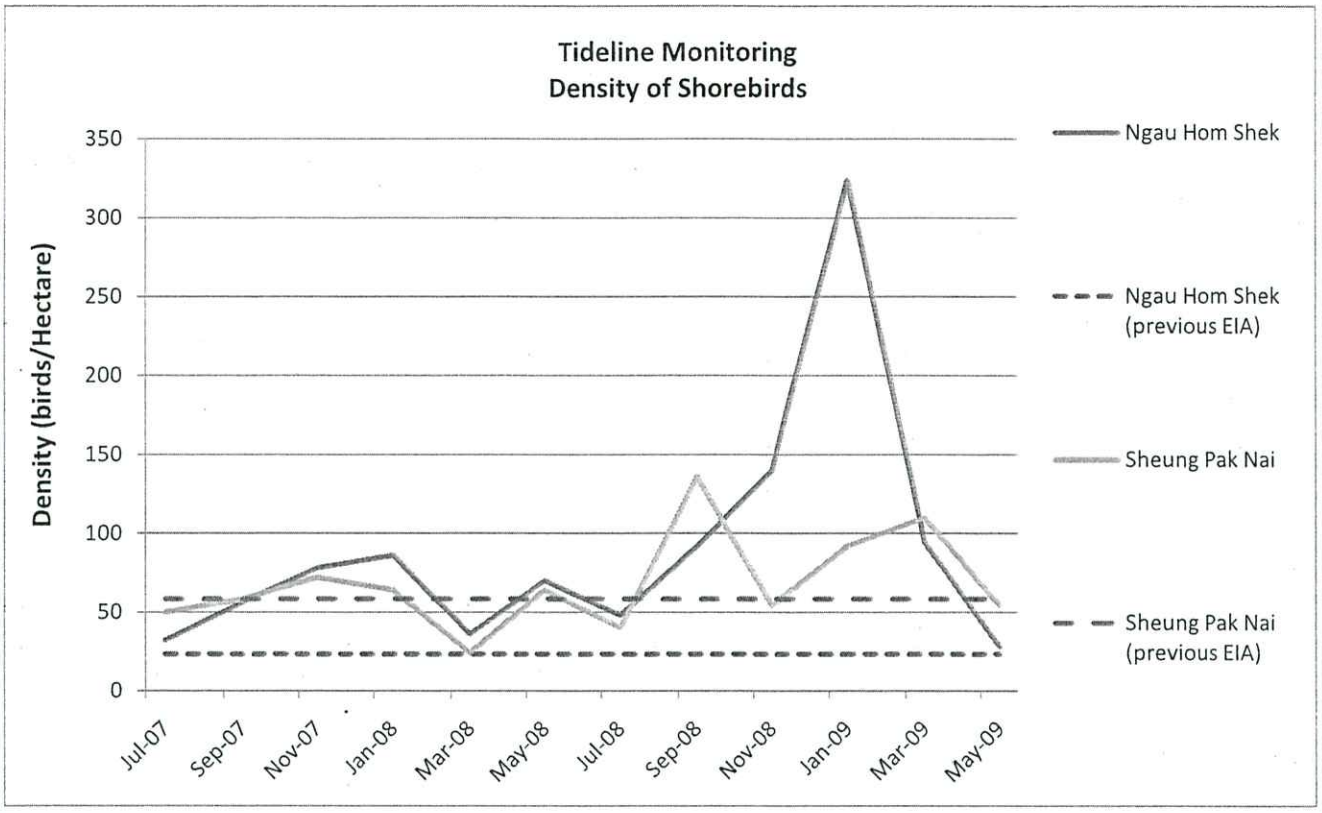
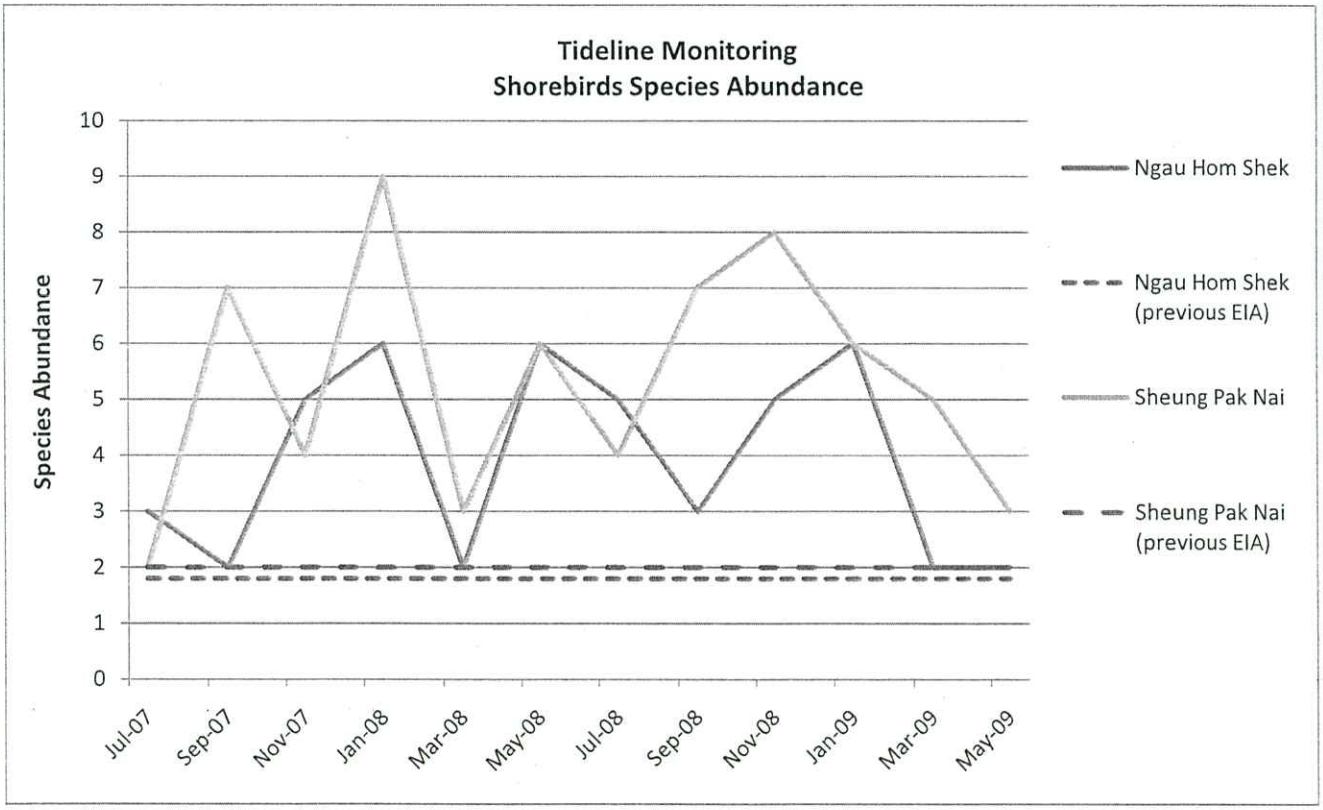
	Hong Kong - Shenzhen Western Corridor (Operational Phase)	CHECK	ENFL	DRAWN	RWHW
	Operational Disturbance on Intertidal Bird Communities	JOB NO.	60025836	APPENDIX E	Rev -





