



環境保護署  
Environmental Protection Department

廢物設施組  
Waste Facilities Group

Agreement No. CE 20/2004(EP)

North East New Territories (NENT)  
Landfill Extension - Feasibility Study

Submission Ref. 088:  
Environmental Monitoring & Audit Manual



May 2007

ARUP



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# 1 Introduction

## 1.1 Background

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Currently, around 6 million tonnes of waste are disposed each year at the three strategic landfills in Hong Kong, including the West New Territories (WENT) Landfill, the South East New Territories (SENT) Landfill, and the North East New Territories (NENT) Landfill.

At time of commissioning, the three landfills with a total capacity in the order of 140 Mm<sup>3</sup> were expected to be able to meet the waste disposal needs of Hong Kong until 2020 or beyond. The actual waste disposal rate at the landfills has been, however, higher than expected. It is thus projected that the three existing landfills would last only until early-to-mid next decade.

To tackle the problem, further efforts have been taken to reduce and recycle waste. Also, the HKSAR Government has planned to develop Integrated Waste Management Facilities (IWMF) to substantially reduce the volume of waste requiring landfill disposal. Yet these measures could not obviate totally the need for new landfill capacity in Hong Kong, especially as the implementation of IWMF will take time and as its residues will still need to be disposed.

The Environmental Protection Department (EPD) of the HKSAR Government therefore commissioned a study in Year 2000 on the Extension of Existing Landfills and Identification of Potential New Waste Disposal Sites. Amongst the potential sites recommended in this territory-wide study is the extension of the existing NENT Landfill, with a target capacity of about 19 Mm<sup>3</sup>. As shown in the attached **Drawing No. 24315/01/001**, the proposed extension, of about 70 ha, is located immediately east of the existing NENT Landfill. A large proportion of the Extension area is in fact the Stockpile and Borrow Area of the existing landfill.

In February 2005, EPD appointed Ove Arup & Partners Hong Kong Ltd. To undertake a detailed feasibility study for the NENT Landfill Extension (hereafter referred to "the Project"), with the following key tasks: formulation and evaluation of layout options for the landfill extension; EIA study; and conceptual design of landfill facilities.

## 1.2 Purpose and Scope of this Manual

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Environmental Monitoring and Audit (EM&A) is an important aspect in the EIA process which specifies the timeframe and responsibilities for the implementation of environmental mitigation measures. The requirements on environmental monitoring (including baseline and impact monitoring) are given in the EM&A Manual (the Manual) which is a supplementary document to the EIA Study for the Project and prepared in accordance with the requirements in the EIA Study Brief and Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO).

The purpose of this EM&A Manual is to guide the establishment of an EM&A programme to ensure compliance with the EIA recommendations, to assess the effectiveness of recommended mitigation measures, and to identify further need for additional mitigation measures or remedial action.

This Manual outlines the monitoring and audit requirements for the construction, operation, restoration and aftercare stages of the NENT Landfill Extension. It aims to provide systematic procedures for monitoring, auditing and minimising environmental impacts associated with construction works and operational activities.

Hong Kong environmental regulations and the Hong Kong Planning Standards and Guidelines have served as environmental standards and guidelines in the preparation of this



Manual. This EM&A Manual was prepared in accordance with the requirements as stipulated in Annex 21 of the TM-EIAO.

This Manual contains the following information:

- Organisation, hierarchy and responsibilities of the DBO Contractor, Environmental Team (ET), Independent Environmental Checker (IEC), and Independent Consultant (IC), with respect to the EM&A requirements during the construction, operation, restoration and aftercare phases of landfill extension;
- Information on project organisation and programming of construction activities;
- Requirements with respect to the construction schedule and necessary EM&A programme to track the varying environmental impacts;
- Full details of methodologies to be adopted, including all field, laboratory and analytical procedures, and details on quality assurance;
- Procedure for undertaking on-site environmental audits;
- Definition of Action and Limit Levels;
- Establishment of Event and Action Plans;
- Requirements of reviewing pollution sources and working procedures required in the event of non-compliance of environmental criteria and complaints;
- Requirements for reviewing the EIA predictions, implementation of mitigation measures, and effectiveness of environmental protection and pollution control measures adopted; and
- Presentation of requirements for EM&A data and appropriate reporting procedures.

