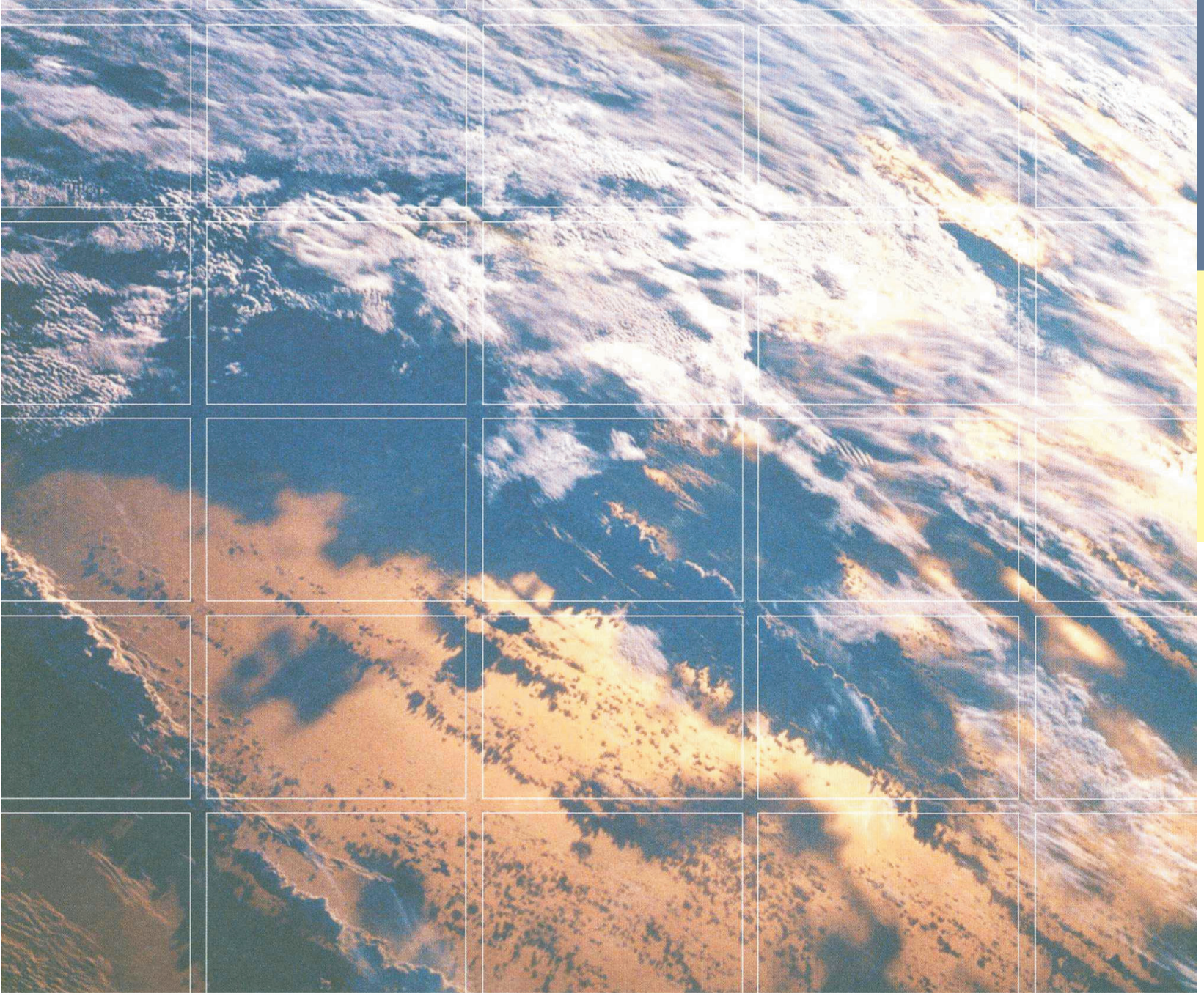

Part 3 - Black Point

Sections 7 - 18

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CLP Power

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Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities

EIA Study (EIA Study Brief ESB-126/2005)

EIA Report
Part 3 - Black Point
Sections 7 - 18

22nd December 2006

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CONTENTS

7 WASTE MANAGEMENT ASSESSMENT

7.1 INTRODUCTION

This section identifies the potential wastes arising from the construction and operation of a LNG terminal at Black Point and assesses the environmental impacts associated with waste handling and disposal. The main issues are:

- The management of dredged marine sediment;
- Handling and disposal of contaminated soil/sediments;
- Handling and disposal of construction and demolition (C&D) materials [1] arising from the demolition, excavation and construction works; and
- Chemical wastes, sewage, general refuse and industrial wastes.

Opportunities for waste reduction, recycling, storage, collection, transport and disposal have been examined and appropriate measures for waste reduction and management are proposed.

7.2 LEGISLATION REQUIREMENTS AND EVALUATION CRITERIA

The following discussion on legislative requirements and evaluation criteria applies to both the construction and operational phases of the LNG terminal.

The criteria and guidelines for evaluating potential waste management implications are laid out in *Annexes 7* and *15* of the *EIAO-TM* under the *EIAO* (Cap 499). The following legislation covers, or has some bearing upon, the handling, treatment and disposal of wastes in Hong Kong, and will also be considered in this Project.

- *Waste Disposal Ordinance (Cap 354);*
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C);*
- *Land (Miscellaneous Provisions) Ordinance (Cap 28)*
- *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances Regulation;* and
- *Dumping at Sea Ordinance (Cap 466).*

(1) "C&D materials" refers to materials arising from any land excavation or formation, civil/building construction, road works, building renovation or demolition activities. It includes various types of reusable materials, building debris, rubble, earth, concrete, timber and mixed site clearance materials. When sorted properly, materials suitable for land reclamation and site formation (known as public fill) will be reused at a public filling area. The rock and concrete can be crushed and processed to produce aggregates for various civil and building engineering applications. The remaining construction waste (comprising timber, paper, plastics and general refuse) are to be disposed of at landfills.

7.2.1 *Waste Disposal Ordinance (Cap 354)*

The *Waste Disposal Ordinance* (WDO) prohibits the unauthorised disposal of wastes, with waste defined as any substance or article, which is abandoned. Construction waste is not directly defined in the *WDO* but is considered to fall within the category of 'trade waste'. Trade waste is defined as waste from any trade, manufacturer or business or any wasted building, or civil engineering materials, but does not include animal waste.

Under the *WDO*, wastes can only be disposed of at a licensed site. The *WDO* also provides for the issuing of licences for the collection and transport of wastes. Licences are not, however, currently issued for the collection and transport of construction waste or trade waste.

The *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* defines construction waste 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, screening or matter removed in or generated from any desludging, desilting or dredging works.

The Construction Waste Disposal Charging Scheme entered into operation on 1 December 2005. From that time, any main contractor who undertakes construction work under a contract with value of $1 million or above is required to open a billing account solely for the contract. Application shall be made within 21 days after the contract is awarded.

For construction work under a contract with value less than $1 million, such as minor construction or renovation work, any person such as the owner of the premises where the construction work takes place or his/her contractor can open a billing account; the account can also be used for contracts each with value less than $1 million. The premises owner concerned may also engage a contractor with a valid billing account to make arrangement for disposal of construction waste.

Under the new construction waste charging scheme, charging for disposal of construction waste started on 20 January 2006 and will also apply to the Project when commenced.

Depending on the percentage of inert materials in the construction waste, inert construction waste can be disposed at public fill reception facilities and mixed construction waste can be disposed of at construction waste sorting facilities, landfills and outlying islands transfer facilities where different disposal cost would be applied. The scheme encourages reducing, reusing and sorting of construction waste such that the waste producer can minimise their disposal fee. *Table 7.1* summarises the government construction waste disposal facilities, types of waste accepted and disposal cost.

Table 7.1 Government Facilities for Disposal of C&D Materials

Government Waste Disposal Facilities	Type of Construction Waste Accepted	Charge Per Tonne
Public fill reception facilities	Consisting entirely of inert construction waste	$27
Sorting facilities	Containing more than 50% by weight of inert construction waste	$100
Landfills	Containing not more than 50% by weight of inert construction waste	$125
Outlying Islands Transfer Facilities	Containing any percentage of inert construction waste	$125

7.2.2 *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C)*

Chemical waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*, if such a substance or chemical occurs in such a form, quantity or concentration so as to cause pollution or constitute a danger to health or risk of pollution to the environment.

A person should not produce, or cause to be produced, chemical wastes without registration with the EPD. Chemical wastes must either be treated using on-site facility licensed by EPD or be collected by a licensed collection for off-site treatment at a licensed facility. Under EPD Regulations, the waste producer, collector and disposal facility must sign all relevant parts of a computerised trip ticket for each consignment of waste. The computerized system is designed to allow the transfer of wastes to be traced from cradle-to-grave.

The EPD *Regulation* prescribes the storage facilities to be provided on site which include labelling and warning signs. To reduce the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written emergency procedures for spillage, leakage or accidents arising from the storage of chemical wastes. They must also provide their employees with training on such procedures.