AECOM	Contract No. HY/2007/04	SCALE	N.T.S.	DATE	2010
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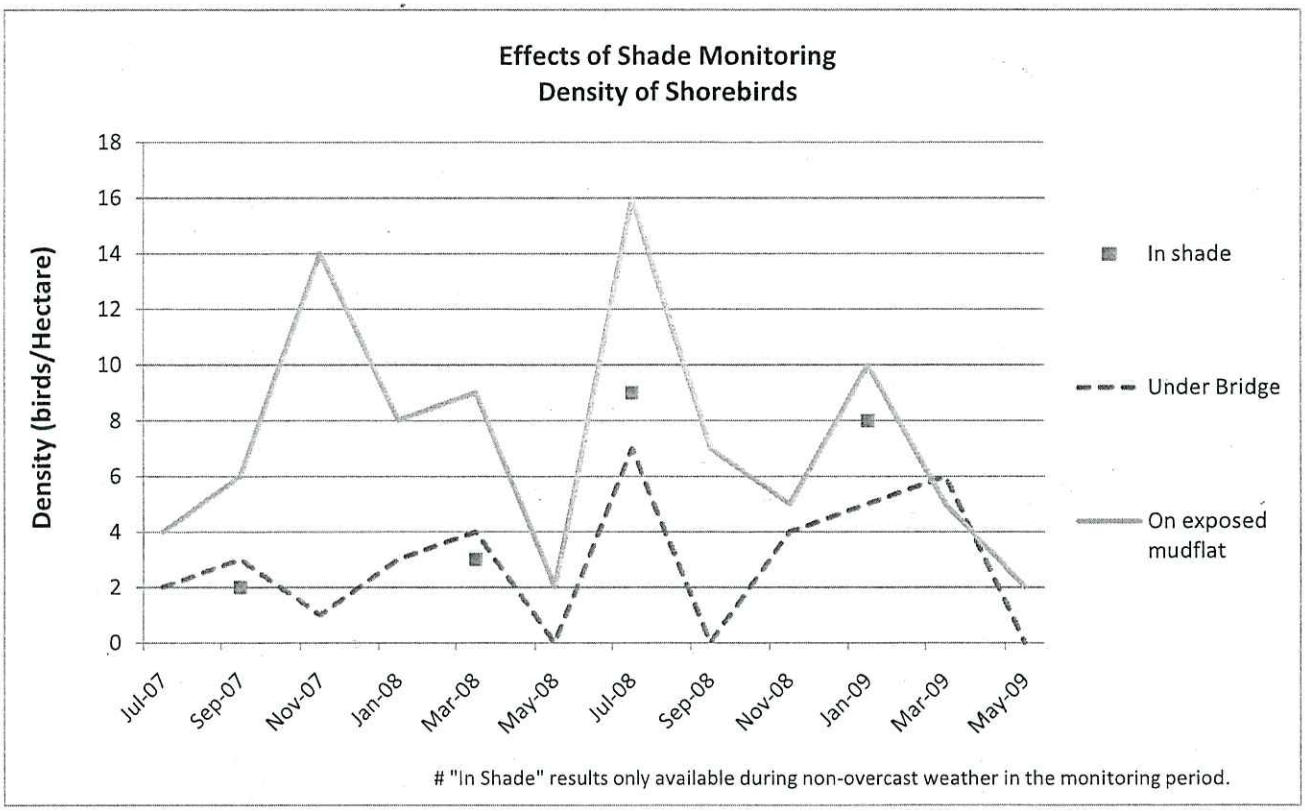
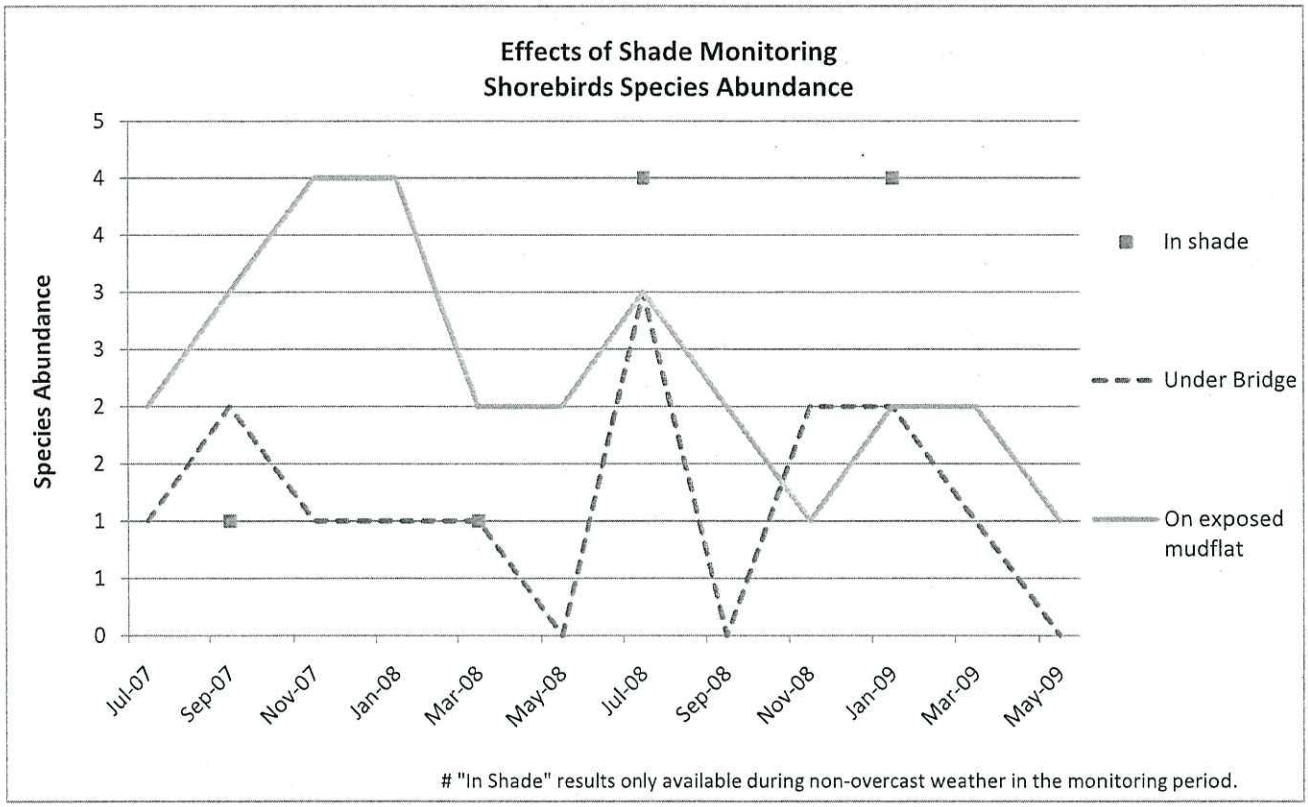
				Rev	-





