

APPENDIX C - MONITORING OF CONTAMINATED GROUNDWATER

Introduction

- 1.1 As recommended in the EIA report, prior to any excavation works within the potentially contaminated areas (including the cut and cover tunnel section and ventilation building in Mai Po, the proposed cut-and-cover tunnel section in Shek Kong, the SSS, the works area in Lai Chi Kok, and the ventilation buildings in Kwai Chung and Nam Cheong), the baseline groundwater quality in these areas should be reviewed based on the relevant site investigation data collected at the EIA stage and any additional groundwater quality measurements to be performed with reference to *Guidance Note for Contaminated Land Assessment and Remediation* (Guidance Note). The review results should be submitted to EPD for examination.
- 1.2 If the review results indicated that the groundwater to be generated from the excavation works is contaminated classified under the Guidance Note and would be recharged on-site as proposed in Remediation Action Plan (RAP), groundwater recharge and groundwater monitoring requirements as described in this Appendix should be followed.

Groundwater Recharge

- 1.3 Groundwater recharging wells should be installed for recharging contaminated groundwater back into the ground, if practicable. The recharging wells should be selected at places where the groundwater quality will not be affected by the recharge operation as indicated in section 2.3 of the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM-DSS) .
- 1.4 The baseline groundwater quality within the work sites and the pollutant levels of any contaminated groundwater to be recharged should be determined by groundwater sampling and chemical testings (as outlined in **Sections 1.6 to 1.11**) prior to the selection of the recharge wells. The pollution levels of groundwater to be recharged should not be higher than the baseline pollution levels at the recharge wells. Any free products should be removed prior to the recharge operation.
- 1.5 Groundwater monitoring wells should be installed near the recharge points to monitor the effectiveness of the recharge wells and to ensure no likelihood of increase of groundwater level and transfer of pollutants beyond the site boundary. A control well shall also be selected to monitor the natural variation of the pollution level. Details of the impact monitoring are given in **Sections 1.12 to 1.13**.

Baseline Monitoring Parameters

- 1.6 Chemical testing of groundwater should include the parameters and reporting limits as shown in **Table 1**. Testings for all the parameters should be carried out by a Hong Kong Laboratory Accreditation Scheme (HOKLAS) accredited laboratory and with individual HOKLAS accredited methods.

Table 1 Groundwater Testing Parameters and Reporting Limits

Parameters	TM-Water Effluent Limit for Inshore Waters (mg/L)	Reporting Limit ⁽¹⁾
pH	See Note 2	-
Temperature °C	See Note 2	-
TPH C6 – C9	-	20 – 25
TPH C10 – C14	-	-
TPH C15 – C28	-	-
TPH C29 – C36	-	-
Dioxin (pg/L)	-	10 pg/L
Cd	See Note 2	-
Cr	See Note 2	-
Cu	See Note 2	-
Ni	See Note 2	-

Parameters	TM-Water Effluent Limit for Inshore Waters (mg/L)	Reporting Limit ⁽¹⁾
Pb	See Note 2	-
Zn	See Note 2	-
Hg	See Note 2	-
As	See Note 2	-
Ba	See Note 2	-
Co	-	-
Mo	-	-
Sn	-	-
Total Cyanide (µg/L)	-	-
PAH (µg/L)	-	0.1 – 1 (low molecular weight)
	-	0.02 – 0.1 (high molecular weight)
Benzene (µg/L)	-	1
Ethylbenzene (µg/L)	-	
Toluene (µg/L)	-	
Meta- & Para Xylene (µg/L)	-	
Ortho Xylene (µg/L)	-	

Note:

- (1) According to Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems Inland and Coastal Waters (TM-DSS), the chemicals concentration for TPH, dioxin, BTEX and PAH should be below the Reporting limit. Discharges of PCB, PAHs, petroleum oil, pesticide and toxicant into foul sewers, inland waters and coastal waters are prohibited.
- (2) Effluent limits will be based on the requirements of the TM-DSS which would be subject to effluent flow rates to be determined prior to the groundwater recharge operation.