7.2.3 *Land (Miscellaneous Provisions) Ordinance (Cap 28)*

The inert portion of C&D materials (also called public fill) may be taken to public fill reception facilities. Public fill reception facilities usually form part of land reclamation schemes and are operated by the Civil Engineering and Development Department (CEDD) and others. The *Land (Miscellaneous Provisions) Ordinance* requires that individuals or companies who deliver public fill to the public fill reception facilities to obtain Dumping Licences. The licences are issued by CEDD under delegated authority from the Director of Lands.

Individual licences and windscreen stickers are issued for each vehicle involved. Under the licence conditions, public fill reception facilities will

only accept earth, soil, sand, rubble, brick, tile, rock, boulder, concrete, asphalt, masonry or used bentonite. In addition, in accordance with paragraph 11 of the ETWB TC(W) No.31.2004, Public Fill Committee will advise on the acceptance criteria (e.g. no mixing of construction waste, nominal size of the materials less than 250mm, etc). The material will, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical wastes, animal and vegetable matter and any other materials considered unsuitable by the public fill reception facility supervisor.

7.2.4 *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances Regulation*

This *Regulation* provides a further control on the illegal dumping of wastes on unauthorised (unlicensed) sites.

7.2.5 *Dumping at Sea Ordinance (Cap 466)*

This *Ordinance* came into operation in April 1995 and empowers the Director of Environmental Protection (DEP) to control the disposal and incineration of substances and articles at sea for the protection of the marine environment. Under the *Ordinance*, a permit from the DEP is required for the disposal of regulated substances within and outside the waters of the Hong Kong SAR. The permit contains terms and conditions that includes the following specifications:

- Type and quantity of substances permitted to be dumped;
- Location of the disposal grounds;
- Requirement of equipment for monitoring the disposal operations; and
- Environmental monitoring requirements.

Management of Dredged/Excavated Sediments for Marine Disposal

Marine disposal of any dredged/excavated sediment is subject to control under the *Dumping at Sea Ordinance 1995*. Dredged/excavated sediment destined for marine disposal is classified based on its contaminant levels with reference to the *Chemical Exceedance Levels* (CEL), as stipulated in *ETWBTC No. 34/2002: Management of Dredged/Excavated Sediment*. This Technical Circular includes a set of sediment quality criteria, as presented in *Table 7.2*, which includes heavy metals and metalloids, organic pollutants and a class of contamination level for highly contaminated sediment not suitable for marine disposal.

Table 7.2 ***Dredged/Excavated Sediment Quality Criteria for the Classification under the ETWBTC No 34/2002***

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (UCEL)
Metals (mg kg^{-1} dry weight)		
Cd	1.5	4
Cr	80	160
Cu	65	110
Hg	0.5	1
Ni [(a)]	40	40
Pb	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (mg kg^{-1} dry weight)		
Arsenic (As)	12	42
Organic-PAHs (µg kg^{-1} dry weight)		
Low Molecular Weight (LMW) PAHs	550	3,160
High Molecular Weight (HMW) PAHs	1,700	9,600
Organic-non-PAHs (µg kg^{-1} dry weight)		
Total PCBs	23	180
Organometallics (µgTBT l^{-1} in interstitial water)		
Tributyl-tin [(a)]	0.15	0.15

Note:
(a) The contaminant level is considered to have exceeded the UCEL if it is greater than the value shown.

The DEP, as the Authority under the *Dumping at Sea Ordinance* (DASO), will classify sediments based on their contaminant levels with reference to the CEL laid down in the *Table 7.2*. In accordance with *ETWBTC 34/2002*, the sediment is classified into three categories based on its contamination levels:

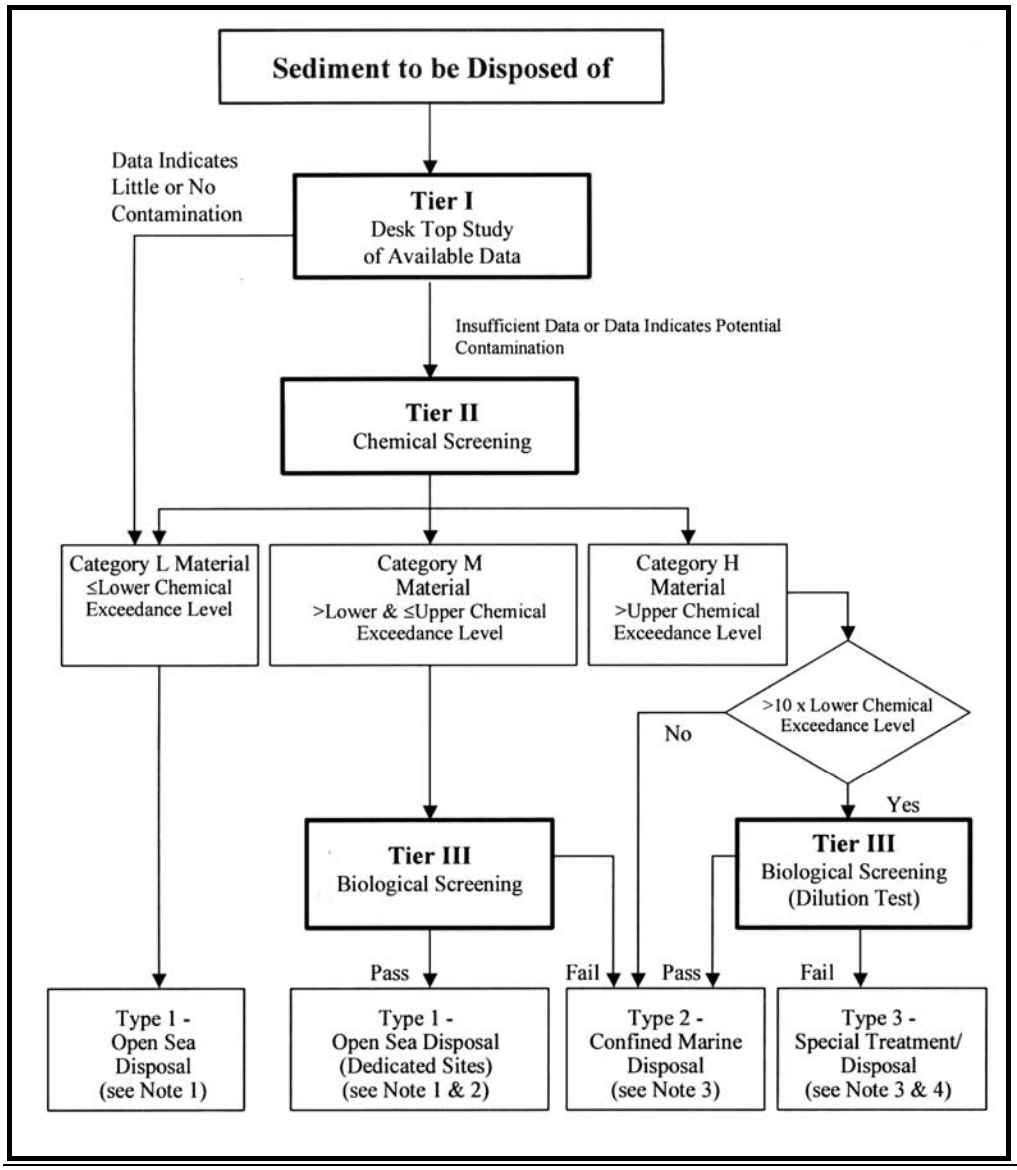
Category L : Sediment with all contaminant levels not exceeding the LCEL. The material must be dredged, transported and disposed of in a manner which reduces the loss of contaminants either into solution or by re-suspension.

Category M : Sediment with any one or more contaminant levels exceeding the LCEL with 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.

Figure 7.1 summarises the sediment classification and disposal arrangements. The determination of the most appropriate open sea or confined marine disposal site will be based on the chemical and biological test results of the sediment.

Figure 7.1 Management Framework for Dredged/Excavated Sediment



Notes:

1. Most open sea disposal sites are multi-user facilities and as a consequence their management involves a flexibility to accommodate varying and unpredictable circumstances. Contract documents will include provisions to allow the same degree of flexibility to divert from one disposal site to another during the construction period of a contract.
2. Dedicated Sites will be monitored to confirm that there is no adverse impact.
3. For sediment requiring Type 2 or Type 3 disposal, contract documents will state the allocation conditions of Marine Fill Committee (MFC) and DEP. At present, East Sha Chau mud pits are designated for confined marine disposal.
4. If any sediment suitable for Type 3 disposal (Category H sediment failing the biological dilution test) is identified, it is the responsibility of the project proponent, in consultation with DEP, to identify and agree, the most appropriate treatment and/or disposal arrangement. Such a proposal is likely to be very site and project specific and therefore

cannot be prescribed. This does not preclude treatment of this sediment to render it suitable for confined marine disposal.