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	Hong Kong - Shenzhen Western Corridor (Operational Phase)	CHECK	ENFL	DRAWN	RWHW
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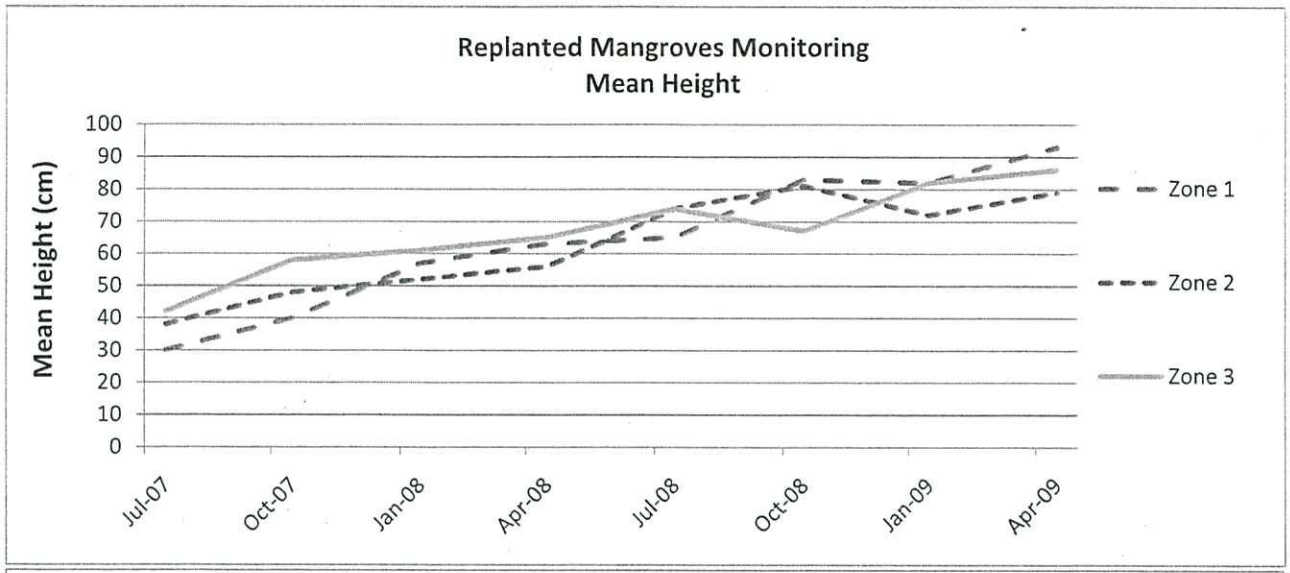

