6 Waste Management Implications

6.1 Introduction

This chapter presents the findings of the assessment of waste management implications arising from the NENT Landfill Extension during the construction, operation, restoration and aftercare phases. Opportunities for waste avoidance, minimisation, reuse, recycling and disposal were examined. With the construction material import/export balancing design approach and the appropriate mitigation measures implemented during the different phases of the Project, potential environmental impacts associated with waste management would be insignificant.

The waste management implication assessment has been conducted in accordance with the requirements of Annexes 7 and 15 of the TM-EIAO and Clause 3.4.4 of the EIA Study Brief for the Project.

6.2 Legislation, Standards and Guidelines

The relevant legislation and associated guidance notes applicable to the study for the assessment of waste management implications include:

- Waste Disposal Ordinance (Cap.354) and subsidiary Regulations;
- Environmental Impact Assessment Ordinance (Cap 499) and subsidiary Regulations;
- Land (Miscellaneous Provisions) Ordinance (Cap 28);
- Public Health and Municipal Services Ordinance (Cap 132);
- Hong Kong Planning Standards and Guidelines (HKPSG), Chapter 9 – Environment;
- A Policy Framework for the Management of Municipal Solid Waste (2005-2014);
- Waste Reduction Framework Plan, 1998 – 2007, Planning Environment and Lands Branch, Government Secretariat;
- Code of Practice on the Packaging, Labeling and Storage of Chemical Wastes, EPD (1992);
- Environment, Transport and Works Bureau Technical Circular (Works) (ETWB TC(W)) No. 33/2002 Management of Construction and Demolition Material Including Rock;
- ETWB TC(W) No.31/2004 Trip Ticket System for Disposal of Construction and Demolition Materials;
- ETWB TC(W) No. 19/2005 Environmental Management on Construction Sites;
- WBTC No. 12/2002, Specifications Facilitating the Use of Recycled Aggregates;
- WBTC Nos. 25/99, 25/99A and 25/99C. Incorporation of Information on Construction and Demolition Material Management in Public Works Subcommittee Papers; and

6.3 Assessment Methodology

The waste management hierarchy principle was adopted following the order of preference: avoidance > minimisation > reuse > recycling > treatment > disposal. Opportunities for reducing waste generation have been critically assessed for:

- Avoiding or minimising waste generation through changes in the design;
- Implementing management practices to promote segregation of wastes; and
- Reuse and recycling.

Waste types and quantities estimation are made reference to the existing capacities of the waste disposal facilities. Disposal options for each waste type consider the environmental implications of handling, collection and disposal of such wastes.

The assessment of waste management implication comprises the following:

- Analysis of activities and waste generation to identify the quantity, quality and timing of the waste arising as a result of the construction, operation, restoration and aftercare activities of the Project, based on the sequence and duration of these activities:
  - Construction and operation phases – excavated construction materials from site preparation; chemical waste arising from maintenance of plant and equipment; sludge from leachate treatment plant; general waste from daily activities; and
  - Restoration and aftercare phases – chemical waste arising from maintenance of plant and equipment; sludge from leachate treatment plant; general waste from daily activities.
- Proposal for waste management:
  - Prior to considering the disposal options for various types of wastes, opportunities for reducing waste generation, on-site or off-site re-use and recycling are fully evaluated. Measures which can be taken in the planning and design stages e.g. by modifying the design approach and in the construction stage for maximising waste reduction were individually considered;
  - After considering all the opportunities for reducing waste generation and maximising re-use, the types and quantities of the wastes required to be disposed of as a consequence are estimated and the disposal options for each type of waste described in detail. Pretreatment processes for slurry before disposal are addressed in details. The disposal method recommended for each type of waste has been considered for the result of the assessment below; and
  - The impact caused by handling (including labelling, packaging and storage), collection, and reuse/disposal of wastes is addressed in detail and appropriate mitigation measures have been proposed. The assessment covers the potential hazard, air and odour emissions, noise, wastewater discharge and public transport.

6.4 Identification and Evaluation of Waste Management Implications

6.4.1 Analysis of Activities and Waste Generation

6.4.1.1 Construction and Operation Phases

During the construction and operation phases between 2009 and 2019, a variety of wastes will be generated including excavated construction materials, chemical waste, general refuse and sludge from leachate treatment plant.