5. The allocation of disposal space may carry a requirement for the project proponent to arrange for chemical analysis of the sediment sampled from 5% of the vessels en-route to the disposal site. For Category M and certain Category H sediment, the chemical tests will be augmented by biological tests. Vessel sampling will normally entail mixing five samples to form a composite sample from the vessel and undertaking laboratory tests on this composite sample. All marine disposal sites will be monitored under the general direction of the CEDD. However, exceptionally large allocations might require some additional disposal site monitoring. These will be stipulated at the time of allocation.
6. Trailer suction hopper dredgers disposing of sediment at East Sha Chau must use a down-a-pipe disposal method, the design of which must be approved in advance by Director of the CEDD. The dredging contractor must provide equipment for such disposal.

Source: Appendix C, ETWBTC 34/2002

In addition, in accordance with *Building Ordinance Office Practice Note for Authorised Persons and Registered Structural Engineers No 155*, any proposal to remove more than 500,000 m^3 of clean mud or any quantity of contaminated mud must be justified on both cost and environmental grounds. The rationale for such removal will also be provided to enable an allocation for disposal to be considered. It is desirable, therefore, to demonstrate that any proposed mud dredging has been reduced as far as reasonably and safely practicable, and to obtain in-principle agreement from the Secretary of the MFC of the CEDD at an early stage. For projects which involve marine disposal of dredged/excavated sediments, the *Practice Note for Authorised Persons No 252* will be followed.

7.2.6 *Other Relevant Guidelines*

Other guideline documents, which detail how the Contractor will comply with the WDO and its associated regulations include:

- *Waste Disposal Plan for Hong Kong* (December 1989), Planning, Environment and Lands Branch Government Secretariat, Hong Kong Government;
- *Chapter 9 Environment (1999)*, Hong Kong Planning Standards and Guidelines, Hong Kong Government;
- *New Disposal Arrangements for Construction Waste* (1992), EPD & CED, Hong Kong Government;
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (1992), EPD, Hong Kong Government;
- *Works Branch Technical Circular (WBTC) No. 32/92, The Use of Tropical Hard Wood on Construction Site*; Works Branch, Hong Kong Government;
- *WBTC No. 2/93, Public Dumps.* Works Branch, Hong Kong Government;

- *WBTC No. 2/93B, Public Filling Facilities*, Works Branch, Hong Kong Government;
- *WBTC No. 16/96, Wet Soil in Public Dumps*; Works Branch, Hong Kong Government;
- *WBTC Nos. 4/98* and *4/98A, Use of Public Fill in Reclamation and Earth Filling Projects*; Works Bureau, Hong Kong SAR Government.
- *Waste Reduction Framework Plan, 1998 to 2007*, Planning, Environment and Lands Bureau, Government Secretariat, 5 November 1998;
- *WBTC Nos. 25/99, 25/99A* and *25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Sub-committee Papers*; Works Bureau, Hong Kong SAR Government;
- *WBTC No. 12/2000, Fill Management*; Works Bureau, Hong Kong SAR Government;
- *WBTC No. 19/2001, Metallic Site Hoardings and Signboards;* Works Bureau, Hong Kong SAR Government;
- *WBTC Nos. 6/2002* and *6/2002A, Enhanced Specification for Site Cleanliness and Tidiness.* Works Bureau, Hong Kong SAR Government;
- *WBTC No. 11/2002, Control of Site Crusher.* Works Bureau, Hong Kong SAR Government;
- *WBTC No. 12/2002, Specification Facilitating the Use of Recycled Aggregates.* Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 33/2002, Management of Construction and Demolition Material Including Rock*; Environment, Transport and Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 34/2002, Management of Dredged/Excavated Sediment;* Environment, Transport and Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 31/2004, Trip Ticket System for Disposal of Construction & Demolition Materials*, Environment, Transport and Works Bureau, Hong Kong SAR Government; and
- *ETWBTC No. 19/2005, Environmental Management of Construction Site,* Environment, Transport and Works Bureau, Hong Kong SAR Government.

7.3 EXPECTED WASTE SOURCES

7.3.1 *Construction Phase*

Optioneering has been conducted to try to avoid waste generation and reuse and recycling of waste generated from the construction of the terminal during the planning and design stages and consideration of options for layout, construction methods and programme, and the proposed scheme comprises the Applicants' proposed best balance. During the construction phase, the main activities, which will potentially result in the generation of waste, include site clearance, site formation, blasting, dredging, reclamation, seawall construction, filling and concreting.

The typical waste types associated with these activities include:

- Dredged marine sediment;
- C & D Materials;
- Chemical waste;
- Sewage; and
- General refuse.

Proper waste management is important to prevent and mitigate potential environmental impacts.

7.3.2 *Operational Phase*

The following wastes will be generated from the operation of the LNG terminal:

- Dredged Sediment;
- Industrial waste;
- Chemical waste;
- Sewage; and
- General refuse.

7.4 ASSESSMENT METHODOLOGY

The potential environmental impacts associated with the handling and disposal of waste arising from the construction and operation of the LNG terminal at Black Point are assessed in accordance with the criteria presented in *Annexes 7* and *15* of the *EIAO-TM*, which are summarised as follows:

- Estimation of the types and quantities of the wastes to be generated based on information provided by the engineering design team and the relevant researches and studies on waste arisings;

- Assessment of the secondary environmental impacts due to the management of waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and traffic; and

- Assessment of the potential impacts on the capacity of waste collection, transfer and disposal facilities.

7.5 WASTE MANAGEMENT ASSESSMENT

7.5.1 Construction Phase

Dredged Marine Sediment

To enable the safe transit of the LNG carrier, dredging along the approach channel, berthing area, and turning basin will be necessary. The quantities of sediment to be dredged are considered as the best estimate based on the available site investigation data.

In *Section 2.2.1*, the "partially dredged" option is selected to be the preferred option for the reclamation in this Project, therefore, the following assessment is carried out based on the "partially dredged" approach.

Approximately 16 hectares of land will be reclaimed immediately adjacent to the Black Point headland. Works will also include the construction of an approximately 1.1 km long seawall.

Taking into account the development programme and the long-term stability of the LNG infrastructure, all marine sediment beneath the seawall will be dredged. The dredging work under the seawalls will be carried out between the late 2009 and early 2010 and a total of approximately 0.66 Mm^3 of marine sediment is estimated to be dredged from this area (see *Table 7.7*).

The dredging work for the turning basin and approach channel will be carried out for four months between late 2009 and early 2010. Approximately 2.49 Mm^3 of marine sediments are to be removed along the proposed approach channel and turning basin (see *Table 7.5*).

In summary, a total of about 3.15 Mm^3 of marine sediment will be dredged (which has considered leaving the marine sediment in place as far as possible) and disposed offsite.

Contaminated Dredged Marine Sediment

A preliminary marine sediment sampling programme has been undertaken as part of the EIA Study to provide an indication of the quality of the sediment

and the volumes of different types of sediment to be dredged. The sediment sampling programme (including the sampling stations, the chemical analysis suite and the biological testing programmes) was developed based on the guidelines described in *ETWBTC 34/2002*. The sampling and testing programmes are summarised in *Table 7.3* and the sampling locations presented in *Figure 7.2*.

Table 7.3 Marine Sediment Sampling and Testing Programme

Sampling Location	ETWBTC Grab (a)	ETWBTC Vibrocore (b)
GV 1	✓	✓
GV 2	✓	✓
GV 3	✓	✓
GV 4	✓	✓
GV 5	✓	✓

Notes:

(a) All sediment grab samples were analysed for sediment quality parameters as listed in the Appendix A of the *ETWBTC 34/2002*.

(b) Vibrocore samplings were conducted and samples analysed for sediment quality parameters as listed in the Appendix A of the *ETWBTC 34/2002* at these locations.

A combination of grab samples and vibrocore samples were taken within the proposed Project area. Vibrocore samples were taken down to the proposed dredging depth (i.e. at seabed, 0.9 m, 1.9 m, 2.9 m below the seabed, every 3 m thereafter and at the end of the vibrocore sampling) or upon refusal, or when encountering rock head in order to determine the depth of contaminated marine deposit. The contaminants tested include all the contaminants stated in *Table 1 - Analytical Methodology* in *Appendix B* of *ETWBTC No 34/2002* plus PCBs and 12 Chlorinated Pesticides.

Tier III biological screening was also performed on samples with one or more contaminant levels exceeding the Lower Chemical Exceedance Level (LCEL) and exceeded 10 times the Upper Chemical Exceedance Level (UCEL) (1). The ecotoxicological-testing programme featured a suite of tests that include three phylogenetically distinct species (amphipod, polychaete and bivalve larvae) which interact with bedded sediments in different ways. The objective of the bioassays is to determine if there are any potential risks of toxicological impacts from the sediment to the marine biota, and whether there is any difference in the toxicity of the sediments samples taking from the Project site and the reference station (collected from a clean area in Port Shelter, New Territories).

The chemical and biological analysis results of the marine sediment are presented in *Table 7.4*. All sediment samples tested have negligible concentration of toxic organics, since they were all below the detection limits of the chemical analysis. Preliminary estimates of the quantities of different types of marine sediment to be disposed are presented in *Table 7.5*.

(1) LCEL and UCEL are Dredged/Excavated Sediment Quality Criteria for the Classification prescribed under *ETWBTC No. 34/2002* and are presented in *Table 7.2*.