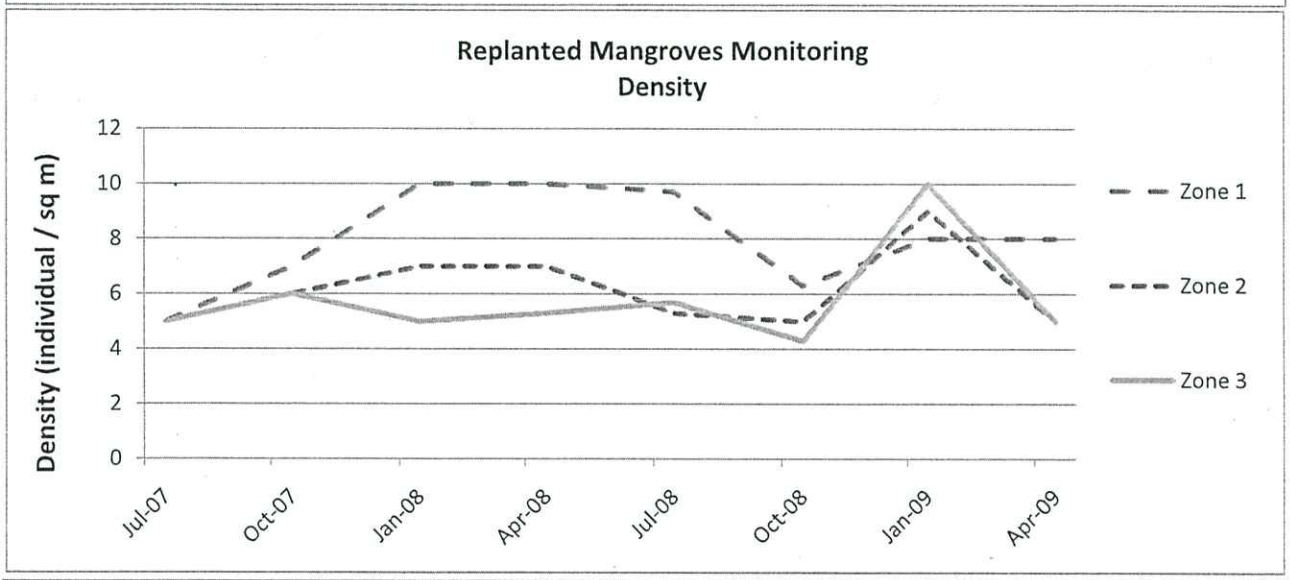

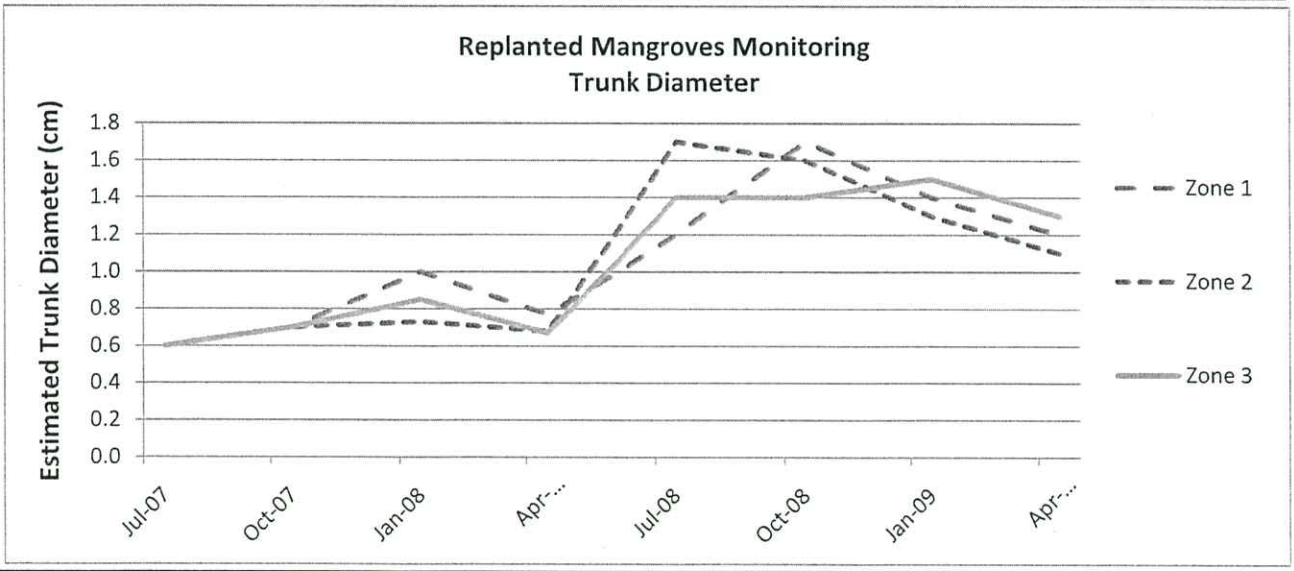

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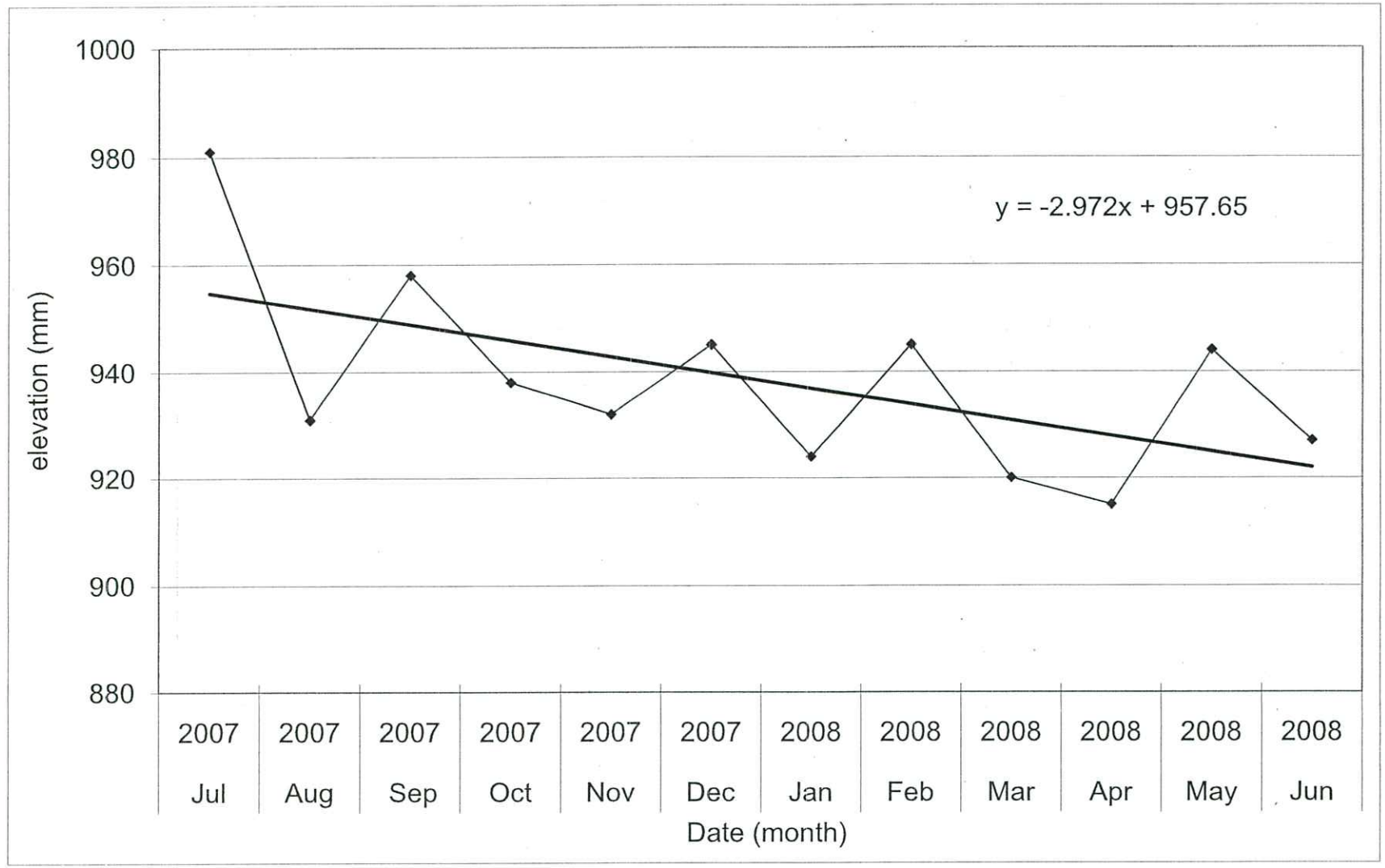
	Operational Disturbance on Intertidal Bird Communities	JOB NO.	60025836	APPENDIX	E
				Rev	-

APPENDIX F
GRAPHICAL PRESENTATIONS OF SEDIMENTATION RATE MONITORING RESULTS



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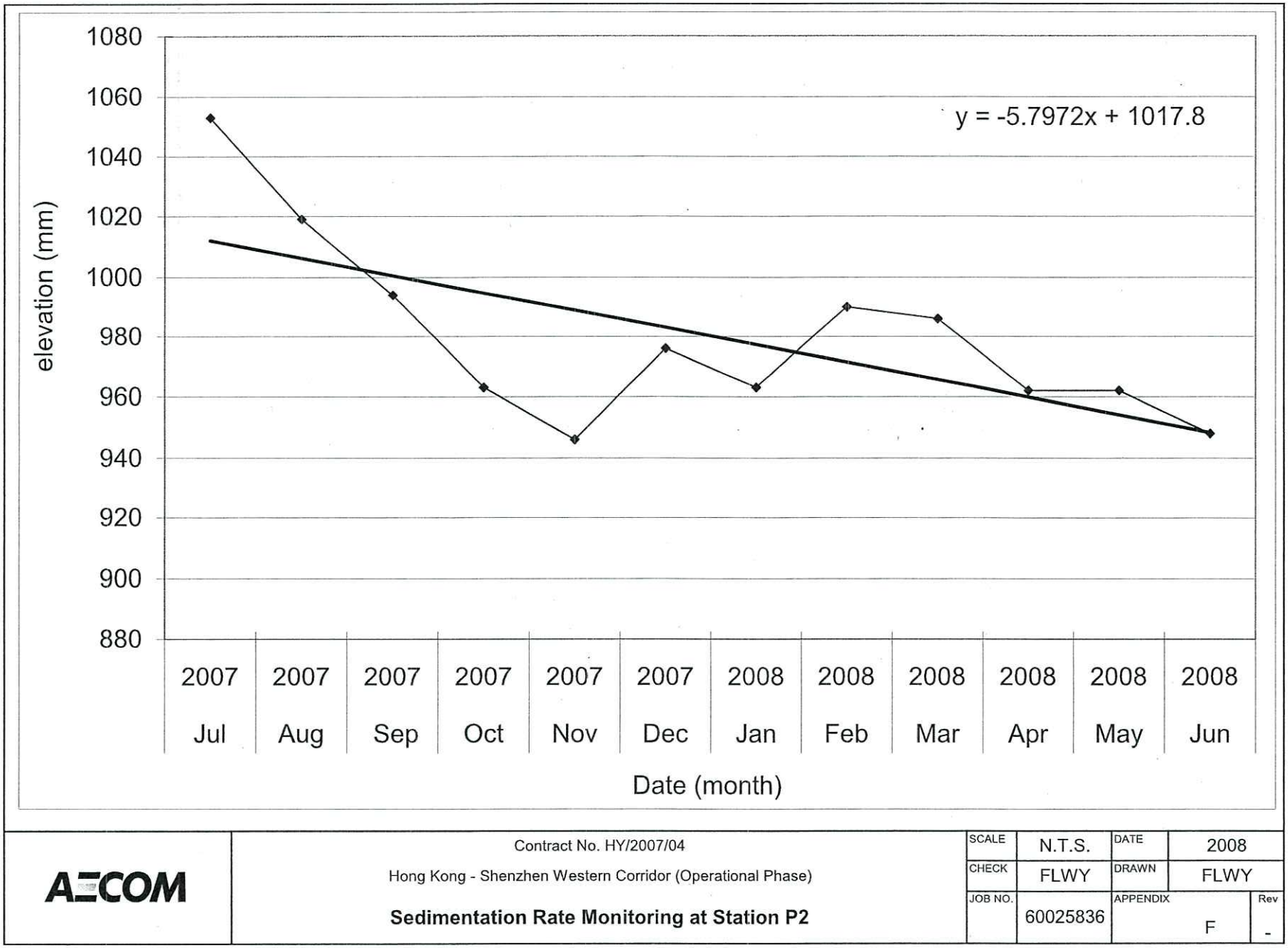
	Sedimentation Rate Monitoring at Station P1	JOB NO.	60025836	APPENDIX F	Rev -



