6 WASTE MANAGEMENT

6.1 Introduction

6.1.1 This section identifies the types of solid wastes that are likely to be generated during the construction and operation phases of the Project and evaluates the potential environmental impacts that may result from these wastes. The main solid waste issues would be related to dredged marine sediment and construction and demolition (C&D) material generated from demolition and excavation works. Mitigation measures and good site practices, including measures for waste handling, storage and disposal, are recommended with reference to the applicable waste legislation and guidelines. Since the reclamation would be fully dredged, the investigation of 'potential biogas problem' stated in the EIA Study Brief is not necessary.

6.2 Environmental Legislation, Policies, Plans, Standards and Criteria

6.2.1 The criteria and guidelines for assessing waste management implications are set out in Annex 7 and Annex 15 of the Technical Memorandum on Environmental Impact Assessment Ordinance (EIAO-TM), respectively.

6.2.2 The following legislation relates to the handling, treatment and disposal of wastes in the Hong Kong SAR and has been used in assessing potential impacts:

- Waste Disposal Ordinance (Cap. 354)
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354)
- Land (Miscellaneous Provisions) Ordinance (Cap. 28)
- Public Health and Municipal Services Ordinance (Cap. 132) - Public Cleansing and Prevention of Nuisances Regulation

Waste Management

6.2.3 The Waste Disposal Ordinance (WDO) prohibits the unauthorised disposal of wastes. Construction waste is defined as any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. Under the WDO, wastes can be disposed of only at designated waste disposal facilities.

6.2.4 Under the WDO, the Chemical Waste (General) Regulation 1992 provides regulations for chemical waste control, and administers the possession, storage, collection, transport and disposal of chemical wastes. The Environmental Protection Department (EPD) has also issued a guideline document, the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (1992), which details how the Contractor should comply with the regulations on chemical wastes.

6.2.5 The Public Cleansing and Prevention of Nuisances Regulation provides control on illegal tipping of wastes on unauthorised (unlicensed) sites.

Dredged Marine Sediment

6.2.6 The ETWB TCW No. 34/2002 sets out the procedure for seeking approval to dredge / excavate sediment and the management framework for marine disposal of dredged / excavated sediment. This Technical Circular outlines the requirements to be followed in assessing and classifying the sediment and explains the marine disposal arrangement for the classified material. The sediment quality criteria for the classification of sediment are presented in **Table 6.1**.

6.2.7 Dumping permits from EPD are required for marine disposal of dredged materials.

Chemical Waste

6.2.8 Under the Waste Disposal (Chemical Waste) (General) Regulations, all producers of chemical waste must register with EPD and treat their wastes, either utilising on-site plant licensed by EPD, or arranging for a licensed collector to transport the wastes to a licensed facility. The regulation also prescribes the storage facilities to be provided on site, including labelling and warning signs, and requires the preparation of written procedures and training to deal with emergencies such as spillages, leakages or accidents arising from the storage of chemical wastes.

Construction and Demolition (C&D) Materials

6.2.9 The current policy related to the disposal of C&D material is documented in the Works Branch Technical Circular No. 2/93, 'Public Dumps'. Construction and demolition materials that are wholly inert, namely public fill, should not be disposed of to landfill, but taken to public filling areas, which usually form part of reclamation schemes. The Land (Miscellaneous Provisions) Ordinance requires that dumping licences be obtained by individuals or companies who deliver public fill to public filling areas. The Civil Engineering & Development Department (CEDD) issues the licences under delegated powers from the Director of Lands.

6.2.10 Under the Waste Disposal (Charges for Disposal of Construction Waste) Regulation, enacted in January 2006, construction waste delivered to a landfill for disposal must not contain more than 50% by weight of inert material. Construction waste delivered to a sorting facility for disposal must contain more than 50% by weight of inert material, and construction waste delivered to a public fill reception facility for disposal must consist entirely of inert material.

6.2.11 Measures have been introduced under Environment, Transport and Works Bureau (ETWB) TCW No. 33/2002, "Management of Construction and Demolition Material Including Rock" to enhance the management of construction and demolition material, and to minimize its generation at source. The enhancement measures include: (i) drawing up a Construction and Demolition Material Management Plan (C&DMMP) at the feasibility study or preliminary design stage to minimize C&D material generation and encourage proper management of such material; (ii) vetting of the C&DMMP prior to upgrading of the project to Category A in the Public Works Programme; and (iii) providing the contractor with information from the C&DMMP in order to facilitate him in the preparation of the Waste Management Plan (WMP) and to minimize C&D material generation during construction. Projects generating C&D material less than 50,000m^3 or importing fill material less than 50,000m^3 are exempt from the C&DMMP. The new ETWB TCW No. 19/2005 "Environmental Management on Construction Sites" includes procedures on waste management requiring contractors to reduce the C&D material to be disposed of during the course of construction. Under ETWB TCW No. 19/2005, the Contractor is required to prepare and implement an Environmental Management Plan (EMP) and the WMP becomes part of the EMP.

6.3 Assessment Methodology

General

6.3.1 The criteria for assessing waste management implications are outlined in Annex 7 of the EIAO-TM. The methods for assessing potential waste management impacts during the construction phase follow those presented in Annex 15 of the EIAO-TM and include the following:

- Estimation of the types and quantities of the wastes generated.
- Assessment of potential impacts from the management of solid waste with respect to potential hazards, air and odour emissions, noise, wastewater discharge and transport.
- Assessment of impacts on the capacity of waste collection, transfer and disposal facilities.

Dredged Marine Sediment

6.3.2 The Phase I marine site investigation works of WDII commenced on 25 August 2006 and were completed on 14 September 2006 and included laboratory testing of contaminants to determine the level of contamination in the marine sediments at the proposed reclamation. The works included vibrocoring in the HKCEC sea channel, the Causeway Bay typhoon shelter, North Point waterfront and the proposed temporary typhoon shelter to obtain sediment samples for chemical testing (**Figure 6.1**). The Phase II marine site investigation works commenced on 27 September 2006 and were completed on 10 October 2006 and included sampling locations to the west and east of the HKCEC and in the Wanchai Public Cargo Working Area (PCWA) basin (**Figure 6.1**). Permission to sample in the WSD prohibition zone and MTR protection zone in the area to the west of HKCEC was not obtained from WSD and MTRC for the Phase II marine site investigation. In addition, MTRC advised that anchoring is not permitted within 20m of their protection zone and hence it was not possible to carry out sampling at the proposed locations.