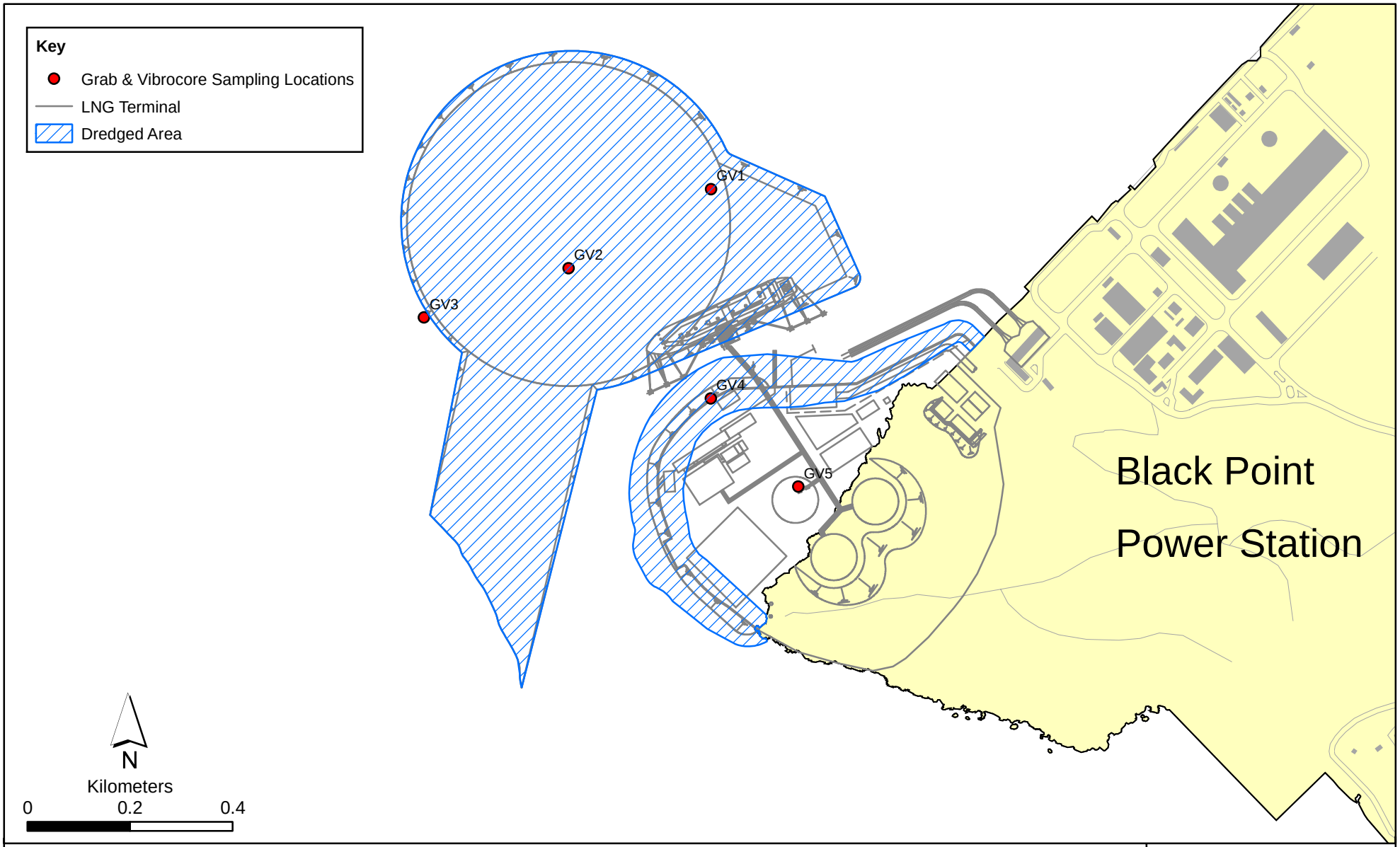


Figure 7.2

Black Point Marine Sediment Sampling Locations

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Date: 29/09/2006

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Based on the results of the preliminary marine sediment quality testing, heavy metal contamination exceeding the LCEL (including arsenic and silver) were found in the surface sediment at four of the five sampling locations (1). The sediments were classified as Category M sediment. Some of the sediment samples (at locations GV1 and GV2) failed the biological screening.

A total of 2.49 Mm^3 of sediment would be dredged in the turning basin area. About 2.14 Mm^3 of the sediments within the proposed dredging in the turning basin area were found to be Category L sediment and could be disposed of at a Type 1 open sea disposal site. About 0.15 Mm^3 of dredged surface sediments (down to approximately 1 m depth) were classified as Category M (failed the biological screening) and will require to be disposed of at a confined marine disposal site (i.e. Type 2 disposal) (see *Figure 7.2*). About 0.20 Mm^3 of category M sediments (GV3 down to 2 m depth) which passed the biological screening could be disposed at Type 1 dedicated open sea disposal site.

At present the East of Sha Chau Mud Pits are designated for confined marine disposal. Due to the size of these pits it is noted that capacity may not be available at the time of disposal. In view of such a situation an alternative site for confined marine disposal would be identified in discussion with the Marine Fill Committee (MFC) and the EPD.

A total of 0.66 Mm^3 of sediments would be dredged along the seawall, berthing trench and intake/outfall. Majority of sediments to be dredged (about 0.62 Mm^3) was uncontaminated and hence could be disposed of at a Type 1 open sea disposal site. A small portion of sediments to be dredged (about 0.04 Mm^3) were found to be category M contaminated but passed the biological screening and hence could be disposed at Type 1 dedicated open sea disposal site (2) (see *Table 7.5*).

(1) Of note is that laboratory errors occurred for silver and mercury analyses during the preliminary marine sediment analysis. The mercury and silver analytical results for all samples were therefore considered invalid and are not presented in this report. CAPCO carried out supplementary sediment grab sampling for which sampling locations (GV2, GV4 and GV5) were selected to cover the proposed project area and the laboratory analysis of mercury and silver along with other test parameters are presented in *Table 7.4*.

(2) The estimated dredged level for the seawall trench at Black Point is approximately -20mPD.

Table 7.4 Marine Sediment Testing Results

Sample Reference		Heavy Metals (mg kg^{-1})									Sediment Category	Biological Sample No.	Failed Biological Tests			Final Disposal
Drillhole No.	Depth (m) From-To	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)	Arsenic (As)	Silver (Ag)			Amphipod	Bivalve	Polychaete	
Reporting Limits		0.1	1	1	1	1	10	0.05	1	0.1						
LCEL		**1.5**	**80**	**65**	**40**	**75**	**200**	**0.5**	**12**	**1**						
UCEL		**4**	**160**	**110**	**40**	**110**	**270**	**1**	**42**	**2**						
GV1		0.1	20	14	16	61	67	NA	**16**	NA	M	1		x	x	**Type 2**
GV1	0.10-0.90m	<0.1	21	8.1	15	70	53	NA	**15**	NA	M	1		x	x	**Type 2**
GV1	0.90-1.90m	0.1	31	16	22	33	83	NA	12	NA	L					Type 1
GV1	1.90-2.90m	0.1	29	16	20	31	81	NA	10	NA	L					Type 1
GV1	2.90-4.00m	0.1	30	16	21	32	84	NA	12	NA	L					Type 1
GV1	4.00-5.00m	<0.1	20	8.3	13	22	50	NA	6.3	NA	L					Type 1
GV1	5.00-6.00m	0.2	33	17	22	30	80	NA	11	NA	L					Type 1
GV1	6.30-7.10m	0.1	34	18	24	30	84	NA	11	NA	L					Type 1
GV1	7.10-8.10m	0.1	23	17	21	30	82	NA	11	NA	L					Type 1
GV2		<0.2	28	17	21	60	86	0.08	**23**	0.2	M	2			x	**Type 2**
GV2	0.90-1.90m	0.1	30	16	15	32	77	NA	12	NA	L					Type 1
GV2	1.90-2.90m	0.1	29	16	21	31	80	NA	12	NA	L					Type 1
GV2	2.90-4.00m	0.1	30	16	21	31	85	NA	10	NA	L					Type 1
GV2	4.00-5.00m	0.1	29	16	20	30	82	NA	11	NA	L					Type 1
GV2	5.00-6.00m	<0.1	29	16	21	30	75	NA	11	NA	L					Type 1
GV3		0.2	28	20	16	52	78	NA	**14**	NA	M	3				Type 1 Dedicated Site
GV3	0.05-0.90m	0.1	30	16	21	31	77	NA	12	NA	L					Type 1
GV3	0.90-2.00m	0.1	31	16	21	29	79	NA	**13**	NA	M	3				Type 1 Dedicated Site
GV4		<0.2	22	15	18	46	81	0.06	**17**	0.2	M	4				Type 1 Dedicated Site
GV4	0.60-0.90m	<0.1	17	8.2	13	73	47	NA	**16**	NA	M	4				Type 1 Dedicated Site
GV4	0.90-1.90m	<0.1	30	13	18	23	65	NA	8.6	NA	L					Type 1
GV4	1.90-2.90m	<0.1	27	12	17	23	64	NA	8.6	NA	L					Type 1