### **1.3 Description of the Project**

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#### **1.3.1 General Description of the Project**

The development of the NENT Landfill Extension will involve the following works:

- Site formation, drainage diversion and preparation;
- Installation of liner system;
- Installation of leachate collection, treatment and disposal facilities;
- Installation of gas collection, utilization and management facilities;
- Operation and environmental monitoring of landfill;
- Restoration and aftercare.

#### **1.3.2 Key Project Requirements**

The key project requirements for the NENT Landfill Extension are:

- Development of sanitary landfill that covers an area of about 70ha with an estimated void space of 21Mm<sup>3</sup>;
- Provision of liner system for the landfill to prevent contamination of land and water resources;
- Provision of leachate collection, treatment and disposal facilities with sufficient capacity for handling the leachate arising from the new landfill;
- Provision of landfill gas (LFG) collection, utilisation and management facilities;

- Provision of utilities, drainage and road network necessary for the proper operation of the Project;
- Provision of facilities (both civil works and electrical and mechanical equipment) for waste reception, inspection, charging, handling and compaction, and plant maintenance;
- Provision of facilities for site administration;
- Operation of landfill in compliance with all relevant engineering, geotechnical and environmental standards;
- Restoration of landfill in compliance with all relevant engineering, geotechnical and environmental standards;
- Provision of aftercare for the landfill for a period of about 30 years
- Carrying out environmental monitoring and audits throughout construction, operation, restoration and aftercare of the landfill; and
- Implementation of environmental measures necessary for the protection of the surrounding environment.

### **1.3.3 Size, Scale, Shape and Design of the Project**

The landfill extension site will be a bowl-shape area with a large void space in the middle for waste filling. The northwestern and southeastern boundaries of the landfill extension site follow the ridgelines to maximise the landfill capacity. Some set back of the northern boundary is included to minimise the impact to woodland and Lin Ma Hang Catchment. The total site area is 70ha and the final height of the landfill would be +255mPD (**Drawing No 24315/01/001 & 107**). Various activities during construction, operation, restoration and aftercare of landfill are discussed in the following sub-sections. The key design features are summarised below:

- Bottom liner system – separate rubbish and leachate from groundwater;
- Landfill cells – store waste within the unit;
- Storm water drainage system – collect rain water run off on the landfill;
- Leachate collection system – collect liquid leaching from the waste mass and convey it to a leachate treatment plant prior to discharging to Shek Wu Hui Sewage Treatment Works;
- Gas collection system – collect gases formed during the decomposition of waste. These gases will be treated and utilised for production of electricity on site; and
- Covering and capping – seal off the top of the landfill with a gas venting layer, an impermeable mineral layer, a drainage layer of at least 0.5m and at least 1m of top soil.

### **1.3.4 Construction Phase Activities**

Simple excavation and slope formation works will be carried out during the construction stage. The permanent works comprise cut and fill earthworks, slope formation and earth wall construction. The temporary works will involve the formations of temporary ditches along the sides of excavations and associated drainage works, and material storage areas. During site formation, sediment will be contained in permanent detention ponds/silt traps that will be constructed according to landfill phasing. Final design and location of sediment traps are yet to be decided, but are likely to be down gradient of each landfill phase or in the downstream valleys near the existing waste reception area. Where possible they will be maintained during the operation of each phase to ensure the effective control of operational soil erosion problem.



### **1.3.5 Operation Phase Activities**

During operation, waste will be disposed of at individual landfill cells. Deposited waste will be compacted to thin layers of up to two metres in thickness. The works will be maintained at a gradient of not greater than 1 in 3 to ensure the effectiveness of the compaction equipment. Daily cover (about 150mm if soil cover used) will be applied to control environmental nuisances such as windblown litter, odour, vermin, flies and birds. There are other more effective alternative biodegradable materials for use as daily cover, including:

- Heavy duty reusable and biodegradable sheets;
- Biodegradable, non-reusable plastic films;
- Geotextiles; and
- Foams and sprays.