Chemical Testing

6.3.3 Each sub-sample recovered from the Phase I and II vibrocoring was tested in the laboratory for the following parameters:

(i) Metal and metalloid concentrations including chromium (Cr), copper (Cu), mercury (Hg), lead (Pb), cadmium (Cd), nickel (Ni), zinc (Zn), silver (Ag) and arsenic (As)
(ii) Concentrations of organic compounds including total polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs)

6.3.4 Grab samples collected from the vibrocoring locations were tested for tributyltin (TBT) in interstitial water. Grab samples were used in view of the difficulty to extract sufficient interstitial water for the TBT analysis in the vibrocore samples to achieve the required detection limit, as was encountered in the EIA study for Wan Chai Development Phase II Comprehensive Feasibility Study.[1]

[1] All testing results of TBT in interstitial water were below the reporting limit of 0.015 µg/L. The practical limitation of being unable to carry out the TBT interstitial water test is therefore not considered to have any significant effect.

6.3.5 Elutriate tests were conducted to assess the likelihood of release of contaminants from sediment to the water, when the seabed is disturbed during dredging. If the contaminant levels are higher in the elutriates in comparison with the sample of marine water from the same site, it can be concluded that the contaminants are likely to be released into the open waters during dredging activities. The potential water quality impacts associated with the dredging of sediment are discussed in Section 5 of this Report.

6.3.6 Under the management and classification system, dredged sediments destined for marine disposal are classified according to their level of contamination by 13 contaminants (**Table 6.1**).

Table 6.1 Sediment Quality Criteria for the Classification of Sediment

Contaminants	**LCEL**	**UCEL**
Heavy Metal (mg/kg dry weight)		
Cadmium (Cd)	1.5	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.5	1
Nickel (Ni)	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (mg/kg dry weight)		
Arsenic	12	42
Organic-PAHs (µg/kg dry weight)		
PAHs (Low Molecular Weight)	550	3160
PAHs (High Molecular Weight)	1700	9600
Organic-non-PAHs (µg/kg dry weight)		
Total PCBs	23	180
Organometallics (µg-TBT L^{-1} in interstitial water)		
Tributyltin	0.15	0.15

Source: Appendix A of ETWB TCW No. 34/2002 Management of Dredged / Excavated Sediment
Note: LCEL – Lower Chemical Exceedance Level
UCEL – Upper Chemical Exceedance Level

6.3.7 Sediments are categorised with reference to the LCEL and UCEL, as follows:

Category L — Sediment with all contaminant levels not exceeding the LCEL. The material must be dredged, transported and disposed of in a manner that minimises the loss of contaminants either into solution or by suspension.

Category M — Sediment with any one or more contaminant levels exceeding the LCEL and none exceeding the UCEL. The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment.

Category H — Sediment with any one or more contaminant levels exceeding the UCEL. The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.

6.3.8 In the case of Category M and Category H contamination, the final determination of appropriate disposal options, routing and the allocation of a permit to dispose of material at a designated site will be made by EPD and the Marine Fill Committee (MFC) in accordance with the ETWB TCW No. 34/2002.

Biological Testing

6.3.9 For Category M sediment, Tier III biological screening was carried out to determine the appropriate disposal methods in accordance with the requirements of ETWB TCW No. 34/2002:

(i) a 10-day burrowing amphipod toxicity test

(ii) a 20-day burrowing polychaete toxicity test

(iii) a 48-96 hour larvae (bivalve) toxicity test.

6.3.10 Sediment classified as Category H with one or more contaminant levels exceeding 10 times the LCEL were also subjected to the above three biological tests but in a diluted manner (dilution test).

6.3.11 The species used for each type of biological test and the test conditions are listed in **Table 6.2** below.

Table 6.2 Test Species for Biological Testing

Test Types	Species	Reference Test Conditions*
10-day burrowing amphipod toxicity test	*Leptocheirus plumulosus*	U.S.EPA (1994)
20-day burrowing polychaete toxicity test	*Neanthes arenaceodentata*	PSEP (1995)
48-96 hour bivalve larvae toxicity test	*Mytilus spp.* or *Crassostrea gigas*	PSEP (1995)

Notes:*

(i) U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.

(ii) PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.

6.3.12 Sediment samples were characterized by the testing laboratory for ancillary testing parameters such as porewater salinity, ammonia, TOC, grain size and moisture content. This provided necessary information on the general characteristics of the sediment. The test endpoints and decision criteria are summarized in **Table 6.3**. The sediment was deemed to have failed the biological testing if it failed in any one of the three toxicity tests.

Table 6.3 Test Endpoints and Decision Criteria for Biological Testing

Toxicity test	Endpoints measured	Failure criteria
10-day amphipod	Survival	Mean survival in test sediment is significantly different ($p \leq 0.05$)[1] from mean survival in reference sediment **and** mean survival in test sediment < 80% of mean survival in reference sediment.
20-day polychaete	Dry Weight[2]	Mean dry weight in test sediment is significantly different ($p \leq 0.05$)[1] from mean dry weight in reference sediment **and** mean dry weight in test sediment < 90% of mean dry weight in reference sediment.
48-96 hour bivalve larvae	Normality Survival[3]	Mean normality survival in test sediment is significantly different ($p \leq 0.05$)[1] from mean normality survival in reference sediment **and** mean normality survival in test sediment < 80% of mean normality survival in reference sediment.

[1] Statistically significant differences should be determined using appropriate two-sample comparisons (e.g., *t-tests*) at a probability of $p \leq 0.05$.

[2] Dry weight means total dry weight after deducting dead and missing worms.