Sample Reference		Heavy Metals (mg kg^{-1})									Sediment Category	Biological Sample No.	Failed Biological Tests			Final Disposal
Drillhole No.	Depth (m) From-To	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)	Arsenic (As)	Silver (Ag)			Amphipod	Bivalve	Polychaete	
Reporting Limits		0.1	1	1	1	1	10	0.05	1	0.1						
LCEL		**1.5**	**80**	**65**	**40**	**75**	**200**	**0.5**	**12**	**1**						
UCEL		**4**	**160**	**110**	**40**	**110**	**270**	**1**	**42**	**2**						
GV4	2.90-4.00m	0.1	33	14	19	30	76	NA	8.5	NA	L					Type 1
GV4	4.00-5.00m	0.1	35	15	19	31	72	NA	9.4	NA	L					Type 1
GV4	5.00-6.00m	0.1	32	14	18	29	66	NA	10	NA	L					Type 1
GV5		<0.2	33	33	23	35	98	0.10	12	0.3	L					Type 1
GV5	0.40-0.90m	<0.1	22	12	12	31	50	NA	11	NA	L					Type 1
GV5	0.90-1.90m	<0.1	8.1	3.8	4.5	26	26	NA	1.8	NA	L					Type 1
GV5	1.90-2.90m	<0.1	5	2.9	2.2	17	37	NA	1.6	NA	L					Type 1
GV5	2.90-4.00m	<0.1	5.3	3.7	2.3	18	24	NA	2.2	NA	L					Type 1
GV5	4.00-4.50m	0.1	5.1	15	3	38	57	NA	<1	NA	L					Type 1

Notes:

(a) NA = Results not available, not tested.

(b) Mercury and silver chemical testing results were not available for a number of samples due to laboratory equipment error occurred during the metal analysis. 3 additional grab samples (GV2, GV4, GV5) were subsequently undertaken for metal and metalloid analysis (Cd, Cr, Cu, Ni, Pb, Zn, Ag, As, Ag and CN) to supplement the missing data and the metals and metalloid analytical results are presented in the Table.

(c) **Bold** = Exceeding LCEL, classified as Category M, which requires biological screening to determine the types of disposal site (ie Type 1 or Type 2 Disposal).

(d) **Bold and underlined** = Exceeding UCEL, classified as Category H, Type 3 Disposal.

(e) **x** = Failed biological testing.

(f) Type 1 Disposal = disposal at an open sea disposal.

(g) Type 1 Dedicated Site = disposal at a dedicated open sea disposal site.

(h) Type 2 Disposal = disposal at confined marine disposal site.

Sample Reference		Total PCBs (ug kg^{-1})	Total PAHs (Low MW) (ug kg^{-1})	Total PAHs (High MW) (ug kg^{-1})	TBT in Interstitial Water (ug L^{-1})	Chlorinated Pesticides (ug kg^{-1})											
Drillhole No.	Depth (m)					Alpha BHC	Beta BHC	Gamma BHC	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor epoxide	Endosulfan 1	p, p'-DDT	p, p'-DDD	p, p'-DDE	Endosulfan sulfate
Reporting Limits		**2**	**550**	**1700**	**0.015**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
LCEL		**23**	**550**	**1700**	**23**												
UCEL		**180**	**3160**	**9600**	**180**												
GV1		<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	0.10-0.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	0.90-1.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	1.90-2.90m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	2.90-4.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	4.00-5.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	5.00-6.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	6.30-7.10m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV1	7.10-8.10m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2		<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2	0.90-1.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2	1.90-2.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2	2.90-4.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2	4.00-5.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV2	5.00-6.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV3		<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV3	0.05-0.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV3	0.90-2.00m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4		<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	0.60-0.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	0.90-1.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	1.90-2.90m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	2.90-4.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	4.00-5.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV4	5.00-6.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Sample Reference		Total PCBs (ug kg^{-1})	Total PAHs (Low MW) (ug kg^{-1})	Total PAHs (High MW) (ug kg^{-1})	TBT in Interstitial Water (ug L^{-1})	Chlorinated Pesticides (ug kg^{-1})											
Drillhole No.	Depth (m)					Alpha BHC	Beta BHC	Gamma BHC	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor epoxide	Endosulfan 1	p, p'-DDT	p, p'-DDD	p, p'-DDE	Endosulfan sulfate
Reporting Limits		**2**	**550**	**1700**	**0.015**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
LCEL		**23**	**550**	**1700**	**23**												
UCEL		**180**	**3160**	**9600**	**180**												
GV5		<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV5	0.40-0.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV5	0.90-1.90m	<2	<550	<1700	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV5	1.90-2.90m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV5	2.90-4.00m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GV5	4.00-4.50m	<2	<550	<1700	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Note:
(a) NA = Results not available, not tested.

Sample Reference		Redox Potential	TOC[b, c]	TOC[b]	TKN	Nitrate	Nitrite	Ammoniacal Nitrogen	Ortho-Phosphate	Total Phosphorous
Drillhole No.	Depth (m) From-To	mV	%	%	mg-N/kg	mg-N/kg	mg-N/kg	mg-NH_4-N/kg	mg-P/kg	mg-P/kg
Reporting Limits			1	0.1		50	1	1	1	1
LCEL										
UCEL										
GV1		370	0.40	0.61	<50	<1	<1	<1	30	4900
GV1	0.10-0.90m	360	0.40	0.79	120	<1	<1	7.6	35	5700
GV1	0.90-1.90m	350	0.40	0.83	470	1.5	<1	23	27	4500
GV1	1.90-2.90m	370	0.45	0.92	240	1.4	<1	16	27	4500
GV1	2.90-4.00m	350	0.35	0.53	<50	<1	<1	1.8	12	1900
GV1	4.00-5.00m	360	0.45	0.95	550	<1	<1	33	21	3400
GV1	5.00-6.00m	410	0.30	0.40	670	5.8	2.8	2.7	5.5	1600
GV1	6.30-7.10m	360	0.45	0.94	<50	5.3	3.3	<1	13	2100
GV1	7.10-8.10m	370	0.45	0.86	480	1.7	<1	32	5.4	840
GV2		380	0.30	0.62	320	2.8	<1	9.4	2.2	350
GV2	0.90-1.90m	400	0.35	0.71	400	1.3	1.2	14	1.7	260
GV2	1.90-2.90m	360	0.35	0.69	1000	1.5	<1	33	1.8	290
GV2	2.90-4.00m	370	0.40	0.82	1000	<1	<1	35	1.4	230
GV2	4.00-5.00m	354	0.45	0.89	1200	<1	<1	41	1.7	270
GV2	5.00-6.00m	390	0.25	0.36	850	<1	1.2	3.4	3.8	1100
GV3		390	0.45	0.93	250	<1	<1	13	4.6	720
GV3	0.05-0.90m	360	0.50	0.97	240	<1	<1	13	2.5	400
GV3	0.90-2.00m	400	0.30	0.44	710	<1	<1	2.8	2.1	610
GV4		420	0.35	0.52	510	1.2	1.2	2.0	1.5	410
GV4	0.60-0.90m	380	0.35	0.50	<50	<1	<1	<1	7.8	1300
GV4	0.90-1.90m	390	0.35	0.71	<50	2.2	2.7	1.6	13	2100
GV4	1.90-2.90m	380	0.35	0.70	<50	2.9	3.2	5.0	23	3900
GV4	2.90-4.00m	380	0.50	1.1	630	<1	<1	40	28	4600
GV4	4.00-5.00m	350	0.45	0.93	660	1.8	<1	42	14	2300
GV4	5.00-6.00m	370	0.50	0.98	700	<1	<1	45	5.8	970
GV5		420	0.35	0.57	560	4.4	1.2	2.2	1.4	380
GV5	0.40-0.90m	380	0.35	0.55	<50	<1	<1	<1	24	3900
GV5	0.90-1.90m	370	0.10	0.12	<50	3.0	<1	<1	5.8	900
GV5	1.90-2.90m	370	0.10	0.12	<50	<1	<1	<1	4.0	620
GV5	2.90-4.00m	410	0.10	0.13	<50	<1	<1	2.0	4.2	650

Sample Reference		Redox Potential	TOC[b, c]	TOC[b]	TKN	Nitrate	Nitrite	Ammoniacal Nitrogen	Ortho-Phosphate	Total Phosphorous
Drillhole No.	**Depth (m) From-To**	mV	%	%	mg-N/kg	mg-N/kg	mg-N/kg	mg-NH_4-N/kg	mg-P/kg	mg-P/kg
Reporting Limits			1	0.1		50	1	1	1	1
LCEL										
UCEL										
GV5	4.00-4.50m	420	<0.05	<0.05	<50	<1	<1	1.8	1.4	220

Notes:

(a) NA = Results not available, not tested.
(b) TOC = Total organic carbons.
(c) TOC are reported as wet weight.
(d) TKN = Total kjeldalh nitrogen.