Advantages of using alternative daily cover over traditional methods may include preservation of void space and soil material; biodegradable and less permeable to water and gas (reduce water infiltration, odour and dust emission).

### **1.3.6 Restoration Phase Activities**

Restoration is a process to restore a landfill site to a condition suitable for afteruse. After completion of waste filling, final capping will be applied to minimise infiltration of rainwater into the waste body thus reducing the amount of leachate generated. The capping system normally includes a number of components including topsoil, subsoil, drainage layer and barrier layer.

### **1.3.7 Aftercare Phase Activities**

Aftercare is the work done after the replacement of the soil and includes cultivations, fertilisation, planting, construction of pathways, access points, vegetation maintenance and an ongoing long term commitment to the restored landfill. Landscaped berms will be created and tree planting will be provided during the aftercare period for aesthetic purpose.

## **1.4 Project Programme**

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The Landfill Extension will start receiving waste only when the Existing NENT Landfill has ceased operation. The timing of this has yet to be determined as it depends on the rate of waste deliveries in the forthcoming period. Based on current predictions, the capacity of the Existing Landfill will probably run out by early-to-mid next decade, by which time the Landfill Extension shall start operation.

Taking into account of the time needed for mobilization and preparatory works prior to commencement of receipt of waste, it may be necessary to award the Landfill Extension contract towards the end of this decade, this should tally with Project Programme anywhere else in the EIA. In order to ensure that new landfill space will be available before the capacity of the existing landfill runs out.

It is anticipated that the DBO (Design-Build-Operate) contract form, which has hitherto worked well for the existing waste management contracts (notably the three strategic landfill contracts and the refuse transfer station contracts), will be adopted for NENT Landfill Extension. Detailed design and formulation of technical details for the construction, operation, restoration and aftercare of the NENT Landfill Extension will be carried out by the DBO Contractor, in accordance with requirements stipulated in the Specification and other documents of the DBO Contract.

A tentative outline programme for implementation of the NENT Landfill Extension is shown in Appendix A. As pointed out above, the exact timing of the various activities may vary, depending on actual volume of waste to be delivered in the forthcoming years.

## 2 Scope of EM&A Programme

The requirements of EM&A programme should include the recommendations from the EIA study and with reference to EPD's "Environmental Monitoring and Audit Guidelines for Development Projects in Hong Kong". Detailed requirements of the EM&A programme for construction, operation, restoration and aftercare phases of this Project are described in the following sections of this EM&A Manual.

### 2.1 Objectives of EM&A Programme

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The EM&A requirements recommended in the EIA Report will ensure compliance with the specified mitigation measures. An EM&A programme should be designed based on these requirements to achieve the following key objectives:

- Establishment of existing environmental setting of the site to assist the development of landfill design and to establish a baseline against which any adverse environmental impacts can be evaluated;
- Provision of a database against which any short- or long-term environmental impacts of the Project can be determined against the Project compliance with regulatory requirements, standards and Government policies;
- Verification of environmental impacts predicted in the EIA study and provision of an early indication of any failure of environmental control measures or practices to achieve the acceptable standards;
- Evaluation of environmental impacts during site preparation works and operational phases of the landfill extension project to assist the determination of effectiveness of the mitigation measures to be implemented, ensure compliance with the relevant environmental regulations, and design of any additional mitigation measures requirements;
- Provision of information to enable environmental audit of Project activities during construction, operation, restoration and aftercare phases, and taking remedial action if unexpected problems or unacceptable impacts arise; and
- Provision of a basis for long-term monitoring programme following the completion of works during the aftercare phase.