[3] Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

6.4 Baseline Conditions

Existing Sediment Characteristics

6.4.1 The results of the marine sediment quality analysis from the Phase I and Phase II marine site investigation works, as compared with the sediment quality criteria for the classification of sediment, are presented in **Appendix 6.1**. All testing results of TBT in interstitial water were below the reporting limit of 0.015 μg/L. The practical limitation of being unable to carry out the TBT interstitial water test is therefore not considered to have any significant effect.

6.4.2 The sediment testing results indicate that Category H sediment was found at the HKCEC sea channel and to the immediate west of the sea channel. At grab sample V06-7, the reported contaminant level of Ag exceeded the LCEL by 10 times.

6.4.3 Along the Wan Chai waterfront, the sediment testing results indicate that Category H sediment was found at all eight vibrocoring locations. At vibrocores V06-14 and V06-17, Category H sediment with contaminant levels exceeding the LCEL by 10 times was reported for Ag. Category M sediment was found at V06-13B.

6.4.4 At the PCWA basin, Category H sediment was found at the two vibrocores. At V06-19, Category H sediment with contaminant levels exceeding the LCEL by 10 times was reported for Ag. At V06-18A, Category M sediment was reported for Hg.

6.4.5 At the Causeway Bay typhoon shelter, the sediment testing results indicate that Category H sediment was found at all but two of the fourteen vibrocoring locations due to high contaminant levels of Cu, Pb, Zn, Hg and Ag that exceeded the UCEL of these five metals. Category L sediment was found at V06-31 and Category L and M sediment was found at V06-32. At vibrocores V06-20, V06-21, V06-22, V06-26, V06-30B, V06-33 and V06-34A, Category H sediment with contaminant levels exceeding the LCEL by 10 times was reported for Ag, Total PCB and Hg.

6.4.6 Along the North Point waterfront, Category H sediment was found at vibrocores V06-35 to V06-37, Category L sediment was found at V06-38 and V06-39, and Category L and M sediment was found at V06-40.

6.4.7 At the proposed temporary typhoon shelter, the sediment testing results indicate that Category H sediment was found at all but three of the eight vibrocoring locations due to high contaminant levels of Cu, Hg and Ag. At V06-44, Category H sediment with the contaminant level of Hg exceeding the LCEL by 10 times was reported. Category L and M sediment was found at V06-41, V06-42 and V06-46.

6.4.8 Tier III biological screening was conducted for the Category M sediment samples (found at V06-13B, V06-18A, V06-19B, V06-21, V06-23A, V06-24, V06-25A, V06-27, V06-29, V06-30, V06-32, V06-34A, V06-35, V06-36, V06-37A, V06-40A, V06-41, V06-42 and V06-44), and the Category H sediment samples with the reported contaminant levels exceeding the LCEL by 10 times i.e. >10xLCEL, as described above. The results of the biological screening are summarized in **Table 6.4** below.

Table 6.4 Results of Biological Screening of Category M and Category H (>10xLCEL) Samples

Vibrocore No. / Depth	Location	Amphipod Test	Polychaete Test	Bivalve Test	Result of Biological Screening	Classification
V06-7 grab	HKCEC sea channel	√	√	√	Pass	Category H
V06-20 0-0.9m	Typhoon shelter	X	√	X	Fail	**Category H****
V06-21 0-0.9m	Typhoon shelter	X	√	X	Fail	**Category H****
V06-21 1.9-2.9m	Typhoon shelter	√	√	√	Pass	Category M
V06-22 0-9-1.9m	Typhoon shelter	X	√	X	Fail	**Category H****
V06-22 1.9-2.9m	Typhoon shelter	X	√	X	Fail	**Category H****
V06-23a 0.9-1.9m	Typhoon shelter	X	X	X	Fail	Category M
V06-24 9-10m	Typhoon shelter	√	√	√	Pass	Category M
V06-25A 1.9-2.9m	Typhoon shelter	X	X	X	Fail	Category M
V06-26 0-0.9m	Typhoon shelter	X	√	X	Fail	**Category H****
V06-27 1.9-2.9m	Typhoon shelter	√	√	√	Pass	Category M
V06-29 3-4m	Typhoon shelter	√	√	√	Pass	Category M
V06-30B 0.9-1.9m	Typhoon shelter	X	√	√	Fail	**Category H****
V06-30 3-4m	Typhoon shelter	√	X	√	Fail	Category M
V06-32 0.9-1.9m	Typhoon shelter	√	X	X	Fail	Category M
V06-33 3.0-4.0m	Typhoon shelter	√	√	√	Pass	Category H
V06-34A 0-0.9m	Typhoon shelter	√	√	√	Pass	Category H
V06-34A 0.9-1.9m	Typhoon shelter	X	X	X	Fail	Category M
V06-35 1.9-2.9m	North Point	X	X	X	Fail	Category M
V06-35 5.9-6.9m	North Point	√	√	√	Pass	Category M
V06-36 0.9-1.9m	North Point	X	X	X	Fail	Category M
V06-36 4.9-5.9m	North Point	X	√	X	Fail	Category M
V06-37A 2.9-3.9m	North Point	√	√	√	Pass	Category M

Vibrocore No. / Depth	Location	Amphipod Test	Polychaete Test	Bivalve Test	Result of Biological Screening	Classification
V06-37A 4.7-5.7m	North Point	X	√	X	Fail	Category M
V06-40A 0-0.9m	North Point	X	√	X	Fail	Category M
V06-40A 1.9-2.9m	North Point	X	√	X	Fail	Category M
V06-41 0-0.9m	Temporary breakwater	√	√	√	Pass	Category M
V06-42 0-0.9m	Temporary breakwater	√	√	√	Pass	Category M
V06-44 0-0.9m	Temporary breakwater	√	√	X	Pass *	Category H
V06-44 0.9-2.9m	Temporary breakwater	√	√	√	Pass	Category M
V06-13B 0-0.9m	Wanchai waterfront	√	√	√	Pass	Category M
V06-14 0-0.9m	Wanchai waterfront	√	√	√	Pass	Category H
V06-17A 0-0.9m	Wanchai waterfront	√	√	√	Pass	Category H
V06-18a 1.9-2.9m	PCWA basin	√	X	√	Fail	Category M
V06-19B 0.9-1.9m	PCWA basin	√	√	√	Pass	Category M
V06-19 2.9-3.9m	PCWA basin	√	√	√	Pass	Category H

Notes:

1. X = fail biological test
2. √ = pass biological test
3. * = high levels of unionized ammonia in overlying water of 0.21 mg/L reported at test termination of the bivalve test. The laboratory test report stated "results could be qualified as possible false positive when ammonia (unionized) is greater than 0.13 mg/L". This sample is therefore not classified as failing the biological screening.
4. ** = sample failed biological screening and therefore would require Type 3 special disposal.