Table 7.5 Estimated Quantities of Different Types of Marine Sediment to be Dredged (Mm^3)

Sediment Type	Turning Basin & Approach Channel	Seawall, Berthing Trench and Intake/ Outfall	Total
Type 1 Open Sea Disposal Site	2.14 (86%)	0.62 (94%)	**2.76 (87%)**
Type 1 Dedicated Open Sea Disposal Site	0.20 (8%)	0.04 (6%)	**0.24 (9%)**
Type 2 Confined Marine Disposal Site	0.15 (6%)	-	**0.15 (4%)**
Total	2.49	0.66	**3.15 (100%)**

The dredging works for the seawall, berthing trenching and intake/outfall construction will take about 160 days with approximately 6 barge trips per day (1). The dredging duration for the turning basin and approach channel is estimated at around 254 days with approximately 13 barge trips per day.

The dredged marine sediments will be loaded onto barges using closed grabs and transported to designated disposal sites depending on their level of contamination. In accordance with the *ETWBTC No 34/2002*, the Category M sediment will be dredged and transported with great care in order to avoid leakage of contaminated sediment into the sea. With the implementation of the mitigation measures recommended in *Section 7.6.2*, sediment disposal at the designated marine disposal sites is not expected to cause adverse environmental impacts.

The testing results presented in this report are for EIA purposes only. The procedures detailed below will be followed prior to obtaining a dumping license. A proposal for sampling and chemical testing of the sediment will be prepared and submitted to the EPD for approval. The approved detailed sampling and chemical testing will be carried out prior to the commencement of the dredging activities to confirm the sediment disposal method. After carrying out the sampling and testing, a *Sediment Quality Report* (SQR) will be prepared for EPD approval as required under the *Dumping at Sea Ordinance*. The SQR will include the sampling details, the chemical testing results, quality control records, proposed classification and delineation of sediment according to the requirements of the Appendix A of *ETWB TC 34/2002*.

The final disposal site will be determined by the MFC and a dumping licence will be obtained from the DEP prior to the commencement of the dredging works.

The potential water quality impacts due to the dredging and disposal of these sediments are assessed and presented in *Section 6, Water Quality Impact*

(1) Dredging rates are calculated at 9,800 m^3/day (4,900 m^3 per dredger per day, with 2 dredgers working on-site). Number of trips required for transportation of dredged sediment from dredging area(s) was calculated using a 750 m^3 loading on each barge.

Assessment. The assessment concluded that the dredging works can meet the relevant assessment criteria with the implementation of mitigation measures recommended in *Section 6*.

C&D Materials

To accommodate the necessary infrastructures of the LNG terminal at Black Point, a total of approximately 32 ha of land will be required. The majority of the land will be formed through reclamation, however, excavation of the Black Point headland will be undertaken to provide suitable screening for the LNG tanks.

Approximately 3 hectares of land within the northern face of the existing Black Point headland will be excavated to approximately +6 mPD for the two LNG storage tanks. A third LNG storage tank can be constructed on the reclaimed land. Site clearance and slope cutting of the Black Point Headland by blasting and excavation will be required. The excavated materials will comprise of both rock and soft materials and small amount of site clearance wastes.

Excavated Materials

Rock and soil will be excavated from site formation works and that will be reused as fill material for the reclamation within the Project as far as practicable. A rock crushing plant will be provided to process excavated rock to the required size for reuse. The quantities of excavated/filling materials are presented in *Table 7.6*.

Table 7.6 Summary of Quantity of Excavated/Fill Materials

Construction Works	Rock		Soil	
	In-situ Volume (m^3)	Period	In-situ Volume (m^3)	Period
Excavation	770,000	early 2009 – early 2010	220,000	early 2009 – end 2009
Filling	785,000	early 2009 – late 2009	2,100,000 (a)	mid 2009 – end 2009
Surplus (+) / Deficit (-)	-15,000	early 2009 – late 2009	-1,880,000	early 2009 – early 2010

Note:
(a) 2,100,000 m^3 of fill comprise 1,560,000 m^3 of marine fill and 540,000 m^3 of public fill.

Excavated Soil

Due to limited space at the Black Point site, all excavated soil (about 0.22 Mm^3) will need to be initially removed from site and stored at a suitable stockpile site. It is intended that the material will be returned to the site and reused as fill for the site formation works or within the reclamation. Several possible stockpile sites, which can be accessed by barge, have been identified and the

availability of these sites is being investigated with the District Land Office (DLO).

An alternative option is to reuse the excavated soil in other concurrent public and private construction projects either in Hong Kong or China. If all these options are not feasible, as a last resort, the excavated soil will be delivered to the public fill reception facilities such as Tuen Mun Area 38 or other locations as agreed with CEDD.

Excavated Rock

Due to limited space at the site, all rock material (about 0.77 Mm^3) will need to be initially removed from site. It is intended that the excavated rock will be taken to a quarry in China for processing. The processed material will be subsequently reused within the project for the submarine gas pipeline bedding works or within the reclamation. However, this option of sending the excavated rock to quarry in China will be subject to obtaining approval from the PRC government for which further investigation will be required.

To supplement the above, some of the excavated rock may be sent to the Lam Tei Quarry. The amount that may be sent to the quarry will be limited in order to reduce the impact on existing road traffic.

Construction Waste

The non-inert construction waste consisting of timber, paper, plastics and general refuse (about 0.07 Mm^3) (1) generated from site clearance works cannot be reused and need to be disposed of at the West New Territories (WENT) Landfill.

C&D Materials Arising from New Building Construction

C&D materials consisting of waste concrete, packing materials, plastics, metal, concrete, wood, etc will be generated from the new building construction. The gross floor areas (GFA) of the main structures to be constructed are summarized in *Table 7.7*.

(1) This is the best estimate based on the latest site layout, nature of vegetation and area to be cleared.

Table 7.7 GFA of Major New Buildings

New Building	GFA (m^2)
Administration building	1,000
Control room	750
Maintenance / warehouse building	800
Electrical substation	800
Gate house	50
Total GFA:	**3,400**

Based on a generation rate of 0.1 m^3 per m^2 of GFA constructed (1), it is estimated that a total of about 340 m^3 of C&D materials will be generated. These materials will be sorted on-site for public fill (inert portion) (about 272 m^3) and construction waste (68 m^3) (2) in order to reduce the amount of construction waste to be disposed of at landfills and the cost for disposal of the C&D materials arising from the Project.

With proper implementation of good construction site practice and the mitigation measures recommended in *Sections 4, 5* and *6*, the handling and transportation of C&D materials to the disposal sites will not cause adverse dust, noise or water quality impacts.

Chemical Wastes

Chemical waste, as defined under the *Waste Disposal (Chemical Waste) (General) Regulation*, includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*. A complete list of such substances is provided under the *Regulation*; however, substances likely to be generated from the construction of the LNG terminal will, for the most part, arise from the maintenance of construction plant and equipment. These may include, but not limited to the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used paint, engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils/cleaning fluids from mechanical machinery; and
- Spent solvents/solutions from equipment cleaning activities.

Chemical wastes may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the *Waste Disposal (Chemical Waste) (General) Regulation* and the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. These hazards may include:

- Toxic effects to workers;

(1) Reduction of Construction Waste Final Report (March 1993). Hong Kong Polytechnics.

(2) Forecast ratio for (C&D waste) : (public fill) is 2 : 8 (Source: Monitoring of Solid Waste in Hong Kong 1997)

- Adverse effects on air, water and land from spills; and
- Fire hazards.

The amount of chemical waste that will arise from the construction activities will be highly dependent on the Contractor's on-site maintenance activities and the quantity of plant and equipment utilized. With respect to the nature of construction works, it is estimated that a few hundred litres of used lubricant oil will be generated per month during the construction period. It is anticipated that the quantities of waste solvent and wasted paint will be minimal.

With the incorporation of suitable arrangements for the storage, handling, transportation and disposal of chemical wastes under the requirements stated in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste*, no adverse environmental and health impacts, and hazards will result from the handling, transportation and disposal of chemical waste arising from the Project.

Sewage

Sewage will arise from the construction workforce, site office's sanitary facilities and from portable toilets. If not properly managed, these materials could cause odour and potential health risks to the workforce by attracting pests and other disease vectors.

It is conservatively assumed up to 1,600 construction workers will be involved in the construction of the LNG terminal. With a sewage generation rate of 0.15 m^3/worker/day (1), about 240 m^3 of sewage will be generated per day. The sewage generated will either be conveyed to public sewage treatment works (STW) or treated by on-site STW (see *Section 6.6.7*). If a small sewage treatment work (STW) will be used, the sewage will be treated to the required effluent discharge standards as stipulated in the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* before discharging into sea. Therefore, no adverse water quality impacts are envisaged. The wastewater discharge impacts have also been discussed in *Section 6*. Since the site is remote and the plant will be designed and operated to reduce odour, adverse odour and noise impacts are not expected.

About 0.26 m^3 (at 30% dry solids) of dewatered sewage sludge will be produced per day from the operation of the sewage treatment plant. It will be disposed of directly to the WENT Landfill. Due to the small quantity of sludge to be disposed of at landfill, it will not have adverse operational to the landfill.

(1) Based on Table 2 of the Drainage Services Department's Sewerage Manual.