### 2.2 Organisation for EM&A Programme

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The proposed project organisation and lines of responsibilities with respect to the EM&A programme are shown in **Appendix B**, which consists of the Project Proponent (EPD/WFG), DBO Contractor, Environmental Team (ET), Independent Environmental Checker (IEC), and Independent Consultant (IC), etc. It should be established to take the responsibilities for environmental protection for this landfill extension project. The IEC will be appointed by the Project Proponent as part of the IC to conduct independent auditing of the overall EM&A programme including environmental and operation monitoring, implementation of mitigation measures, EM&A submissions, and any other submissions required under the Environmental Permit (EP). The individual responsibilities are:

#### DBO Contractor

- Employment of an ET to carry out environmental monitoring, laboratory analysis and reporting of environmental monitoring and audit;
- Provision of assistance to ET in carrying out monitoring and auditing;
- Submission of proposals of mitigation measures in case of exceedances of Action and Limit (A/L) Levels in accordance with the Event and Action Plan (EAP);



- Implementation of mitigation measures to reduce the impacts where A/L Levels are exceeded; and
- Adherence to the agreed procedures for carrying out complaint investigation.

#### ET

- Setting up of all the required environmental monitoring stations;
- Monitoring of various environmental parameters as required;
- Analysis of monitoring and audit data and review the success of EM&A programme to cost-effectively confirm the adequacy of mitigation measures implemented and the validity of the EIA predictions and to identify any adverse environmental impacts arising;
- Carrying out site inspections to investigate and audit the DBO Contractor's site practices, equipment and work methodologies with respect to pollution control and environmental mitigation, and take proactive actions to pre-empt problems;
- Auditing and preparation of audit reports on environmental monitoring data and site conditions;
- Reporting of environmental monitoring and audit results to the IEC, DBO Contractor, IC and Project Proponent or its delegated representative;
- Recommendation of suitable mitigation measures to the DBO Contractor in case exceedance of A/L Levels in accordance with the EAP; and
- Undertaking of regular on-site audits/ inspections and reporting to the DBO Contractor and IC of any potential non-compliance; and
- Following up and closing out of non-compliance actions.

#### IEC

- Review of EM&A programme by the ET (at not less than monthly intervals);
- Auditing of monitoring activities and results (at not less than monthly intervals);
- Reporting of audit results to the IC and Project Proponent in parallel;
- Reviewing of EM&A reports (monthly, quarterly and annual summary reports) submitted by the ET;
- Reviewing of proposal of mitigation measures submitted by the DBO Contractor in accordance with the EAP;
- Checking of mitigation measures recommended in the EIA Report and EM&A Manual, and ensuring they are properly implemented in timely manner when required; and
- Reporting of findings of site inspections and other environmental performance reviews to IC and Project Proponent.

#### IC

- Verification and checking DBO Contractor's activities and ensure that the requirements in the EM&A Manual are fully complied with;
- Informing DBO Contractor when action is required to reduce impacts in accordance with the EAP;
- Ensure compliance with the agreed Event Action Plan in case any exceedance.

Sufficient and suitably qualified professional and technical staff should be employed by the respective parties to ensure full compliance with their duties and responsibilities, as required under the EM&A programme for the duration of the Project.

### **2.3 Environmental Management Plan**

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A systematic Environmental Management Plan (EMP) should be developed and implemented by the DBO Contractor in accordance with the ETWB TC(W) 19/2005 Environmental Management on Construction Sites to ensure effective implementation of the mitigation measures, monitoring and remedial requirements presented in the EIA, EM&A and environmental mitigation implementation schedule (EMIS) (**Appendix C**). The IEC should audit the implementation status of EMP and advise the necessary remedial action as required. Such remedial actions should be enforced through contractual requirements. The EMP should be certified by the ET and verified by the IEC.

The EMP should require the DBO Contractor (and sub-contractors) and ET to define in details how to implement the recommended mitigation measures in order to achieve the environmental performance stipulated in the Hong Kong environmental legislation and EIA documents. The review of on-site environmental performance should be undertaken by IEC through a systematic checklist and audit once the construction commences. The environmental performance review programme comprises a regular assessment on the effectiveness of the EMP.

The EMP should summarise the requirements for the DBO Contractor to submit a Landfill Monitoring Plan (LMP) and an Emergency Response Plan (ERP) for approval. The LMP should describe the procedures and provide details of the environmental monitoring programme for the DBO Contractor to carry out throughout the construction, operation, restoration and aftercare phases of the Project. The ERP should address various scenarios within NENT Landfill Extension, in particular in the event of leakage of LFG/ leachate, failure of LFG/ leachate treatment operation, fire, chemical/ DG spillage, etc.