6.5 Identification of Potential Sources of Impact

6.5.1 The construction activities to be carried out for the proposed Project would generate a variety of wastes that can be divided into distinct categories based on their composition and ultimate method of disposal. The identified waste types include:

- Marine dredged sediment
- C&D material
- Chemical waste
- General refuse

6.5.2 Another identified waste type within the project area is floating refuse. It should be noted that floating refuse in Victoria Harbour is an existing waste and the Project itself is not designed to generate floating refuse. Since the project area is in the vicinity or within Victoria Harbour, some refuse and debris may be unintentionally brought from the site into the harbour during heavy rains or typhoons. Nevertheless, it is considered that the quantity of floating refuse generated from this situation would be limited.

6.5.3 Waste arising from the operation of the Project would include waste grease from the ventilation system of the Trunk road, filtration cake from cleaning process of the electrostatic precipitation system at the East Ventilation Building, and municipal waste/general refuse from the visitors/pedestrians using the waterfront area. During the operation of the ventilation system, the bearings of the ventilation fans adopted in the ventilation system would be required to be lubricated by grease periodically, probably once a year and hence only minimum amount of waste grease would be generated. For the electrostatic precipitation system, less than 10 kg per day filtration cake would be generated from the regular cleaning process. The filtration cake would be disposed of as industrial waste. For the waterfront area, it is expected that only limited amount of municipal waste/general refuse would be generated from visitor/pedestrians during the operational phase. With the provision of rubbish/recycle bins and collection of rubbish by maintenance agent for this open space, no insurmountable environmental impact would be anticipated.

6.5.4 Each type of waste arising is described below, together with an evaluation of the potential environmental impacts associated with the generation, handling, storage and transport of the waste.

6.6 Prediction and Evaluation of Environmental Impacts

Dredged Marine Sediment

6.6.1 The seabed would be dredged for seawall construction and reclamation formation. The total volume of dredged sediment for the Project is estimated to be approximately 1.15 Mm^3. Based on the results of the chemical and biological screening, the estimated volume of contaminated dredged sediment (Category M and H) requiring Type 2 confined marine disposal is approximately 0.7 Mm^3, and the estimated volume of Category L sediment suitable for open sea disposal is approximately 0.4 Mm^3. The volume of Category H (>10xLCEL) sediment requiring Type 3 special disposal is estimated to be approximately 0.05 Mm^3. The final disposal site will be determined by the MFC and a dumping licence will be obtained from EPD prior to the commencement of the dredging works.

6.6.2 To minimise any potential adverse impacts arising from the dredged marine sediment, the sediment should be dredged, transported and disposed of in a manner that would minimise the loss of contaminants either into solution or by resuspension. Mitigation measures to minimise potential environmental impacts are recommended in Section 6.7. The use of a geosynthetic container system is proposed as the Type 3 special disposal method for the Category H sediment (>10xLCEL) (refer to Section 6.7 for a description of the proposed special disposal method). Since the dredging activities are marine based activities and negligible dust impacts on nearby air sensitive receivers would be expected. The findings of the noise impact assessment presented in Section 4 of this report indicated that adverse noise impact would not be expected during the course of the dredging activities.

6.6.3 Mitigation measures to minimise potential environmental impacts are recommended in Section 6.7. With the implementation of mitigation measures, no unacceptable impacts would be expected from the transportation and disposal of the dredged sediment.

Construction and Demolition Materials

6.6.4 Demolition material will be generated from the removal of the Wan Chai ferry piers, Expo Drive East ferry pier, west and east bridges at the HKCEC, temporary seawalls and the temporary breakwater formed for the temporary typhoon shelter. Based on the preliminary construction programme, the demolition of the existing ferry piers is scheduled to take place in early 2011. The demolition of the west and east bridges at the HKCEC is scheduled to take place between mid 2010 and late 2011, respectively. The removal of the temporary typhoon shelter breakwater is scheduled to take place in late 2015. The estimated volume of demolition material from removal of the Wan Chai ferry piers, Expo Drive East ferry pier, the west and east bridges at the HKCEC and seawall structures is approximately 0.058 Mm^3. In addition, demolition material will be generated from the removal of the IEC west-bound and east-bound connections, with an estimated volume of approximately 0.02 Mm^3 and 0.03 Mm^3, respectively. The estimated volume of demolition material from removal of the temporary reclamation and the temporary typhoon shelter breakwater is approximately 0.2 Mm^3 and 0.156 Mm^3, respectively. The total volume of demolition material is approximately 0.46 Mm^3.

6.6.5 The amount of C&D material expected to be generated will be quantified in the site Waste Management Plan to be prepared by the Contractor. Since the construction activities will be located near the waterfront, improper management of C&D materials or spillage of slurry / grouting mixes may introduce debris and pollutants to the harbour waters, and mitigation measures will be required (refer to Section 6.7).