Since the STW will be enclosed and the nearest ASR is identified at 600 m away, potential odour impact from the STW will be negligible.

General Refuse

The presence of a construction site with workers and associated site office will result in the generation of general refuse (mainly consist of food waste, aluminium cans and waste paper) which requires off-site disposal. The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if the waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. These secondary impacts are discussed in *Section 6*. The site may also attract pests, vermin, and other disease vectors if the waste storage areas are not well maintained and cleaned regularly. Licensed chemical waste management contractor will be engaged for the collection, handling, transportation and disposal of the general refuse.

Assuming up to 1,600 construction workers will be working on site at any one time. With a general refuse generation rate of 0.65 kg per worker per day (1), the amount of general refuse to be generated will be about 1,040 kg per day.

Recyclable materials such as paper and aluminium cans will be separated and delivered to the recyclers. Adequate number of waste containers will be provided to avoid over-spillage of waste. The non-recyclable waste will be collected and disposed of at the North West New Territories refuse transfer station on daily basis. With respect to the small quantity of general refuse to be transferred via the North West New Territories refuse transfer station or directly to the WENT Landfill, it is not anticipated that it will cause adverse operational impact to these facilities.

Provided that the mitigation measures recommended in *Section 7.6* are adopted, no adverse environmental impacts caused by the storage, handling, transport and disposal of general refuse are expected.

7.5.2 *Operational Phase*

Dredged Marine Sediment

As the proposed Project area is located within the Pearl River Delta, it is anticipated that continuous deposition of marine sediment will occur through out the project period. In order to enable the safe transit of the LNG carrier, periodic maintenance dredging of the approach channel and turning basin for the LNG carrier will be required. It is anticipated that approximately 10 to 20 cm of marine sediment deposition per year (please refer to *Section 6*) will occur in the Project area. Based on this estimate, maintenance dredging will be required once every four to five years and will be restricted to the turning

(1) This is considered as a conservative estimate based on the number reported in a number of EIA reports approved under the EIAO.

basin and approach channel areas. Bathymetric surveys will be carried out to ascertain the volume of marine sediment to be removed due to siltation.

Regarding the sediment quality testing results at the turning basin and surrounding area (summarized in *Table 7.4*), the dredged sediment within the turning basin is anticipated to be contaminated and would be disposed at respective designated sites according to the level of contamination. However, a separate sediment quality testing would be conducted prior to the maintenance dredging works to confirm the level of contamination and to identify the disposal method. The sediment quality testing would follow the requirement set out in the *ETWBTC 34/2002*. The final disposal site would be determined by the MFC and a dumping licence will be obtained from the DEP prior to the commencement of the maintenance dredging works.

Other potential impact from the maintenance dredging activities, such as water quality has been discussed in *Section 6*. Proposed mitigation measures, monitoring and audit requirement have also been discussed in *Section 6*.

Industrial Waste

Industrial waste will arise from the maintenance activities at the LNG terminal. The materials may include scrap materials from maintenance of plant and equipment and cleaning materials. Provided the scrap materials are collected regularly for recycling, it is not expected that storage, handling, transport and disposal of industrial waste will cause any adverse environmental impacts. General industrial waste such as plastic, metal cans and waste paper, will be collected together with the general refuse disposed of at the refuse transfer station at North West New Territories or directly to WENT Landfill.

Chemical Waste

With respect to the operation activities of the terminal, it is anticipated that chemical waste will be generated from laboratory and also the maintenance activities at the LNG terminal. The chemical wastes include various chemical reagents, lubricants from air and BOG compressors, firewater and potable water pumps, generators, and hydraulic loading arm package. The quantity of laboratory waste (including various chemical reagents) and used lubricant oil to be generated are estimated to be 550 m^3 and 1.5 m^3 per year, respectively(1). The quantity of the chemical wastes generated is small. The chemical waste will be collected by a licensed chemical waste collector for disposal at the Chemical Waste Treatment Centre at Tsing Yi. The handling, storage, collection and transportation of chemical waste will be undertaken in accordance with requirement stated in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste*, and no adverse environmental impacts and hazards are anticipated.

(1) This is estimated with reference to the operation of other similar LNG terminals.

Sewage

Sewage will arise from the operation staff and canteen facilities. Assuming up to 100 staff will be working on-site and the sewage generated from the sanitary system (about 6 m^3 per day) and kitchen (about 29 m^3 per day) will be approximately 35 m^3 per day (1). A small sewage treatment system will be provided on-site to treat the wastewater to the required effluent discharge standards as stipulated in the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* before discharging into sea. Therefore, no adverse water quality impacts are envisaged. Since the site is remote and the plant will be designed and operated to reduce odour and noise, therefore adverse odour and noise impacts from the sewage treatment system are not expected.

About 0.02 m^3 (at 30% dry solids) of dewatered sewage sludge per day (2)will arise from the operation of the sewage treatment plant. It will be disposed of directly to the WENT Landfill. Due to the small quantity of sludge to be disposed of at landfill, it will not have any adverse operational effect to the landfill.

General Refuse

General refuse will arise from the operation staff and administrative activities. General refuse may consist of food waste, plastic, aluminium can and waste paper. With a general refuse generation rate of 0.65 kg per worker per day (3), the amount of general refuse to be generated will be about 65 kg per day.

Recyclable materials (i.e. paper, plastic bottle and aluminium can) will be separated and delivered to recyclers in order to reduce the amount of general refuse to be disposed of at landfill. The non-recyclable general refuse will be disposed of by barge to the refuse transfer station at North West New Territories or directly to landfill on a regular basis. With respect to the small quantity of general refuse to be disposed of, no adverse environmental impact associated with the handling and disposal of the refuse is anticipated.

7.6 MITIGATION OF ADVERSE IMPACTS

This section recommends the mitigation measures to avoid or reduce potential adverse environmental impacts associated with handling, collection and disposal of waste arising from the construction and operation of the proposed LNG terminal.

(1) Based on Table 2 of the Drainage Services Department's Sewerage Manual. Unit flow factor for employee = 60L/head/day. Unit flow factor for commercial activities (canteen) = 290L/head/day.

(2) It is estimated based on the quantity of BOD removed.

(3) This is considered as a conservative estimate based on the number reported in a number of EIA reports approved under the EIAO.

The Contractors will incorporate these recommendations into a Waste Management Plan for the construction works. The Contractors will submit the plan to CAPCO's Engineer Representative for endorsement prior to the commencement of the construction works. Such plan will incorporate site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

It is the Contractor's responsibility to ensure that only reputable licensed waste collectors are used and that appropriate measures to reduce adverse impacts, including windblown litter and dust from the transportation of these wastes, are employed. In addition, the Contractor must ensure that all the necessary permits or licences required under the Waste *Disposal Ordinance* are obtained for the construction and operational phases.

Waste Management Hierarchy

The various waste management options are categorised in terms of preference from an environmental viewpoint. The options considered to be most preferable have the least environmental impacts and are more sustainable in the long term. The hierarchy is as follows:

- Avoidance and reduction;
- Reuse of materials;
- Recovery and recycling; and,
- Treatment and disposal.

The above hierarchy has been used to evaluate and select waste management options. The aim has been to reduce waste generation and reduce waste handling and disposal costs.

CAPCO will ensure that their contractors consult the EPD for the final disposal of wastes and as appropriate implement the good site practices and mitigation measures recommended in this EIA Study and those given below.

- Nomination of approved personnel 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 handling procedures;
- Provision of sufficient waste disposal points and regular collection for disposal;
- Appropriate measures to reduce windblown litter and dust transportation of waste by either covering trucks or by transporting wastes in enclosed containers;

- Separation of chemical wastes for special handling and appropriate treatment at the Chemical Waste Treatment Centre;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors; and
- A recording system for the amount of wastes generated/recycled and disposal sites.

Waste Reduction Measures

Good management and control can prevent generation of 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:

- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of material and their proper disposal;
- Encourage collection of aluminium cans and waste paper by individual collectors during construction with separate labelled bins provided to segregate these wastes from other general refuse by the workforce;
- Any unused chemicals and those with remaining functional capacity will be recycled as far as possible;
- Use of reusable non-timber formwork to reduce the amount of C&D materials;
- Prior to disposal of construction waste, wood, steel and other metals will be separated to the extent practical, for re-use and/or recycling to reduce the quantity of waste to be disposed of to landfill;
- Proper storage and site practices to reduce the potential for damage or contamination of construction materials; and
- Plan and stock construction materials carefully to reduce amount of waste generated and avoid unnecessary generation of waste.

7.6.1 Dredged Materials

For sediments dredged during the construction of the LNG terminal, their disposal will be as indicated in *Section 7.5.1*, and in accordance with the requirements of the *ETWBTC No 34/2002*.

Detailed sampling and chemical testing will be carried out prior to the commencement of the dredging activities to confirm the sediment disposal method. The final disposal site will be determined by the Marine Fill Committee (MFC) and a dumping licence will be obtained from EPD prior to

the commencement of the dredging works. Uncontaminated sediments will be disposed of at open sea disposal sites designated by the MFC. For contaminated sediments requiring Type 2 confined marine disposal, CAPCO will ensure that the relevant contract documents will specify the allocation conditions of the MFC and EPD.