If the DBO Contractor would adopt alternative construction methods or implementation schedules, the detailed modifications of methodology and equipment should be submitted to the IEC for approval prior to the commencement of works. Any changes in construction methods should be indicated in the revised EMP. The DBO Contractor should review the EMIS with respect to the design developments and construction methodology. All necessary mitigation measures identified and recommended in the EIA study are summarised in the EMIS, which specifies the extent, locations, time frame and responsibilities for the implementation of the environmental mitigation measures identified.

### **2.4 Waste Management Plan**

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The DBO Contractor should develop the waste management requirements as part of the EMP in **Section 2.3** above for the construction phase of the Project. The DBO Contractor should also prepare a Waste Management Plan (WMP) for the Project during the operational, restoration and aftercare phases. Where waste generation is unavoidable, any opportunities for recycling or reuse of the wastes should be maximised. If the wastes cannot be recycled, recommendations for appropriate disposal routes should be provided in the WMP. A method statement for stockpiling and transportation of the excavated materials and other construction wastes should also be included in the WMP and approved before the commencement of construction. All mitigation measures arising from the approved WMP should be fully implemented. The WMP should be certified by the ET and verified by IEC.

It is not anticipated that any significant quantities of excavated C&D materials would require off-site disposal, as most will be reused on-site. 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 C&D Materials taken off-site) should be kept for record purposes.

For the purpose of enhancing the management of Construction and Demolition (C&D) materials including rock, and minimising its generation at source, construction would be undertaken in accordance with the Environment, Transport and Works Bureau Technical Circular (Works) No 33/2002 – Management of Construction and Demolition Material Including Rock, or its latest versions. The management measures stipulated in the Technical Circular should be incorporated.

## **2.5 Baseline Monitoring**

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Prior to the commencement of construction works, the baseline conditions of environmental parameters should be established at designated monitoring locations to determine the nature and ranges of natural variation and to demonstrate the suitability of the proposed impact, control and reference monitoring locations in the EM&A programme. The baseline conditions of the following environmental parameters should be established by the ET, including air quality (dust, organic emissions, odour), noise, water quality (groundwater and surface water), ecology (vegetation and biodiversity), landscape and visual, and cultural heritage.

## **2.6 Impact Monitoring**

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During the implementation of the Project, environmental monitoring should be conducted at designated monitoring locations to detect the changes of environmental parameters attributed to the Project. Impact monitoring should be conducted during all phases of the Project. The environmental monitoring parameters during construction phase should include air quality (dust, organic emissions, odour), noise, water quality (groundwater and surface water), ecology (vegetation and biodiversity), landscape and visual, and cultural heritage. The monitoring during operational, restoration and aftercare phases should include all parameters of construction phase, in addition to leachate and LFG.

## **2.7 Compliance with Action and Limit Levels**

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The A/L Levels should be defined for environmental monitoring at designated monitoring locations exceeding which a prescribed response should be required. Individual A/L Levels should be quantitatively defined for the respective environmental monitoring parameters according to the following basic principles:

### **2.7.1 Action Level**

Action Levels indicate deteriorating ambient environmental quality potentially due to the Project implementation. It acts as a sign to trigger appropriate remedial actions in order to rectify any mal-practices or non-conformance of Project activities thereby preventing the deterioration of environmental quality and to resume the ambient environmental quality back to normal levels.

### **2.7.2 Limit Level**

Limit Levels are the statutory and/or contractual levels below which environmental conditions are considered unacceptable. If Limit Levels were exceeded, the relevant part of the works should not be continued without implementation of immediate remedial action, including a critical review of plant and working methods.

## **2.8 Event and Action Plan**

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The EAP should lay down the systematic procedures for implementation in case exceedances of A/L Levels and environmental complaints in order to timely address, investigate and resolve such incidents and minimise their recurrence. The EAP should



define the action under specific conditions, i.e. exceedances of A/L Levels, and trigger the relevant parties in the EM&A programme to take the action.

