5. SEDIMENT CONTAMINATION

5.1 Background

5.1.1.1 The SEKD reclamation is to be carried out in phases. **Table 5.1** shows the approximate areas of the reclamation zones. The locations of the reclamation zones are shown in **Drawing No. 22936/EN/020**.

Table 5.1 Reclamation Zones

Reclamation	Zoning	Sub-zone	Area (m^2)
Hoi Sham (Kowloon Bay)	1		
Earth Bund		Zone 1B	22,500
Phase 1		Zones 1D and 1E	258,250
Phase 2		Zones 1A and 1C	329,950
Kai Tak Approach Channel	2		
Upper Section		Zone 2A	166350
Lower Section		Zone 2B	87,750
Kwun Tong Typhoon Shelter	3		
Main Portion		Zone 3A	295,100
Seafront Portion		Zone 3B	98,800
Cha Kwo Ling	4	-	13,300

5.1.1.2 The water quality in the KTAC, KTTS and Hoi Sham has been heavily polluted by sewage discharges and discharges from polluting industries in the past. A large amount of sediments has been deposited on the bottom of these areas. These sediments contain high concentrations of organic matter and heavy metals.

5.1.1.3 The sediments in these areas would either be left in place or dredged away when carrying out the reclamation. In case where the sediments have to be dredged and disposed of, identification of quality and quantity of the sediments is required in order to determine a suitable disposal option. The sediment volume to be dredged and disposed of should be minimized in accordance with EPD's policy.

5.1.1.4 Alternatively, if the sediments were to be left in place, marine sand and/or public fill material used for reclamation will cover the sediments. Under anaerobic conditions, biogas may be generated underneath the future reclaimed land. Biogas mainly composes of methane and carbon dioxide. There is a potential risk of methane to the SEKD. Estimation of biogas generation from the reclaimed land is required to assess the potential methane hazards.

5.1.1.5 The following sections present assessment of sediment chemical quality in the KTAC, KTTS and Hoi Sham. Relevant guidelines were used to classify the sediments. Different reclamation options and sediment treatment methods were proposed. In addition, potential biogas generation from the proposed reclamation was assessed. The estimated biogas emission rates were also compared with the maximum safe rate of gas emission to evaluate the potential hazards.

5.2 Legislation, Policies, Plans, Standards and Criteria

5.2.1.1 Relevant legislation and guidelines for disposal of contaminated material at marine disposal sites are listed as below:

- *Dumping at Sea Ordinance* (Cap. 466);
- *Technical Circular No. (TC) No.1-1-92, Classification of Dredged Sediments for Marine Disposal;*

- *Works Branch Technical Circular No. 22/92*, (WBTC No. 22/92) *Marine Disposal of Dredged Mud;*
- *Works Bureau Technical Circular No. 3/2000*, (WBTC No. 3/2000) *Management of Dredged/Excavated Sediment; and*
- *Works Bureau Technical Circular No. 12/2000*, (WBTC No. 12/2000) *Fill Management.*

5.2.1.2 The Dumping at Sea Ordinance is the major statutory legislation to control dumping of sediments at sea. This safeguards the water quality and ecology of the Hong Kong waters. The WBTC No. 22/92 and WBTC No. 3/2000 set out the management framework for dredged/excavated sediment disposal. For projects, which will commence before 31 December 2001, the WBTC No. 22/92 should be followed. Classification of dredged sediments is presented in TC No. 1-1-92. Project proponents may also follow the new management framework (WBTC No. 3/2000). The projects, which will commence on or after 1 January 2002, should follow the WBTC No. 3/2000. As the commencement of the SEKD is likely to be after 1 January 2002, the reclamation needs to follow the WBTC No. 3/2000.

5.2.1.3 According to the EPD's TC No. 1-1-92, sediments are classified according to their levels of contamination by toxic metals. The classification comprises of three levels and is defined as Class A, Class B or Class C sediment.

5.2.1.4 The WBTC No. 3/2000 provides guidelines for the classification of sediment based on their contaminant levels with reference to the Chemical Exceedance Levels. Sediment quality criteria for sediment classification include metals (cadmium, chromium, copper, mercury, nickel, lead, silver and zinc); metalloid (arsenic); and organic micro-pollutants (PAHs, PCBs and TBT). Based on the sediment quality criteria, the sediment is defined as Category L material (low contaminant levels), Category M material (medium contaminant levels) or Category H material (high contaminant levels).

5.2.1.5 WBTC No. 3/2000 stipulates a three-tier screening for sediment assessment. Tier I screening is a desk top study of available data. The data will be used to determine whether the sediment is Category L material and is suitable for open sea disposal. If decision cannot be made as a result of insufficient information, Tier II screening, which categories the sediment based on testing the chemical contaminant levels, is required. Tier II screening determines the suitability of open sea disposal for the sediment and decides whether further testing is required. Tier III screening should be conducted to identify the most suitable disposal option for Category M material and certain Category H material identified in Tier II screening.