7.6.2 *Excavated Materials*

Management of Waste Disposal

The contractor will open a billing account with EPD in accordance with the *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* for the payment of disposal charges. Every waste load transferred to Government waste disposal facilities such as public fill, sorting facilities, landfills or transfer station will require a valid "Chit" which contains the information of the account holder to facilitate waste transaction recording and billing to the waste producer. A trip-ticket system will be established in accordance with *ETWBTC No. 31/2004* to monitor the reuse of surplus excavated materials offsite and disposal of C&D waste and general refuse at transfer stations/landfills, and to control fly-tipping. The billing "chit" and trip-ticket system will be included as one of the contractual requirements and implemented by the contractor. CAPCO will also conduct regular audits of the waste management measures implemented on site as described in the Waste Management Plan.

A recording system (similar to summary table as shown in Annex 5 and Annex 6 of Appendix G of *ETWBTC No. 19/2005*) for the amount of waste generated, recycled and disposed of (including the disposal sites) will be established during the construction stage.

Measures for the Reduction of C&D Materials Generation

Majority of the inert C&D materials (rock and soil) will be reused within the Project. Public fill and construction waste shall be segregated and stored in different containers or skips to facilitate reuse or recycling of materials and their proper disposal. Specific areas of the work site will be designated for such segregation and storage if immediate use is not practicable.

7.6.3 *Chemical Waste*

Chemical waste producers will be registered with the EPD.

Chemical waste, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation*, will be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows. Containers used for storage of chemical wastes will:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;

- Have a capacity of less than 450 L unless the specifications have been approved by the EPD; and
- Display a label in English and Chinese in accordance with instructions prescribed in *Schedule 2* of the *Regulations*.

The storage area for chemical wastes will:

- Be clearly labelled and used solely for the storage of chemical waste;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- Have adequate ventilation;
- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposed of as chemical waste, if necessary); and
- Be arranged so that incompatible materials are appropriately separated.

Chemical waste will be disposed of:

- Via a licensed waste collector; and
- To a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers.

7.6.4 Sewage

An adequate number of portable toilets will be provided for the on-site construction workforce. The sewage generated from the construction works will be treated by on-site sewage treatment plant. The sludge will be sent to the WENT Landfill by licensed collector on a regular basis.

7.6.5 General Refuse

General refuse will be stored in enclosed bins or compaction units separately from construction and chemical wastes. A reputable waste collector will be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

Recycling bins will be provided at strategic locations to facilitate recovery of aluminium can and waste paper from the site. Materials recovered will be sold for recycling.

7.6.6 *Industrial Wastes*

Industrial waste arising from maintenance activities will be segregated. It is recommended to send scrap metals for recycling to reduce the overall quantity of waste disposed from these activities.

7.6.7 *Staff Training*

Training will be provided to workers on the concepts of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the construction works.

7.7 *RESIDUAL ENVIRONMENTAL IMPACTS*

With the implementation of the recommended mitigation measures no adverse residual impacts are anticipated from the construction and operation of the LNG terminal.

7.8 *ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS*

7.8.1 *Construction Phase*

To facilitate monitoring and control over the contractors' performance on waste management, a waste monitoring and audit programme will be implemented throughout the construction phase. The aims of the monitoring and audit programme are:

- To review the Contractor's WMP including the quantities and types of C&D materials generated, reused and disposed of off-site; the amount of fill materials exported from/imported to the site and the quantity of timber used in temporary works construction for each process/activity;
- To monitor the implementation and achievement of the WMP on site to assess its effectiveness; and
- To monitor the follow-up action on deficiencies identified.

Joint site audits by the CAPCO and the contractor will be undertaken on a weekly basis. Particular attention will be given to the contractor's provision of sufficient spaces, adequacy of resources and facilities for on-site sorting and temporary storage of C&D materials. The C&D materials to be disposed of from the site will be visually inspected. The public fill for delivery to the off-site stockpiling area will contain no observable non-inert materials (e.g. general refuse, timber, etc). Furthermore, the waste to be disposed of at refuse transfer stations or landfills will as practicable contains no observable inert or reusable/recyclable C&D materials (e.g. soil, broken rock, metal, and paper/cardboard packaging, etc). Any irregularities observed during the weekly site audits will be raised promptly to the contractor for rectification.

To facilitate assessment of the effectiveness of the waste management measures, the WMP will state the performance targets to be achieved in reducing or minimising generation of C&D materials taking account the site constraints. The performance targets will cover the following items and will be agreed with the CAPCO at the beginning of the contract.

- The percentage of excavated materials to be sorted to recover the soil and broken rock for reuse on site or deliver to the off-site stockpiling area;
- The percentage of metal to be recovered for collection by recycling contractors; and
- The percentage of cardboard and paper packaging (for plant, equipment and materials) to be recovered. The recovered materials will be properly stockpiled in dry and covered condition to prevent cross contamination by other wastes.

The findings of the waste audits will be reported in the *Environmental Monitoring and Audit Reports*.

7.8.2 *Operational Phase*

As it is not expected that large quantities of waste will be generated from the operation of the LNG terminal and no adverse environmental impacts will arise with the implementation of good waste management practices, waste monitoring and audit programme for the operational phase of the LNG terminal is not required.

7.9 *CONCLUSIONS*

7.9.1 *Construction Phase*

Optioneering has been conducted to try to avoid waste generation and reuse and recycling of waste generated from the construction of the terminal during the planning and design stages and consideration of options for layout, construction methods and programme, and the proposed scheme comprises the Applicants' proposed best balance. The key potential impacts during the construction phase are related to wastes generated from site clearance, site formation, blasting, dredging, reclamation, seawall construction, filling and concreting.

It is estimated that a total of approximately 3.15 Mm^3 of marine sediment will be dredged between late 2008 and early 2010. It is estimated that about a total of 2.76 Mm^3 of the sediments are uncontaminated and could be disposed of at open sea disposal site. About 0.24 Mm^3 of the contaminated sediment will be disposed of dedicated open sea disposal site. The remaining portion of contaminated sediment (0.15 Mm^3) will have to be disposed of at the confined marine disposal site. The final disposal site will be subject to

detailed sediment sampling, testing and analysis in accordance with the *ETWBTCW 34/2002* and disposal method reviewed prior to the commencement of the dredging activities. In addition, CAPCO will liaise with the MFC for the designated disposal site and a dumping licence will be applied from the DEP prior to the commencement of the dredging work.

Approximately 0.07 Mm^3 construction wastes will be generated from the site clearance works and will be disposed of at the WENT Landfill.

Approximately 0.22 Mm^3 of excavated soil will need to be initially removed from site. Suitable stockpiling sites are currently being sought at this stage and if this is not possible, the excavated soil will be reused in other concurrent construction projects either in Hong Kong or China. If all these options are not feasible, as a last resort, the surplus excavated soil may have to be disposed of at the public fill reception facilities at Tuen Mun Area 38 or other locations as agreed with CEDD.

Due to limited space on site, it is intended that all the excavated rock (approximately 0.77 Mm^3) generated from the site formation works will be taken to a quarry in China for processing and subsequently reused within the project. Some of the excavated rock may also be sent to the Lam Tei Quarry.

The construction programme is preliminary and subject to reduce, therefore, the Contractor's programme will be reviewed by CAPCO when the construction programme is finalized.

About 340 m^3 of C&D materials will be generated during the construction of new buildings. A few hundred litres of used lubrication oil will be generated per month and a maximum of about 1,040 kg of general refuse will be generated each day. A small quantity of dewatered sludge (i.e. approximately 0.26 m^3 per day) will be generated from the on-site sewage treatment works. In view of the small quantity of waste generated, the handling and disposal of the waste generated from construction of new buildings, chemical wastes, general refuse and sludge to licensed facilities will not cause any significant environmental impacts. With the implementation of the recommendations in *Section 7.6*, the potential environmental impacts arising from storage, handling, collection, transport and disposal of wastes is expected to meet the criteria specified in the *EIAO-TM*. No adverse waste management impact is anticipated based on the information available. No residual and cumulative environmental impacts and hazards associated with handling and disposal of wastes arising from the construction of the LNG terminal proposed at Black Point are anticipated.

A Waste Management Plan will be prepared by the Contractors and will be audited through the environmental monitoring and auditing (EM&A) programme recommended in *Section 7.8* to reduce the potential environmental impact arising from waste management.

7.9.2 *Operational Phase*

With good site practice, the potential environmental impacts associated with the storage, handling, collection, transport and disposal of a small quantity of industrial, general refuse, sewage and chemical wastes arising from the operation of the LNG terminal proposed at Black Point will meet the criteria specified in the *EIAO-TM* and no unacceptable waste management impact is anticipated.

Handling of marine sediments resulting from maintenance dredging will be carried out in accordance with the *ETWBTCW 34/2002* and disposal method reviewed prior to the commencement of the dredging activities.

No residual and cumulative environmental impacts and hazards associated with handling and disposal of wastes arising from the operation of the LNG terminal proposed at Black Point are anticipated.