6.6.6 C&D material generated from the demolition works will be sorted on-site into public fill (which should be re-used on-site as far as possible) and C&D waste (which will require disposal to landfill). Demolition material will arise from the site clearance of the piers and highway structures as mentioned in section 6.6.3 and will comprise primarily concrete. It is assumed that approximately 95% of the C&D material will be public fill and the other will be C&D waste. Suitable (inert) material should be broken down to 250 mm in size for reuse as public fill in the WDII reclamation (for filling from +2.5 mPD to the formation level and use as surcharge). By reducing the quantity of C&D material requiring off-site disposal, the potential for environmental impacts from the transportation of material by road will also be reduced (such as noise impacts, possible congestion due to increased traffic flows, and dust and exhaust emissions from the haul vehicles). It is recommended that C&D material should be transported from the site by barge wherever possible to reduce impacts from road transportation. The disposal of surplus public fill by dump trunks would be considered as the last resort. It is estimated that approximately 0.058 Mm^3 of demolition material comprising 0.055 Mm^3 of public fill can be broken down to 250mm in size for re-use in the reclamation works and the other 0.003 Mm^3 comprising C&D waste to be

disposed to landfill. And around 0.03 Mm^3 of the removed temporary reclamation will be re-used in the reclamation works. The estimated volume of C&D material, which is generated after the reclamation works have been completed (such as form the temporary breakwater and the connection to existing IEC which will only be demolished at the last stage of the Trunk Road construction), is around 0.372 Mm^3, of which 0.048 Mm^3 of inert material (i.e. broken concrete) and 0.156 Mm^3 of rock material from the temporary breakwater and 0.166 Mm^3 from demolition of temporary reclamation will require off-site disposal to public fill reception facilities and 0.002 Mm^3 of C&D waste will require off-site disposal to landfill. It should be noted that since some structures (e.g. the existing IEC structure) that can only be demolished at the very late stage of the Project when all of the reclamation work have been completed, the C&D material generated from this demolition activities could not be reused on site.

6.6.7 Excavated materials will mainly arise from the excavation works for the CWB tunnel that will take place upon completion of the diaphragm walls of the tunnel. The excavated material will comprise reclamation fill material and will not contain marine sediment and could be reused on-site as fill material for other areas of the WDII reclamation, except those materials, including the residual bentonite slurries, arising from the later stages of excavation works which would require off-site disposal. Considering the inert nature of the fill material, reuse on-site would not result in any unacceptable environmental impact. The amount of residual used bentonite slurry requiring disposal is estimated to be about 0.12 Mm^3.

6.6.8 The excavated material from the excavation for the tunnel box on reclaimed land would be mainly sand fill from permanent reclamation area, of about 0.6 Mm^3, and fill material from temporary reclamation (quality CDG), of about 0.5 Mm^3. Since a section of the tunnel would also be constructed through existing land, approximately 1.27 Mm^3 of existing ground material and around 0.085 Mm^3 of rock material would also be excavated. Out of 0.6 Mm^3 of sand fill excavated from permanent reclamation, around 0.2 Mm^3 can be reused. Out of 0.5 Mm^3 of fill material excavated from temporary reclamation, around 0.23 Mm^3 can be reused. Out of 1.27 Mm^3 of existing ground material, around 0.57 Mm^3 can be reused. All the rock material excavated i.e. 0.085 Mm^3 can also be reused. The estimated volume of surplus excavated material likely to require off-site disposal is approximately 1.37 Mm^3. This volume arises due to excavation of the sections of the CWB tunnel during the later stages of the project, when filling has been completed in all the reclamation areas. There will therefore be little scope for reuse of this excavated material on-site. Some of this excavated material could be used in the later stages of the Project in road abutments and landscaped areas and, depending on the detailed construction programming, however, these quantities would be relatively small in relation to the off-site disposal requirement noted above.

6.6.9 As described above, the use of excavated/demolished material is maximized and the required import of marine fill is minimized in light of the proposed construction sequence. It should be noted that the construction sequence is dictated by the reprovisioning arrangement for the existing waterfront facilities along the waterfront, such as the ferry piers, cooling water systems, salt water pumping stations, cooling water systems, salt water pumping stations, sewage outfall, and cross habour watermains, etc. The proposed programme sequencing has taken into account these constraints and to meet the critical project implementation dates.

Chemical Waste

6.6.10 The maintenance and servicing of construction plant and equipment may generate some chemical wastes such as cleaning fluids, solvents, lubrication oil and fuel. It is difficult to quantify the amount of chemical waste that will arise from the construction activities since it will be dependent on the Contractor's on-site maintenance requirements and the amount of plant utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance, would be small and in the order of a few cubic metres per month. The amount of chemical waste to be generated will be quantified in the site Waste Management Plan to be prepared by the Contractor.

6.6.11 Chemical wastes arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. The potential hazards include:

- Toxic effects to workers
- Adverse impacts on water quality from spills
- Fire hazards

6.6.12 Materials classified as chemical wastes will require special handling and storage arrangements before removal for appropriate treatment at the Chemical Waste Treatment Facility (CWTF) or other licensed facility. Wherever possible opportunities should be taken to reuse and recycle materials. Mitigation and control requirements for chemical wastes are detailed in Section 6.7. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts would not be expected to result.

General Refuse

6.6.13 The construction workforce would generate general refuse comprising food scraps, waste paper, empty containers, etc. As the introduction of these wastes is likely to have detrimental effects on water quality in the area, such refuse should be properly managed so intentional or accidental release to the surrounding environment does not occur. Disposal of refuse at sites other than approved waste transfer or disposal facilities shall be prohibited. Effective collection of site wastes would be required to prevent waste materials being blown around by wind, flushed or leached into the marine environment, or creating an odour nuisance. The waste storage area should be well maintained and cleaned regularly so as to prevent from attracting pests and vermin to the work sites.

6.6.14 The maximum number of construction workers to be employed is estimated to be about 450 workers. Based on a generation rate of 0.65 kg per worker per day, the maximum daily arising of general refuse during the construction period would be approximately 293 kg. With the implementation of waste management practices at the site (as recommended in Section 6.7), adverse environmental impacts would not be expected from the storage, handling and transportation of refuse.