## **2.9 Environmental Audit**

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Environmental audit should include the following components:

- Regular inspection of site practices should be conducted to assess and ensure the environmental protection and pollution control measures to be in accordance with the EIA recommendations and complied with contract specifications.
- Examination of all available information related to the investigation of the nature and cause of actual, potential and cumulative environmental impacts and complaints/queries;
- Proposal for remedial measures for resolution of impacts, effective implementation of proposed mitigation measures, documentation and summary of audit findings, and liaison and consultation with the public and concerned parties on the effects of such remedial works; and
- Enquiries and complaints related to the environmental performance of the Project should be anticipated from individuals and organisations, which should be referred to the ET Leader for investigation and action. Systematic procedures for environmental complaints should be established and followed. During the complaint investigation, the DBO Contractor and IEC should facilitate the ET by providing all necessary information.

## **2.10 Reporting**

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### **2.10.1 Baseline Monitoring**

Baseline Monitoring Report should be prepared by the ET and submitted within 4 weeks of completion of baseline monitoring to include all the baseline monitoring data and findings. The Report should be certified by the ET and verified by the IEC prior to submission to the EPD.

### **2.10.2 Impact Monitoring**

Monthly EM&A Reports should be prepared by the ET and submitted within 21 days of each reporting month during construction, operational, restoration and aftercare phases to include all the impact monitoring data, findings and recommendations. Quarterly Summary, Annual Review and Final Review EM&A Reports should be prepared by the ET and submitted within 10 days of each reporting quarter, reporting year and cessation of project phase, respectively, during construction and operational, restoration, and aftercare phases to include all the summary of monitoring trends, findings and recommendations. These reports should be certified by the ET and verified by the IEC prior to formal submission to the EPD.

## **2.11 Cessation of EM&A Programme**

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To implement the EM&A programme according to the Construction and Operational Phases, Restoration Phase and Aftercare Phase in which different EM&A requirements should be imposed, the ET and IEC should notify the EPD the completion of EM&A programme for the specific Project phases and request for agreement to cease the EM&A programme.

## 3 Air Quality Monitoring

### 3.1 Construction Dust

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#### 3.1.1 Air Quality Parameters

Monitoring of the Total Suspended Particulate (TSP) levels shall be carried out by the ET to ensure that any deteriorating air quality could be readily detected and timely action be taken to rectify the situation. 1-hour and 24-hour TSP levels should be measured to indicate the impacts of construction dust on air quality. The TSP levels shall be measured by following the standard high volume sampling method as set out in the Title 40 of the Code of Federal Regulations, USA, Chapter 1 (Part 50), Appendix B. Upon approval by the IEC, 1-hour TSP levels can be measured by direct reading methods which are capable of producing comparable results as that by the high volume sampling method, to indicate short event impacts.

All relevant data including temperature, pressure, weather conditions, elapsed-time meter reading for the start and stop of the sampler, identification and weight of the filter paper, and other special phenomena and work progress of the concerned site etc. shall be recorded down in details.

#### 3.1.2 Monitoring Equipment

High volume sampler (HVS) in compliance with the following specifications shall be used for carrying out the 1-hr and 24-hr TSP monitoring:

- 0.6-1.7 m<sup>3</sup>/min (20-60 SCFM) adjustable flow range;
- equipped with a timing/control device with +/- 5 minutes accuracy for 24 hours operation;
- installed with elapsed-time meter with +/- 2 minutes accuracy for 24 hours operation;
- capable of providing a minimum exposed area of 406 cm<sup>2</sup> (63 in<sup>2</sup>);
- flow control accuracy: +/- 2.5% deviation over 24-hr sampling period;
- equipped with a shelter to protect the filter and sampler;
- incorporated with an electronic mass flow rate controller or other equivalent devices;
- equipped with a flow recorder for continuous monitoring;
- provided with a peaked roof inlet;
- incorporated with a manometer;
- able to hold and seal the filter paper to the sampler housing at horizontal position;
- easy to change the filter; and
- capable of operating continuously for 24-hr period.