Groundwater Collection

- 1.7 Groundwater samples at each monitoring well should be collected with PVC bailer (or equivalent). The bailer should be decontaminated prior to use and in between sampling. The groundwater samples should be transferred to clearly labeled and pre-cleaned sample containers with necessary preservatives immediately after collection. Sufficient quantity of samples should be collected for all laboratory analyses. After collection, the groundwater samples should be stored at 0-4 °C and delivered to the laboratory within 24 hours under proper chain-of-custody system.

Baseline Monitoring

- 1.8 Prior to construction, ambient groundwater quality measurements should be conducted. The parameters and the associated reporting limits/TM-Water limits as shown in **Table 1** should be adopted. Groundwater sampling should be conducted daily for 7 days.
- 1.9 The locations of the recharging wells should be determined on the basis that the pollutant levels of groundwater to be recharged should not be higher than the baseline at the recharge well. Monitoring wells should be selected near to the recharge points and at site boundaries. A control well should also be selected within the site.
- 1.10 A monitoring plan should be submitted to EPD for agreement prior to commencement of baseline measurement.
- 1.11 An action level should be developed based on the ambient ground water quality measurements.

Impact Monitoring

- 1.12 During the re-charging of groundwater, the water level at the monitoring wells should be monitored on a daily basis to ensure that the water levels at the site boundary will not increase significantly. The water quality in the monitoring wells and control well should be measured on a week basis to ensure that the pollution level will not increase significantly.
- 1.13 Should the pollutants of the recharging groundwater exceed the baseline value and there are no justifications from the measurements at the control well, the Contractor should treat the pollutants in the recharging groundwater. Appropriate treatment would include chemical precipitation and activated

carbon adsorption.

Event and Action Plan

1.14 The event and action plan is summarized in **Table 2**.

Table 2 Event and Action Plan for Groundwater Recharging

Event	Action			
	ET Leader	IEC	ER	Contractor
Groundwater Level at Recharge Point Exceeds 1m from Baseline	<ol style="list-style-type: none"> 1. Notify IEC and the Contractor. 2. Carry out investigation. 3. Report the results of investigation to IEC and the Contractor. 4. Discuss with the Contractor and formulate remedial measures. 5. Increase monitoring frequency to check mitigation measures. 	<ol style="list-style-type: none"> 1. Review with analysed results submitted by ET. 2. Review the proposed remedial measures by the Contractor and advise ER accordingly. 3. Supervise the implement of remedial measures. 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of exceedance in writing. 2. Notify the Contractor. 3. Require the Contractor to propose remedial measures for the analysed groundwater problem. 4. Ensure remedial measures are properly implemented. 	<ol style="list-style-type: none"> 1. Reduce the recharge rate and/or 2. Suspend the recharge until the groundwater level at recharge points falls back to less than 1m difference with the baseline
Pollution Level of Recharging Groundwater Exceed the Baseline Level / the Pollution Levels at the Monitoring Well	<ol style="list-style-type: none"> 1. Notify IEC and the Contractor. 2. Carry out investigation. 3. Report the results of investigation to IEC and the Contractor. 4. Discuss with the Contractor and formulate remedial measures. 5. Increase monitoring frequency to check mitigation measures. 	<ol style="list-style-type: none"> 1. Review with analysed results submitted by ET. 2. Review the proposed remedial measures by the Contractor and advise ER accordingly. 3. Supervise the implement of remedial measures. 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of exceedance in writing. 2. Notify the Contractor. 3. Require the Contractor to propose remedial measures for the analysed groundwater problem. 4. Ensure remedial measures are properly implemented. 	<ol style="list-style-type: none"> 1. Reduce the recharge rate and/or 2. Suspend the recharge until the groundwater level at recharge points falls back to less than 1m difference with the baseline