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Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Sedimentation Rate Monitoring at Station P2

SCALE	N.T.S.	DATE	2008
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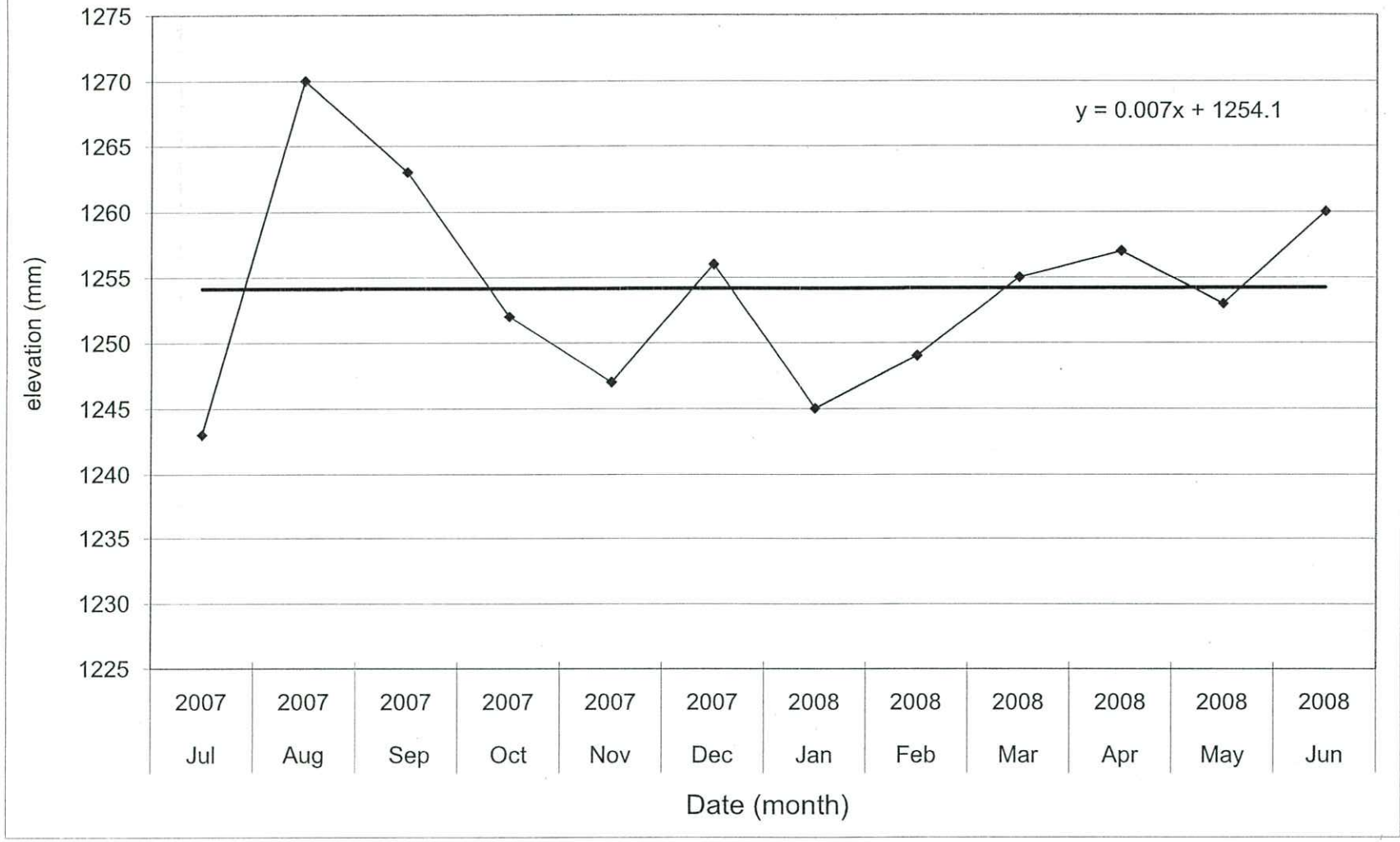
JOB NO.	60025836	APPENDIX	F
		Rev	-



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Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Sedimentation Rate Monitoring at Station P7

SCALE	N.T.S.	DATE	2008
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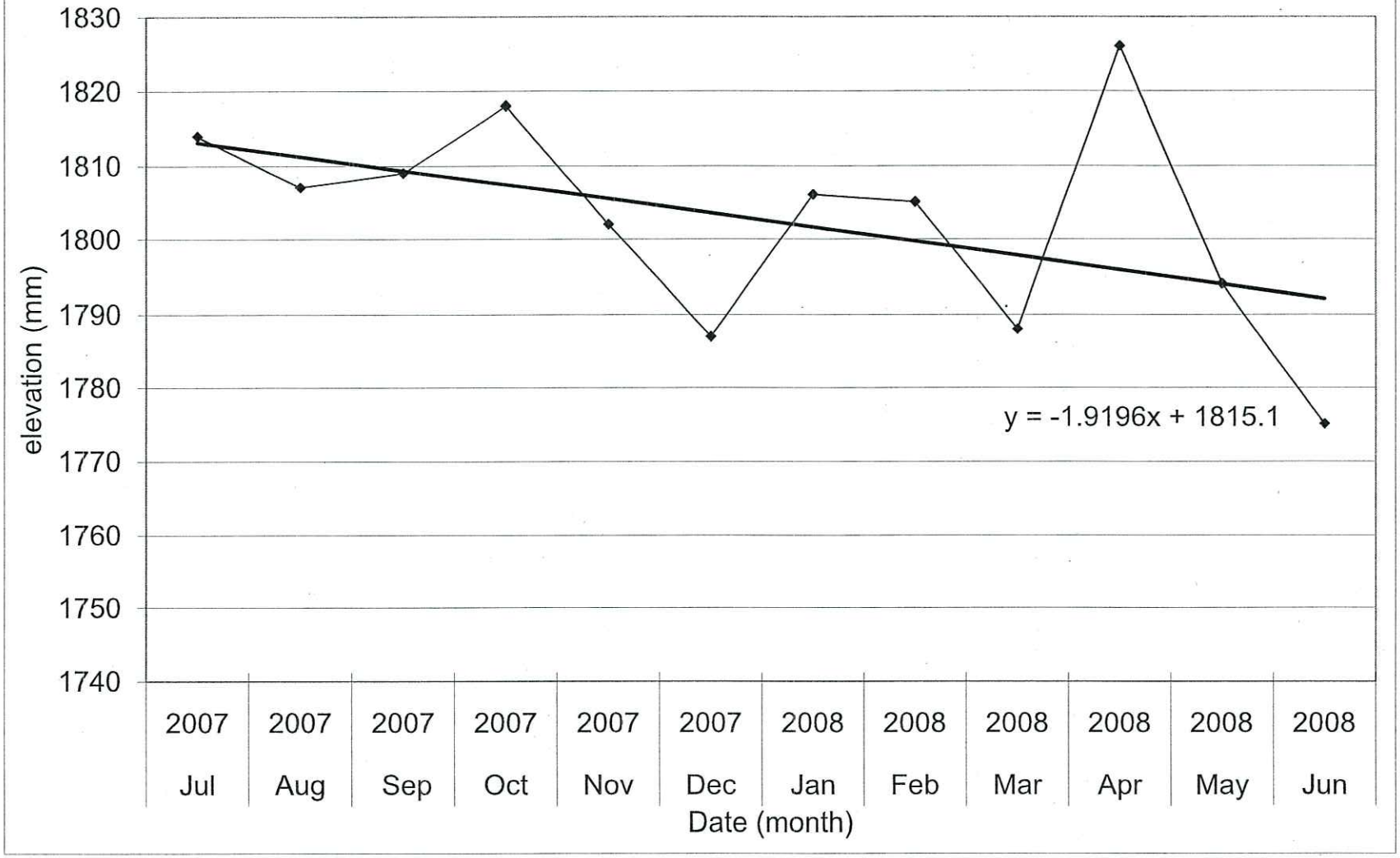
JOB NO.	60025836	APPENDIX	F
		Rev	-