Floating Refuse

6.6.15 Floating refuse in Victoria Harbour is an existing waste. The record of floating refuse collected by Marine Department's contractor within the project area is shown in **Table 6.5** below. The data indicates a decreasing trend in the quantity of floating refuse collected. During the reporting period, approximately 31% to 42% of the refuse within the project area was collected within the Causeway Bay Typhoon Shelter. The quantity of floating refuse collected was higher in the summer months which may be attributed to the heavy rains and typhoons bringing more refuse into the harbour. In the summer, the wind direction is from the south-west which also brings more refuse into the harbour.

6.6.16 Floating refuse, if not collected, may drift along the waterfront, which may create aesthetic impact. In view of the project design, the Project itself is not designed to generate floating refuse. Considering that the project area is in the vicinity or within Victoria Harbour, some refuse and debris may be unintentionally brought from the site into the harbour during heavy rains or typhoons. However, it is expected that the quantity of floating refuse generated from this situation would be limited. Given that the proposed reclamation is designed with streamlined shoreline, the potential floating refuse problem would be minimized. Furthermore, with the implementation of the control measures in Section 6.7, the accumulation of floating refuse within the temporary embayment formed between the HKCEC extension and the CRIII site during construction phase would be avoided/minimized. Since the Project would not worsen the shoreline configuration and the implementation of appropriate control measures during construction phase, it is considered that the future quantity of refuse to be found along the shoreline would be similar if not better than the existing situation.

6.6.17 Specialised refuse collection vessels currently operate in Victoria Harbour to provide a refuse scavenging and collection service under the responsibility of the Pollution Control Unit of Marine Department (MD). During the construction phase, the project proponent's contractor will be responsible for the collection of any refuse within their works area. With the implementation of the refuse collection system properly within the project area, no insurmountable environmental impact with regard to floating refuse would be anticipated during the construction phase, or after completion of the Project.

Table 6.5 Record of Floating Refuse Collected within the Project Area

Area	Jul 05	Aug 05	Sep 05	Oct 05	Nov 05	Dec 05	Jan 06	Feb 06	Mar 06	Apr 06	May 06	Jun 06	Jul 06	Aug 06	Sep 06	Oct 06
Project Area excluding Causeway Bay T/S	45.9	31.1	30.5	26.1	23.6	26.6	25.9	23.9	25.3	24.4	25.0	26.9	32.0	31.8	24.3	24.2
Causeway Bay T/S	27.4	21.8	14.8	19.0	12.8	15.5	12.3	11.0	14.8	12.3	11.4	15.8	18.5	15.6	17.4	14.6
TOTAL	73.3	52.9	45.3	45.1	36.4	42.1	38.2	34.9	40.1	36.7	36.4	42.7	50.5	47.4	41.7	38.8

Notes:
1. Project Area: Starts from the shoreline immediately to the west of the HKCEC and extends in an easterly direction along the shoreline to the North Point waterfront.
2. The above quantity represents the floating refuse collection by MD's contractor Kai Fat Harbour Cleaning Services Ltd.
3. The above quantity is on a monthly basis and in units of tonnes.
4. T/S = Typhoon Shelter

6.7 Mitigation Measures

Dredged Marine Sediments

6.7.1 The basic requirements and procedures for dredged mud disposal are specified under the ETWB TCW No. 34/2002. The MFC is responsible for the provision and management of disposal capacity for dredged/excavated sediment, and DEP is responsible for the issue of permits for marine disposal under the provisions of the Dumping at Sea Ordinance (Cap. 466).

6.7.2 The dredged marine sediments would be loaded onto barges, transported to and disposed of at the designated disposal sites at South of Cheung Chau, East of Ninepin, East of Tung Lung Chau, South of Tsing Yi and East of Sha Chau to be allocated by the MFC depending on their level of contamination or at other disposal sites after consultation with the MFC and EPD. Based on the chemical screening results, the majority of the marine sediment to be dredged was classified as contaminated and would require Type 2 confined marine disposal. In accordance with the ETWB TCW No. 34/2002, the contaminated material must be dredged and transported with great care, and the mitigation measures recommended in Section 5 of this Report should be strictly followed. Furthermore, the dredged contaminated sediment must be effectively isolated from the environment upon final disposal and the project proponent will consult the MFC about the disposal requirement.

6.7.3 Based on the biological screening results, the Category H (>10xLCEL) sediment which failed the biological testing would require Type 3 special disposal. The volume of Category H sediment from the Causeway Bay typhoon shelter which would require special disposal arrangements is estimated to be approximately 0.05 Mm^3. It was agreed with EPD during the WDII Comprehensive Feasibility Study (CFS) that special disposal arrangements, rather than pre-treatment, would be appropriate provided there would be negligible loss of sediment to the marine environment during the dumping operations.[(2)] A detailed review of possible special disposal arrangements for the contaminated sediment was carried out in the WDII CFS with the objective of keeping the loss of sediment to the surrounding marine environment to a negligible extent. The method pursued as having the least potential for loss of contaminants to the marine environment is by containment of the sediments in geosynthetic containers. A feasible containment method is proposed whereby the dredged sediments are sealed in geosynthetic containers and, at the disposal site, the containers would be dropped into the designated contaminated mud pit where they would be covered by further mud disposal and later by the mud pit capping, thereby meeting the requirements for fully confined mud disposal. The technology is readily available for the manufacture of the geosynthetic containers to the project-specific requirements. Similar disposal methods have been used for projects in Europe, the USA and Japan (for example, geosynthetic fabric containers have been used to contain contaminated dredged sediment at Marina Del Rey in California and Yokohama Port in Japan) and the issues of fill retention by the geosynthetic fabrics, possible rupture of the containers and sediment loss due to impact of the container on the seabed have been addressed.[(3)] The recommended field

(2) Agreement No. CE 74/98. Wan Chai Development Phase II Comprehensive Feasibility Study. EIA Report. July 2001.

(3) (i) Young, H. M. et al. "The migration of contaminants through geosynthetic fabric containers utilized in dredging operation". Engineering Geology, 53 (1999), 167-176;

(ii) Fleischer, P., Bowles, F. A. "Turbidity currents generated by seafloor impact of geotextile fabric containers". Applied Ocean Research, 21 (1999) 215-217;

trials were undertaken during the WDII Design and Construction (D&C) consultancy (Agreement No. CE54/2001 (CE)) using uncontaminated mud to demonstrate the feasibility of the proposed method.