Excavated Construction Material

Given the remote location of the site, the site formation works will be based on a material balance approach and no significant import or export of soil materials is expected. To construct the landfill bowl, ~6.2Mm^3 of construction materials will be excavated from the existing Stockpile and Borrow Area, ~2.2Mm^3 of which will be used as fill material for site formation while the remaining will be stockpiled on-site for future use during operation phase as daily cover and final capping materials. [6-1]

The DBO Contractor will be responsible for sorting construction materials into inert and non-inert portions. Inert portion of construction materials should be reused on-site as far as practicable, whilst any non-inert portion should be reused whenever possible and be

[6-1] With reference to the existing NENT Landfill, volume of final capping layer ≈ 0.5Mm^3; volume of daily cover + haul raods + channels is about 17% of the void space ≈ 3.5Mm^3. Total fill required ≈ 4Mm^3.

disposed of as a last resort. The contract documents should specify that no excavated materials are to be removed from the site.

Chemical Waste

The Waste Disposal (Chemical Waste) (General) Regulation defines chemical waste as any substance being scrap material or unwanted substances specified in its Schedule 1, and provides a complete list of such substances. Substances likely to be generated by construction and operation activities would mainly arise from the maintenance of plants and equipment. These include:

- Scrap batteries or spent acid/alkali;
- Used engine oils, lubricating and hydraulic fluids and waste fuel;
- Spent mineral oils/ cleaning fluids from mechanical machinery; and
- Spent solvents/ solutions, some of which may be halogenated, from equipment cleaning activities.

The volume of chemical waste arising will depend upon the total number of plants and equipment and the level of maintenance. Chemical waste data of the existing NENT Landfill is benchmarked for a conservative estimation of waste quantity arising from the future extension. The typical quantities of chemical waste arising during construction and operation phases of existing NENT Landfill in 2005 are summarised in Table 6.1.

Table 6.1: Estimated quantities of chemical waste arising during construction and operation phases of NENT Landfill Extension

Description	Existing NENT Landfill (in 2005)	NENT Landfill Extension (Estimated for 10 years)
Waste battery	50 pieces	500 pieces
Spent lube oil filters and rag from mobile plants	150kg	1,500kg
Spent lube oil from routine operation	30,000L	300,000L
Spent acid from laboratory	80L	800L

General Refuse

The general refuse during the construction and operation of the existing NENT Landfill encompasses a wide variety of waste, e.g. site office activities, kitchen refuse, packaging of equipment and construction materials, maintenance of plants and equipment, etc, and the total volume would depend on the employed workforce on-site.

The typical quantities of general refuse arising from ~100 staff during the construction and operation phases of the existing NENT Landfill was 280 tonnes in 2005.

Assuming the number of staff during the construction and operation of future NENT landfill extension would be similar, the total quantity of general refuse arising from the 10-year construction and operation phases is ~2,800 tonnes.

Sludge

Though it is preferable to use the existing leachate treatment plant for the future landfill extension, a new treatment plant with a capacity of 1,200 m^3 per day is planned as a worst-case scenario.

The typical quantity of sludge arising from the leachate treatment plant during the construction and operation phases of the existing NENT Landfill was 3,270 m^3 in 2005.

Assuming the same treatment capacity (i.e. 1,200 m^3 per day) throughout the 10-year of construction and operation phases of the future NENT Landfill Extension, the total quantity of sludge generated would be ~32,700 m^3.

6.4.1.2 Restoration and Aftercare Phases

During the restoration and aftercare phases between 2019 and 2049, chemical waste, sludge from leachate treatment plant, and general refuse will be the major waste stream anticipated. The DBO Contractor should also consider the reuse and recycling of wastes as far as practicable, thereby reducing the level of generation.

Chemical Waste

With reference to the existing NENT Landfill, the estimated quantity of chemical waste generated from the restoration and aftercare phases is assumed to be approximately 30% of that during construction and operation phases of NENT Landfill Extension due to the substantial reduction of number of plants and equipment on-site, as summarised in Table 6.2.