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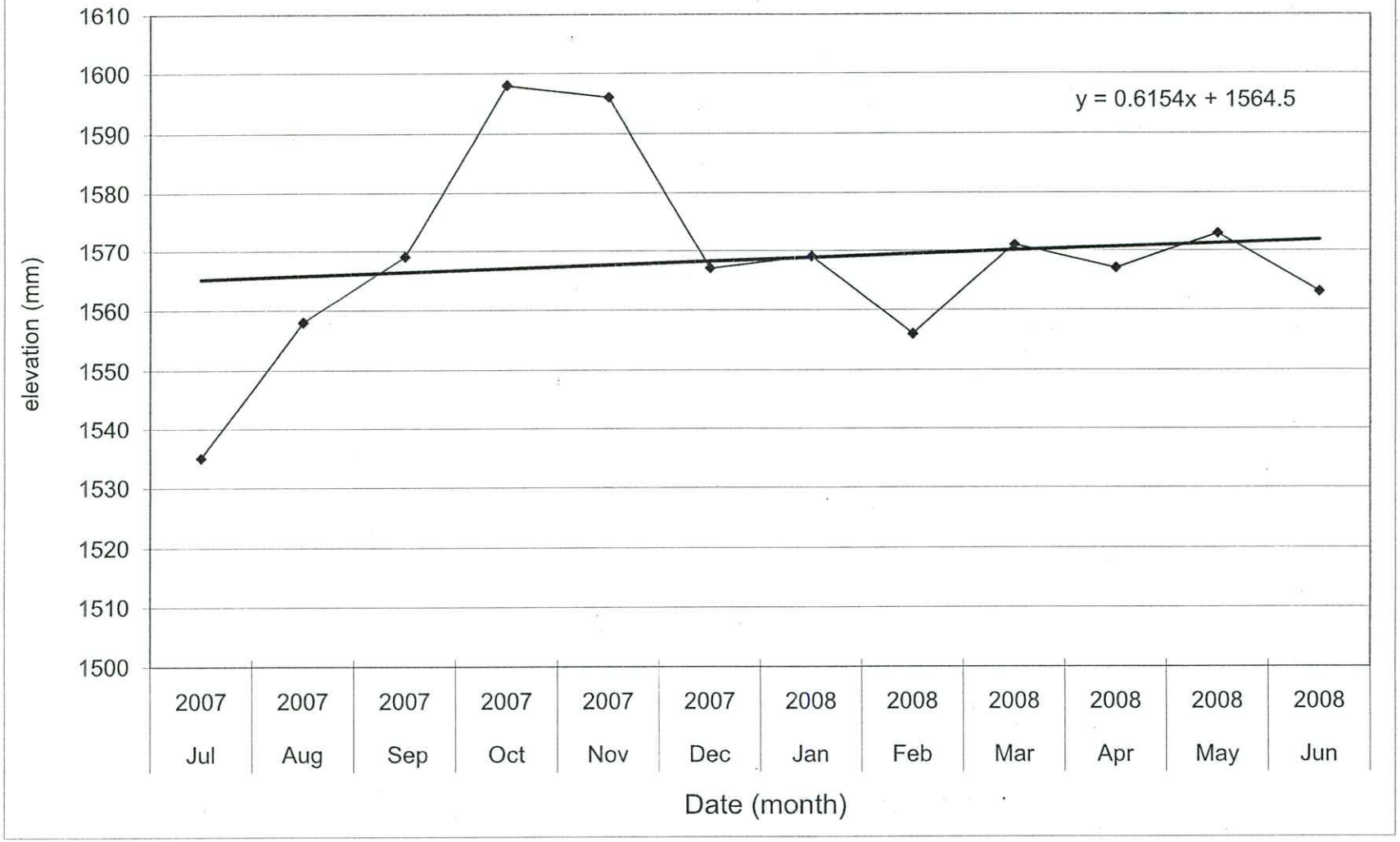
		JOB NO.	60025836	APPENDIX F	Rev -



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Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Sedimentation Rate Monitoring at Station P5

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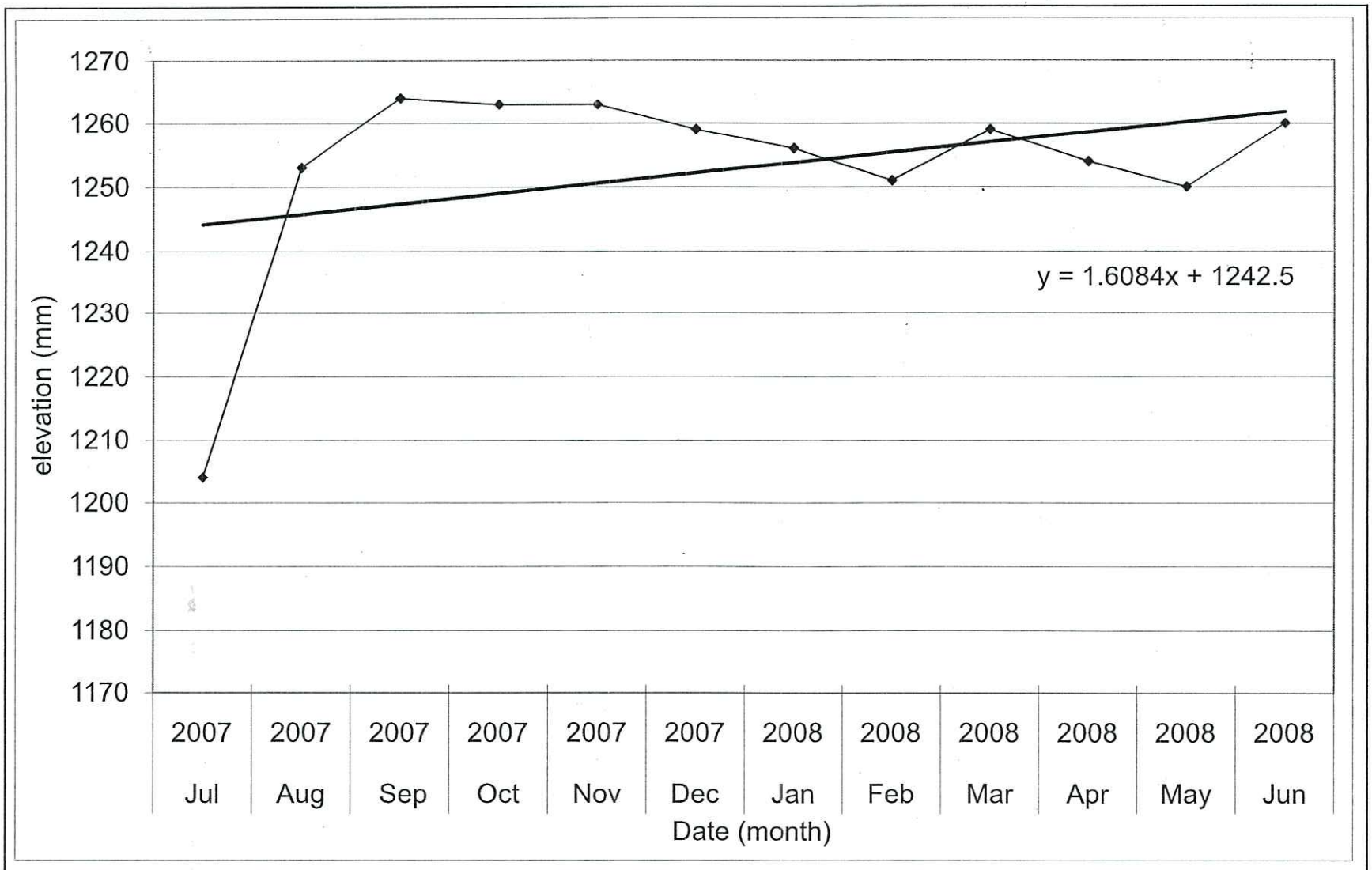
JOB NO.	60025836	APPENDIX	F
		Rev	-