The ET Leader is responsible for provision of the monitoring equipment. He shall ensure that sufficient number of HVSs with an appropriate calibration kit are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. The HVSs shall be equipped with an electronic mass flow controller and be calibrated against a traceable standard at regular intervals. All the equipment, calibration kit, filter papers, etc. shall be clearly labeled.

Initial calibration of dust monitoring equipment shall be conducted upon installation and thereafter at bi-monthly intervals. The transfer standard shall be traceable to the internationally recognised primary standard and be calibrated annually. The calibration data shall be properly documented for future reference. All the data should be converted into

standard temperature and pressure condition. The flow-rate of the sampler before and after the sampling exercise with the filter in position shall be verified to be constant and be recorded down in the data sheet.

If the ET Leader proposes to use a direct reading dust meter to measure 1-hr TSP levels, he shall submit sufficient information to the IC and IEC to prove that the instrument is capable of achieving a comparable result as that of the HVS and may be used for the 1-hr sampling. The instrument should also be calibrated regularly, and the 1-hr sampling shall be determined periodically by HVS to check the validity and accuracy of the results measured by direct reading method.

Wind data monitoring equipment shall also be provided and set up at conspicuous locations for logging wind speed and wind direction near to the dust monitoring locations. The equipment installation location shall be proposed by the ET Leader and agreed with the ER. For installation and operation of wind data monitoring equipment, the following points shall be observed:

- the wind sensors should be installed on masts at an elevated level 10m above ground so that they are clear of obstructions or turbulence caused by the buildings;
- the wind data should be captured by a data logger and to be downloaded for processing at least once a month;
- the wind data monitoring equipment should be re-calibrated at least once every six months; and
- wind direction should be divided into 16 sectors of 22.5 degrees each.

In exceptional situations, the ET Leader may propose alternative methods to obtain representative wind data upon approval from the IC and IEC, and agreement from EPD.

### **3.1.3 Laboratory Measurement/Analysis**

A clean laboratory with constant temperature and humidity control, and equipped with necessary measuring and conditioning instruments, to handle the dust samples collected, shall be available for sample analysis, and equipment calibration and maintenance. The laboratory should be HOKLAS accredited.

If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment shall be approved by the IC and IEC and the measurement procedures (first measurement) shall be witnessed by the IC and IEC. The ET Leader shall provide the IC and IEC with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for his reference.

Filter paper of size 8"x10" shall be labeled before sampling. It shall be a clean filter paper with no pin holes, and shall be conditioned in a humidity controlled chamber for over 24-hr and be pre-weighed before use for the sampling.

After sampling, the filter paper loaded with dust shall be kept in a clean and tightly sealed plastic bag. The filter paper is then returned to the laboratory for reconditioning in the humidity controlled chamber followed by accurate weighing by an electronic balance with a readout down to 0.1 mg. The balance shall be regularly calibrated against a traceable standard. All the collected samples shall be kept in a good condition for 6 months before disposal.

### **3.1.4 Monitoring Locations**

The dust monitoring locations are shown in Table 3.1. The status and locations of dust sensitive receivers may change after issuing this manual. If such cases exist, the ET



Leader shall propose updated monitoring locations and seek approval from IC and IEC and agreement from EPD on the proposal.

The ET shall also write to the relevant private owners or owner's incorporation for their agreement to install the HVS at suitable location at least 3 months before construction works. The purpose of monitoring (to minimize potential impact and to safeguard the residential) should be clearly stipulated. The specification, wiring, fixing, maintenance, communication and payment of electricity cost shall be detailed in the letter. If there is objection from the owner, alternative monitoring location at premises in the vicinity shall be identified and agreed with EPD, IEC and IC. The monitoring location is illustrated in **Drawing No. 24315/13/151**.

**Table 3.1 Description of dust monitoring locations**

AML ID	EIA ASR Ref	Location	Land Uses	Monitoring Parameters
AM(D)1	ASR11	Tung Lo Hang	Residential/ Pig Farm	1-hr and 24-hour TSP
AM(D)2	ASR7	Heung Yuen Wai	Residential	1-hr and 24-hour TSP
AM(D)3	ASR1	Wo Keng Shan Tsuen	Residential	1-hr and 24-hour TSP

When alternative monitoring locations are proposed, the following criteria, as far as practicable, should be followed:

- At the site boundary or such locations close to the major dust emission source;
- Close to the sensitive receptors; and
- Account for the prevailing meteorological conditions.