Table 6.2: Total estimated quantity of chemical waste arising during restoration and aftercare phases of NENT Landfill Extension

Description	Construction & Operation (Estimated for 10 years)	Restoration & Aftercare (Estimated for 30 years)
Waste battery	500 pieces	450 pieces
Spent lube oil filters and rag from mobile plants	1,500kg	1,350kg
Spent lube oil from routine operation	300,000L	270,000L
Spent acid from laboratory	800L	720L

General Refuse

Based on the above estimated quantity of general waste (~2,800 tonnes) for 100 workers during the 10-year construction and operation phases and assuming on average ~20 workers would also be present on site for 6 days a week during the 30-year restoration and aftercare phases, the total general refuse arising would be ~1,680 tonnes.

Sludge

The quantity of leachate generated from the existing landfill during restoration and aftercare phases is estimated to be ~300m^3/day. On pro-rata from the estimated quantity of sludge in section 6.4.1.1, the total sludge arising from the 30 years of restoration and aftercare phases would be ~25,000 m^3.

6.4.2 Waste Management Proposal

6.4.2.1 Construction and Operation Phases

Excavated Construction Materials

Although significant amount of excavated construction materials will be generated during site formation stage, there would be no significant import or export of soil materials. With the implementation of proper preventive and mitigation measures for handling, transport and disposal, no insurmountable environmental impact is anticipated.

It is not anticipated to have any significant quantities of excavated construction materials requiring off-site disposal. Notwithstanding this, a trip-ticket system should be put in place in accordance with ETWB TC(W) No.31/2004. Copies/counterfoils from trip-tickets (showing the quantities of construction Materials taken off-site) should be kept for record purposes.

Chemical Waste

Chemical waste can pose serious environmental, health and safety hazards if not properly managed. Such hazards include toxic effects to workers, adverse effects on water quality from spills, fire hazards, and disruption of sewage treatment plant should the chemical

waste enter the sewerage system. Plant and equipment maintenance schedules should be optimised to minimise the generation of chemical wastes.

The DBO Contractor should register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lubricants) should be recycled at an appropriate facility. Any transport for off-site treatment and disposal must be conducted by licensed collectors to licensed disposal facilities, e.g. Chemical Waste Treatment Centre in Tsing Yi.

Landfilling of chemical waste should be avoided. Collection receipts issued by the licensed chemical waste collector showing the quantities and types of chemical waste taken off-site and details of the treatment facility should be kept for record purposes. With the implementation of proper preventive and mitigation measures for the handling, transport and disposal of chemcial waste, no insurmountable environmental impacts would be anticipated.

General Refuse

Potential environmental impacts of general refuse include odour (if the waste is not collected frequently), windblown litter, water quality impacts (if the waste enters water bodies), and visual impacts. The refuse can also attract pests and vermin if the storage areas are not well maintained and regularly cleaned.

Waste disposal at sites other than approved waste transfer or disposal facilities can also lead to environmental impacts. Handling and disposal of general refuse should cope with the presence of peak workforce during the construction period. Receipts of refuse collection should be kept for record purposes.

Regular in-house training for the staff of the DBO Contractor should be conducted to advocate the avoidance, reduction, reuse and recycling of general refuse. Recycling bins for separate collection of paper, plastic bottles and aluminium cans should be provided. Provided that the refuse will be stored and transported in accordance with proper practices and disposed at licensed landfills, no insurmountable environmental impact is anticipated.

Sludge from Leachate Treatment Plant

Although there are rare opportunities to consider the reuse or recycling of sludge from NENT Landfill Extension, there are other ways to reduce the quantity of sludge generated.

The quantity of sludge arising from the operation of the leachate treatment plant will depend on the technology selected, namely conventional aeration lagoon, sequencing batch reactor, membrane biological filter, biological aerated filter, etc. Preference will be given to technology which generates low sludge yield, but the decision will be made by the DBO Contractor. Sludge generated will be disposed of at NENT Landfill Extension and receipts of disposal should be kept for record purposes. Co-disposal with ordinary solid waste would be adopted to reduce the average water content of the waste mass.

Provided that the sludge will be stored and transported in accordance with proper practices, no insurmountable environmental impact is anticipated.

6.4.2.2 Restoration and Aftercare Phases

Chemical Waste

With the implementation of proper preventive and mitigation measures similar to the construction management approach for the handling, transport and disposal of chemical waste, no insurmountable environmental impact is anticipated during the restoration and aftercare phases.

General Refuse

With the implementation of proper preventive and mitigation measures similar to the construction management approach for the handling, transport and disposal of general

refuse, no insurmountable environmental impact is anticipated during the restoration and aftercare phases.