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Contract No. HY/2007/04

Hong Kong - Shenzhen Western Corridor (Operational Phase)

Sedimentation Rate Monitoring at Station P6

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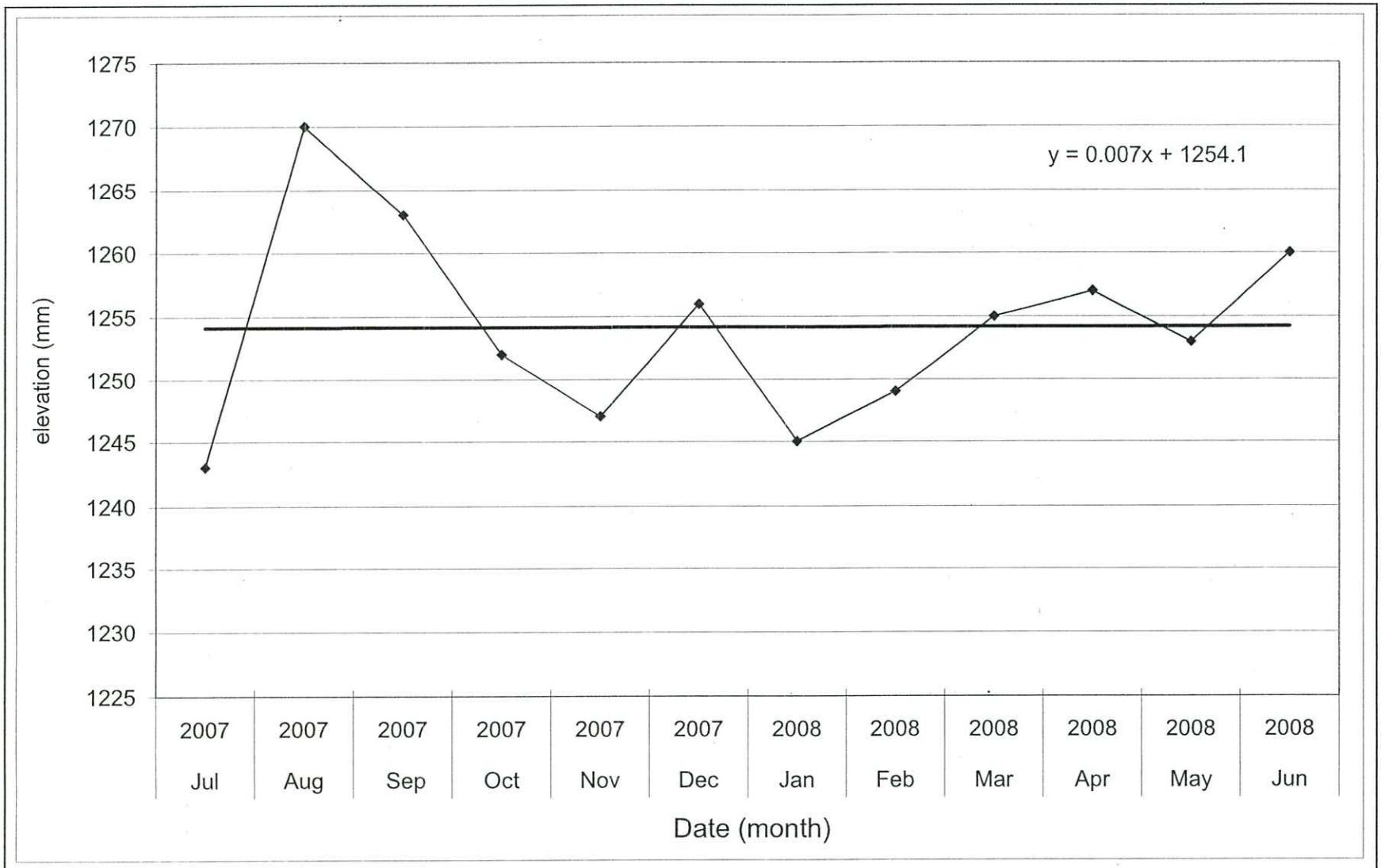
JOB NO.	60025836	APPENDIX	F
		Rev	-



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Hong Kong - Shenzhen Western Corridor (Operational Phase)