5.2.1.6 The WBTC No. 12/2000 defines the responsibilities of the Marine Fill Committee (MFC) and the Public Fill Committee (PFC). The circular sets out the terms of reference and membership of the two committees and provides explanation on the management of fill resources, construction and demolition material, and dredged/excavated sediment disposal.

5.2.1.7 With regard to the biogas assessment, there is no legislation in Hong Kong covering hazards to the development caused by landfill gas or methane gas generated from anthropogenic organic deposits. The Landfill Gas Hazard Assessment Guidance Note issued by EPD can be used as reference for assessment of the generation of methane gas. The guidance note recommends that methane gas should be monitored periodically in all excavations, manholes and chambers and any confined spaces during construction.

5.2.1.8 The Waste Management Paper No. 26A on Landfill Completion issued by the UK Department of the Environment provided reference for methane emission rates from monitoring boreholes. A safe methane emission rate for borehole monitoring was recommended in the paper. A maximum safe rate of gas emission (10 $L/m^2/d$)[1] was derived in the Green Island Development

[1] Based on the Green Island Development Study, the maximum safe rate of methane ingress was defined as that at which it would take 1 day for the methane concentration to reach 1%. The height of void space and rate of natural ventilation were assumed to be

Study with reference to the Waste Management Paper No. 26A. This maximum safe rate of gas emission, however, was not derived from borehole monitoring targets. Use of this maximum safe rate of gas emission was accepted by EPD for assessment of potential methane hazards from reclamation sites. This value is adopted as the assessment criteria in the present study.

5.3 Description of the Environment

5.3.1 *Sediment Quality in the WCZs*

5.3.1.1 There are five sediment sampling stations (VS3, VS5, VS6, VS9 and VS10) in the Victoria Harbour WCZ. The Western Buffer WCZ covers two sediment monitoring stations (WS1 and WS2) and the Eastern Buffer WCZ covers three sediment monitoring stations (ES1, ES2 and ES4). EPD adopts the sampling method of taking grab samples of the top 10cm layer of sediment for sediment metal analysis.

5.3.1.2 The average copper concentrations between 1995-1999 in the Victoria Harbour WCZ were shown to be high in all the sediment sampling stations. Station VS3 is closest to the SEKD, average levels of cadmium, chromium, lead, mercury, nickel and zinc were low (in the Class A category). However, the levels of copper were consistently high, with an average of over 65mg/kg or within Class C category.

5.3.1.3 Elevated levels of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) were detected in the central and western parts of Victoria Harbour. At station VS6, average PCB and PAH concentrations were over 20μg/kg dry solids and 200μg/kg dry solids respectively (*Marine Water Quality in Hong Kong in 1999)*. **Drawing Nos. 22936/EN/017** to **019** present the copper, PAH, and PCB levels recorded at EPD's sediment sampling stations within the Victoria Harbour WCZ.

5.3.1.4 In 1999, the levels of cadmium, chromium, lead, mercury, nickel and zinc recorded at the two sampling stations (WS1 and WS2) within the Western Buffer WCZ were low (in the Class A category). The copper levels at both WS1 and WS2 were in the Class B category (between 55 and 64 mg/kg dry weight).

5.3.1.5 In the Eastern Buffer WCZ, the copper levels at ES4 located near Chai Wan were the highest (in the Class C category) in 1999. At ES1, the copper levels were comparatively lower but still classified in the Class B category. Besides, the other heavy metal contents in the sediments collected at the three sampling stations in the Eastern Buffer WCZ were low (in the Class A category).

5.3.2 *Sediment Quality in Typhoon Shelters*

5.3.2.1 The SEKD reclamation will have direct impacts on the existing KTTS and To Kwa Wan Typhoon Shelter (TKWTS). The sediment samples collected in KTTS (VS14) by EPD showed high levels of heavy metals including cadmium, chromium, copper, lead, mercury, nickel and zinc. This was related to the uncontrolled effluent discharges from polluting industries in the past.

5.3.2.2 Sediment collected in TKWTS (VS20) contained high levels (in the Class C Category) of chromium, copper, lead, mercury and zinc. Chromium levels, in particular, were consistently high in the past years, with concentrations of 80mg/kg dry solids and above.

1 m and 1 air change per day respectively. Therefore, the maximum safe rate of gas emission was calculated as 1.0 m x 0.01 /day (equivalent to m^3 CH_4 / m^2/day) = 10 L/m^2/d.