Sludge from Leachate Treatment Plant

With the implementation of proper preventive and mitigation measures similar to the construction management approach for the handling, transport and disposal of sludge, no insurmountable environmental impact is anticipated during the restoration and aftercare phases.

6.5 Mitigation Measures

6.5.1.1 Excavated Construction Materials

As the design has adopted a construction material balance approach, the impact on the handling, collection, transportation and disposal of construction material is insignificant. Excavated slope, stockpiled material and bund walls will be covered (e.g. by a tarpaulin) until used in order to prevent wind-blown dust during dry weather, and to reduce muddy runoff during wet weather. If any topsoil-like materials need to be stockpiled for any length of time, consideration should be given to hydroseeding of the topsoil on the stockpile to improve its visual appearance and prevent soil erosion.

6.5.1.2 Chemical Waste

Plant/ equipment maintenance schedule should be designed to optimise maintenance effectiveness and to minimise the generation of chemical wastes. Chemical waste should be properly stored and transported off-site for treatment by a licensed collector. The DBO Contractor should register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lube oil) should be recycled by licensed treatment facilities.

6.5.1.3 General Refuse

All recyclable materials (separated from the general waste) should be stored on-site in appropriate containers with cover prior to collection by a local recycler for subsequent reuse and recycling. Residual, non-recyclable, general waste should be stored in appropriate containers to avoid odour. Regular collection should be arranged by an approved waste collector in purpose-built vehicles that minimise environmental impacts during transportation.

6.5.1.4 Sludge

Sludge should be collected by a licensed collector at regular intervals, to suit the operation schedule of the leachate treatment plant. The use of purpose-built sludge tankers can minimise the potential of environmental impacts during transportation.

6.6 Residual Impacts

Potential environmental impacts due to wastes generation from the Project will be controlled by means of a construction material balance approach with the implementation of appropriate mitigation measures, which are practical, proven and cost-effective for controlling potential impacts from the waste types. Provided that these measures are adopted and properly implemented during the construction, operation, restoration and aftercare phases, no residual impact is anticipated.

6.7 Environmental Audit

Auditing of each waste stream should be carried out periodically to determine if waste is being managed in accordance with the prescribed procedures in the Waste Management Plan (WMP). The audits will examine all aspects of waste management including waste generation, storage, recycling, treatment, transportation, and disposal. The general site inspections including waste management issues will be undertaken weekly by Environmental Team to check all construction activities for compliance with all appropriate environmental protection and pollution control measures, including those stimulated in the WMP. Monthly waste management audit will be carried out by the IEC.

6.8 Implication of IWMF Implementation

If the Integrated Waste Management Facility (IWMF) implementation were considered in Year 2010s, the incoming waste characteristics to the NENT Landfill Extension site would be altered substantially, mainly with inert incinerator ashes.

Due to its inherent characteristics changes of waste to the NENT Landfill Extension, the leachate quality might be affected with higher concentration of heavy metals. Alternative treatment technology such as metal precipitation will be considered to fulfil the requirements of discharge license.

It is anticipated that any incoming incinerator ashes would comply with the Toxicity Characteristic Leaching Procedure (TCLP) limits for landfill disposal, but the leachate quality and hence the amount of precipitate and sludge arising from the metal treatment process would be affected. Depending on the sludge treatment and disposal arrangement of the territory at time of operation of the extension landfill, non-landfill disposal or pretreatment of the sludge arising from leachate treatment works should also be considered.

Assuming metal precipitation process will be adopted in the leachate treatment works, the sludge so arising will be concentrated and hazardous in nature, special disposal arrangement will be required, e.g. disposal at designated trenches within future NENT Landfill Extension site and/or co-disposed of in designated trenches.

6.9 Conclusion

The waste management assessment has reviewed the potential impacts from various types of wastes generated from the construction, operation, restoration and aftercare stages of the NENT Landfill Extension. Through the analysis of the Project activities, the quantity, quality and timing of waste arising have been identified, including excavated materials from site preparation, chemical waste arising from maintenance of plant and equipment, general waste from daily activities, and sludge from leachate treatment plant. By adopting a material balance approach (e.g. balance cut-and-fill in site formation design, general waste from daily activities to be collected and recycled, etc.) and with the appropriate mitigation measures in place, no adverse environmental impact is anticipated.