6.7.4 The ACE Report [to be endorsed by ACE] (**Appendix 6.2**) on the field trials of geosynthetic containers concluded that disposal by sealing the dredged sediments in geosynthetic containers and dropping these containers into the contaminated mud pits at East Sha Chau has been shown to be a successful and viable disposal method. The use of a geosynthetic container system for special disposal was considered to be an effective system with negligible loss of contaminants to the marine environment during disposal. The container design and handling method were refined through the field trials for the determination of the optimal design and handling method.

6.7.5 It will be the responsibility of the Contractor to satisfy the appropriate authorities that the contamination levels of the marine sediment to be dredged have been analysed and recorded. According to the ETWB TCW No. 34/2002, this will involve the submission of a formal Sediment Quality Report to the DEP, at least 3 months prior to the dredging contract being tendered.

6.7.6 During transportation and disposal of the dredged marine sediments requiring Type 1 and Type 2 disposal, the following measures should be taken to minimise potential impacts on water quality:

- Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material.
- Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self-monitoring devices as specified by the DEP.
- Barges or hopper barges shall not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation.

Good Site Practices

6.7.7 Adverse impacts related to waste management are not expected to arise, provided that good site practices are strictly followed. Recommendations for good site practices during the construction activities include:

- Nomination of an approved person, such as a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site.
- Training of site personnel in proper waste management and chemical waste handling procedures.
- Provision of sufficient waste disposal points and regular collection for disposal.
- Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers.

(iii) Valent, P. J. et al. "Engineering concepts for the placement of wastes on the abyssal seafloor". Journal of Marine Systems, 14 (1998) 273-288.

- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors.
- A recording system for the amount of wastes generated, recycled and disposed of (including the disposal sites).

Waste Reduction Measures

6.7.8 Good management and control can prevent the generation of a significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Sort C&D waste from demolition of the existing waterfront structures to recover recyclable portions such as metals.
- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal.
- Encourage collection of aluminium cans, PET bottles and paper by providing separate labelled bins to enable these wastes to be segregated from other general refuse generated by the work force.
- Any unused chemicals or those with remaining functional capacity shall be recycled.
- Use of reusable non-timber formwork, such as in casting the tunnel box sections, to reduce the amount of C&D material.
- Proper storage and site practices to minimise the potential for damage or contamination of construction materials.
- Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste.

6.7.9 In addition to the above measures, specific mitigation measures are recommended below for the identified waste arisings to minimise environmental impacts during handling, transportation and disposal of these wastes.

General Refuse

6.7.10 General refuse should be stored in enclosed bins or compaction units separate from C&D material. A licensed waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D material. Preferably an enclosed and covered area should be provided to reduce the occurrence of 'wind blown' light material.

Chemical Wastes

6.7.11 After use, chemical wastes (for example, cleaning fluids, solvents, lubrication oil and fuel) should be handled according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Spent chemicals should be collected by a licensed collector for disposal at the CWTF or other licensed facility, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.

Construction and Demolition Material

6.7.12 The C&D material should be sorted on-site into inert C&D material (that is, public fill) and C&D waste. Considering that a large quantity of C&D material will be generated from the demolition works and excavation for the tunnel construction and in order to minimise the impact resulting from collection and transportation of material for off-site disposal, it is recommended that the inert C&D material should be re-used on-site in the reclamation works as far as practicable. All the suitable (inert) material should be broken down to 250 mm in size for reuse as public fill and surcharge in the WDII reclamation. C&D waste, such as wood, glass, plastic, steel and other metals should be reused or recycled and, as a last resort, disposed of to landfill. It is recommended that a suitable area be designated to facilitate the sorting process and a temporary stockpiling area will be required for the separated materials.

6.7.13 In order to monitor the disposal of public fill and C&D waste at public filling facilities and landfills, respectively, and to control fly tipping, a trip-ticket system should be included as one of the contractual requirements and implemented by an Environmental Team undertaking the Environmental Monitoring and Audit work. An Independent Environmental Checker should be responsible for auditing the results of the system.

6.7.14 Bentonite slurries used in diaphragm wall and bore-pile construction should be reconditioned and reused wherever practicable. The disposal of residual used bentonite slurry should follow the good practice guidelines stated in ProPECC PN 1/94 “Construction Site Drainage” and listed as follows:

- If the disposal of a certain residual quantity cannot be avoided, the used slurry may be disposed of at the marine spoil grounds subject to obtaining a marine dumping licence from EPD on a case-by-case basis.
- If the used bentonite slurry is intended to be disposed of through the public drainage system, it should be treated to the respective effluent standards applicable to foul sewers, storm drains or the receiving waters as set out in the *Technical Memorandum of Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*.
- If the used bentonite slurry is intended to be disposed to public filling reception facilities, it will be mixed with dry soil on site before disposal.

6.7.15 **Table 6.6** provides a summary of the various waste types likely to be generated during the construction phase, together with the recommended handling and disposal methods.