Sedimentation Rate Monitoring at Station P7

SCALE	N.T.S.	DATE	2008
CHECK	FLWY	DRAWN	FLWY
JOB NO.	60025836	APPENDIX	F
		Rev	-

APPENDIX G
SUMMARY OF ENVIRONMENTAL MITIGATION IMPLEMENTATION SCHEDULE

Appendix G — Summary of Environmental Mitigation Implementation Schedule

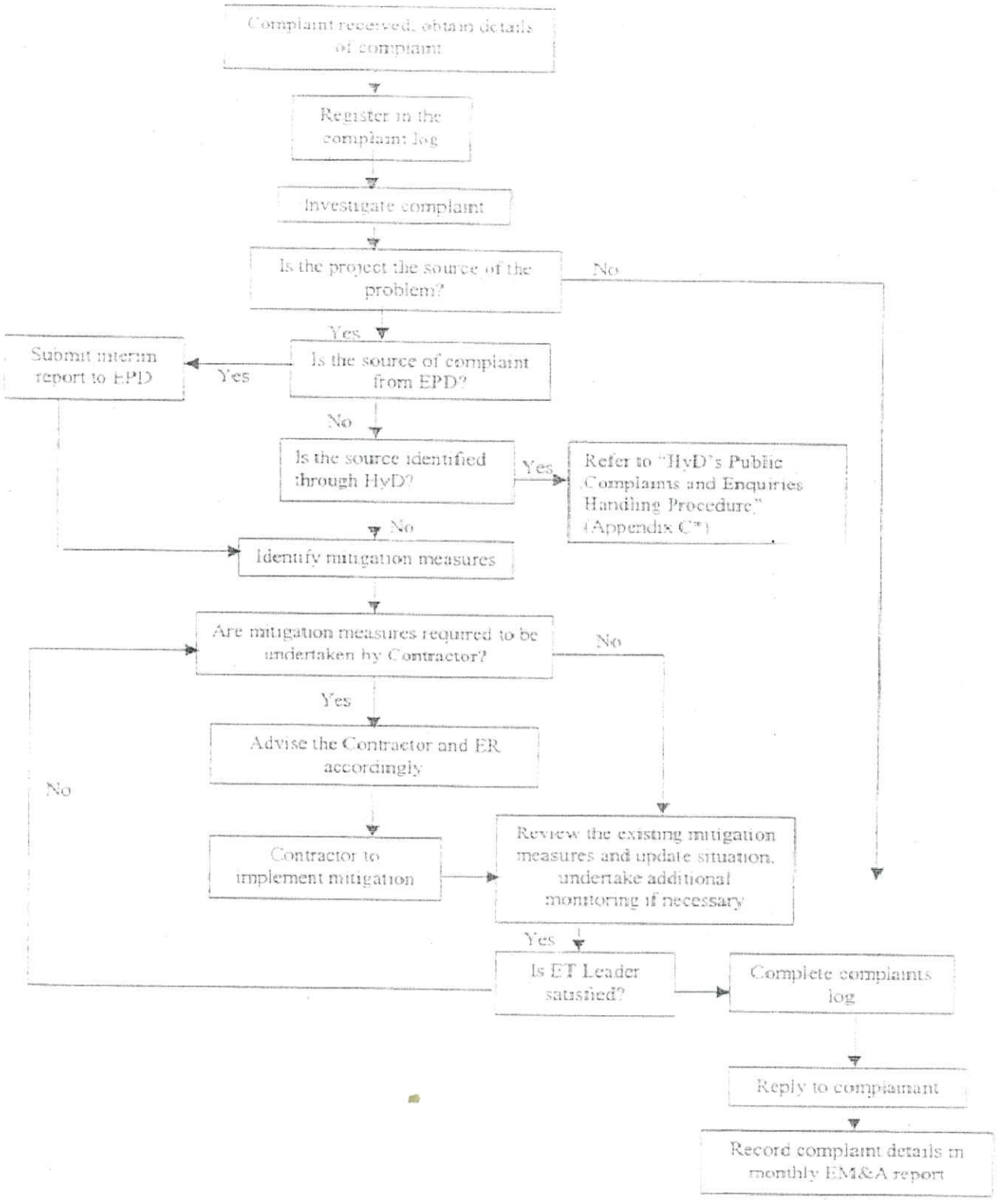
EM&A Manual / EP Reference Section	Types of Impacts	Mitigation Measures	Status
Water Quality			
EM&A Manual S.4.1 – 4.9	Road runoff from SWC Bridge	• Carry out bridge runoff monitoring to confirm the effectiveness of the cleaning frequency to remove vehicle-generated pollutants from the bridge;	√
		• Best management practices should be implemented to reduce the pollutants from the road section to the Deep Bay waters and mudflat	√
		• Standard HyD road gullies with silt traps to collect sediment should be provided on SWC bridge.	√
		• Undertake regular cleaning of road by vacuum air sweeper / suction truck for removal of grits and pollutants twice a week. Each of the cleaning events should not be separated by more than four days. The removed pollutants should be tinkered away for off site disposal at landfill sites.	√
		• An energy dissipater should be installed in the drainage down pipe at the bottom of the pier.	√
EM&A Manual S.4.11.41 – 4.11.42	Accidental Spillage of Chemicals During Accidents	• Emergency response actions should be undertaken by relevant government departments, during general vehicle accidents not involving chemical spillage, to control the spreading of oil spill on the road surface and release of spills into Deep Bay; and clean up the spill.	√
		• Minimise the impacts related to vehicle accidents involving chemicals spillage through: - Implementation of the revised regulations of FSD to minimise the risk of accidents on SWC; - Development of a detailed Emergency Response Plan to enhance the established response actions in order to take due consideration of the need to protect the ecologically sensitive Deep Bay; - Implementation of the detailed Emergency Response Plan with the support from relevant government departments to deal with any spill incident; - Quick response to vehicle accident, which involves chemical spillage, on SWC; - Storage of clean up materials at HKPF's weigh-station near Ha Tsuen Interchange for use in controlling the spreading of spill; and	N/A (no vehicle accident involving chemical spillage was recorded)
Ecology			
EP (EP-162/2003/B) S.6.9 & EM&A Manual S.6.3.2	Operation disturbance on inter-tidal bird communities	• Surveys on the distribution of feeding shorebirds, bird abundance and species richness being carried out at the bridge and the control site at a frequency not less than once per two months.	√

EM&A Manual / EP Reference Section	Types of Impacts	Mitigation Measures	Status
EP (EP-162/2003/B) S.6.7 & EM&A Manual S.6.3.3	Monitoring of bridge lighting and bird collisions	• Monthly survey to be carried out to study a suitable bridge lighting scheme to minimise the probability of bird collision. Records should include the types of illumination used, weather conditions, number of dead birds by species and estimated cause of death.	√
EP (EP-162/2003/B) S.6.10 & EM&A Manual S.6.3.4	Mangrove loss	• Number of mangrove seedlings planted and location of planting should be checked for compliance with the plan determined during the design and construction stage. Compensatory mangrove planting should be monitored quarterly for survival and growth for 2 years.	√
EP (EP-162/2003/B) S.6.2	Sedimentation Rate in Deep Bay	• Monthly monitoring on sedimentation rate in Deep Bay shall be carried out in accordance with the approved Sedimentation Rate Monitoring Plan.	√
Landscape and Visual			
EM&A Manual S.8.2.2		• Woodland tree and shrub planting should be implemented adjacent to the Deep Bay Road where it is at grade.	√
		• Implementation of bio-engineering techniques to the cut slopes.	√
		• Non-invasive Climbing plants should be used to soften the appearance of viaduct columns at ground level.	√
		• Woodland tree and shrub planting should be undertaken at cut slopes so as to compensate for vegetation lost during construction. Any affected slope areas should hydroseeded and planted with woodland species, avoid shotcreting.	√
		• Native shrub planting should be undertaken to screen the proposed works and blend it into the landscape.	√
		• Planting should be incorporated where possible to screen the road and bridge in low level views from adjacent areas and to tone down the extent of hard paving and surfaces and reduce the amount of glare.	√

Note:

√	Compliance of mitigation measure
×	Non-compliance of mitigation measures
@	Non-compliance but rectified by the contractor
N/A	Not applicable

APPENDIX H
COMPLAINT FLOW DIAGRAM AND COMPLAINT LOG



AECOM	Contract No. HY/2007/04	SCALE	N.T.S.	DATE	2007
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	Environmental Complaint Handling Procedure	JOB NO.	60025836	APPENDIX H	Rev -