Table 6.6 Summary of Waste Handling Procedures and Disposal Routes

Waste Type	Generated from Works Item	Total Quantity Generated	Quantity to be disposed off-site / re-used	Handling	Disposal
C&D Material	Demolition of waterfront structures	0.058 Mm^3	0.055 Mm^3 of inert C&D material (public fill) to be re-used 0.003 Mm^3 of C&D waste to landfill	Sort on-site into : • Inert C&D material (public fill) • C&D waste	Suitable material broken down to 250 mm in size for reuse as public fill and reuse of removed temporary reclamation in WDII reclamation (approx. 0.085 Mm^3 of inert C&D material, i.e. public fill) To be disposed to public fill reception facilities for other beneficial uses (approx. 0.22 Mm^3) To be disposed to landfill (approx. 0.005 Mm^3)
	Modification of IEC	0.05 Mm^3	0.048 Mm^3 of inert C&D material (public fill) to off-site public fill reception facilities 0.002 Mm^3 of C&D waste to landfill		
	Removal of temporary reclamation	0.2 Mm^3	0.03 Mm^3 of inert C&D material (public fill) to be re-used and the remaining 0.17 Mm^3 to off-site public fill reception facilities		
	Removal of Temporary typhoon shelter	0.156Mm^3	0.156Mm^3		To be disposed to public fill reception facilities for other beneficial uses (approx 0.156Mm^3)
	Excavation for CWB tunnel box on reclaimed land & existing ground	0.6 Mm^3 sand fill 0.5 Mm^3 selected public fill 1.27 Mm^3 existing ground material 0.085 Mm^3 rock material 0.12Mm^3 of bentonite slurries	1.37 m^3 of surplus excavated material 0.12Mm^3 of residual bentonite slurries	Segregate to avoid contamination from other wastes	Reuse on-site as far as practicable (approx. 1.085 Mm^3) Surplus fill material to be disposed off-site (approx. 1.37 Mm^3) Residual bentonite slurries (approx 0.12Mm^3)

Waste Type	Generated from Works Item	Total Quantity Generated	Quantity to be disposed off-site / re-used	Handling	Disposal
Dredged Sediments	Causeway Bay Typhoon Shelter – Category H sediment (>10xLCEL)	0.05 Mm^3	0.05 Mm^3	Special disposal arrangement – containment of sediment in geosynthetic containers	Type 3 special disposal – dropping of sealed containers at the designated contaminated mud pit (approx. 0.05 Mm^3)
	Category H and Category M sediment	0.7 Mm^3	0.7 Mm^3	Techniques to minimise resuspension (closed grabs, tight seal on barges, controlled loading and transfer)	Type 2 confined marine disposal - contaminated mud pit (approx. 0.7 Mm^3)
	Category L sediment	0.4 Mm^3	0.4 Mm^3		Type 1 open sea disposal - gazetted marine disposal ground (approx. 0.4 Mm^3)
Chemical Wastes	Cleansing fluids, solvent, lubrication oil and fuel from construction plant and equipment	Few cubic metres per month (preliminary estimate)	Few cubic metres per month (preliminary estimate)	Recycle on-site or by licensed companies Stored on-site within suitably designed containers	Chemical Waste Treatment Facility or other licensed facility
General Refuse	Waste paper, discarded containers, etc. generated from workforce	approx. 293 kg per day (preliminary estimate based on workforce of 450)	approx. 293 kg per day	Provide on-site refuse collection points	Refuse station for compaction and containerisation and then to landfill

6.8 Evaluation of Residual Impacts

6.8.1 With the implementation of the recommended mitigation measures for the handling, transportation and disposal of the identified waste arisings, no adverse residual impact is expected to arise during the construction of the proposed Project.

6.9 Environmental Audit

6.9.1 Waste management will be the contractor's responsibility to ensure that all wastes produced during the construction of the Project are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements. The mitigation measures recommended in Section 6.7 should form the basis of the site Waste Management Plan to be developed by the Contractor in the construction stage.

6.10 Conclusion

6.10.1 A review of the sediment quality data from the marine ground investigation indicated that the majority of marine sediments to be dredged for the WDII and CWB reclamation were classified as contaminated. The total dredged volume was estimated as approximately 1.15 Mm^3, of which 0.7 Mm^3 was classified as contaminated (Category M and H) requiring Type 2 confined marine disposal, and 0.4 Mm^3 was classified as Category L and would be suitable for Type 1 open sea disposal. With the implementation of the recommended mitigation measures in accordance with the requirements of ETWB TCW No. 34/2002, no adverse residual impact was predicted. Since the dredging activities are marine based activities and negligible dust impacts on nearby air sensitive receivers would be expected. The findings of the noise impact assessment in Section 4 of this report indicated that adverse noise impact would not be expected during the course of the dredging activities.

6.10.2 Based on the results of the biological screening, approximately 0.05 Mm^3 of highly contaminated sediment from the CBTS would require Type 3 special disposal arrangements. A review of possible disposal arrangements has recommended the use of a geosynthetic container system with negligible loss of material to the marine environment during disposal. It is proposed that the dredged sediments are sealed in geosynthetic containers and, at the disposal site, the containers would be dropped into the designated contaminated mud pit where they would be covered by further mud disposal and later by the mud pit capping, thereby meeting the requirements for fully confined mud disposal. Field trials undertaken during the WDII D&C consultancy using uncontaminated mud established the optimum handling methodology for the proposed special disposal method.

6.10.3 Wastes generated by the construction activities will include C&D material (including excavated material and demolition material), general refuse from the workforce and chemical waste from the maintenance of construction plant and equipment. The quantity of C&D materials generated is estimated to be approximately 2.915 Mm^3 of which around 1.17 Mm^3 will be reused on-site and the remaining surplus of around 1.745 Mm^3 will be disposed off-site. By reducing the quantity of C&D material requiring off-site disposal, the potential impacts from the transportation of material by road will be reduced (such as noise impacts, possible congestion due to increased traffic flows, and dust and exhaust emissions from the haul vehicles). Provided that these identified waste arisings are handled, transported and disposed of using approved methods and that recommended good site practice are strictly followed, adverse environmental impacts of air and odour emissions, noise, potential hazards, wastewater discharge and transport would not be expected during the construction phase.

6.10.4 Floating refuse is an existing waste and the Project itself is not designed to generate floating refuse. Owing to the project area in close proximity to or within Victoria Harbour, limited amount of refuse and debris may be unintentionally brought from the site into the harbour during heavy rains or typhoons. Given that the Project would not worsen the shoreline configuration and the implementation of appropriate control measures during construction phase, it is considered that the future quantity of refuse to be found along the shoreline would be similar if not better than the existing situation.

6.10.5 With the implementation of the refuse collection system properly within the project area, no insurmountable environmental impact with regard to floating refuse would be anticipated during the construction phase, or after completion of the Project.