The ET Leader shall agree with the IC and IEC on the position of the HVS for installation of the monitoring equipment. When positioning the samplers, the following points shall be noted:

- a horizontal platform with appropriate support to secure the samplers against gusty wind should be provided;
- no two samplers should be placed less than 2 meter apart;
- the distance between the sampler and an obstacle, such as buildings, must be at least twice the height that the obstacle protrudes above the sampler;
- a minimum of 2 metres separation from walls, parapets and penthouses is required for rooftop samplers;
- a minimum of 2 metres separation from any supporting structure, measured horizontally is required;
- no furnace or incinerator flue is nearby;
- airflow around the sampler is unrestricted;
- the sampler is more than 20 metres from the drip-line;
- any wire fence and gate, to protect the sampler, should not cause any obstruction during monitoring;
- permission must be obtained to set up the samplers and to obtain access to the monitoring stations; and
- a secured supply of electricity is needed to operate the samplers.

### 3.1.5 Baseline Monitoring

The ET Leader shall carry out baseline monitoring at all of the designated monitoring locations for at least 14 consecutive days prior to the commencement of the construction works to obtain daily 24-hr TSP samples. 1-hour sampling shall also be done at least 3

times per day while the highest dust impact is expected. During the baseline monitoring, there should not be any construction or dust generation activities in the vicinity of the monitoring stations.

In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, the ET Leader shall carry out the monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring locations shall be approved by the IC and IEC and agreed with EPD.

In exceptional case, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to IC and IEC for approval.

If the baseline level for air quality exceeds the limit level, the ET shall carry out an investigation to determine the cause of the exceedance in consultation with EPD. Regardless of whether the exceedance was caused by poor weather condition (e.g. high API) or as a result of inadequate control measures on construction activities being carried out on other nearby construction sites, a second set of baseline monitoring shall be conducted by the ET to determine an appropriate baseline level for the EM&A programme in agreement with EPD.

Ambient conditions may vary seasonally and shall be reviewed at every three months. If the ET Leader considers that the ambient conditions have been changed and a repeat of the baseline monitoring is required to be carried out for obtaining the updated baseline levels, the monitoring should be at times when the DBO Contractor's activities are not generating dust, at least in the proximity of the monitoring stations. Should change in ambient conditions be determined, the baseline levels and, in turn, the air quality criteria, should be revised. The revised baseline levels and air quality criteria should be agreed with EPD.

### **3.1.6 Impact Monitoring**

The ET Leader shall carry out impact monitoring during the course of the Works. For regular impact monitoring, the sampling frequency of at least once in every six-days, shall be strictly observed at all the monitoring stations for 24-hr TSP monitoring. For 1-hr TSP monitoring, the sampling frequency of at least three times in every six-days should be undertaken when the highest dust impact occurs. The specific time to start and stop the 24-hr TSP monitoring shall be clearly defined for each location and be strictly followed by the DBO Contractor.

In case of non-compliance with the dust criteria, more frequent monitoring exercise, as specified in the Action Plan in Section 3.1.7, shall be conducted within 24 hours after the result is obtained. This additional monitoring shall be continued until the excessive dust emission or the deterioration in air quality is rectified.

### **3.1.7 Event and Action**

The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The ET Leader shall compare the impact monitoring results with air quality criteria set up for 24-hour TSP and 1-hour TSP. Table 3.2 shows the dust criteria, namely Action and Limit levels to be used. Should non-compliance of the air quality criteria occur, the ET, the IC/IEC and the DBO Contractor shall undertake the relevant action in accordance with the Action Plan in Table 3.3.

**Table 3.2 Action and limit levels for dust impact**

Parameters	Action	Limit
24-hour TSP Level in $\mu\text{g}/\text{m}^3$	For baseline level $\leq 200 \mu\text{g}/\text{m}^3$ , Action level = (130% of baseline level + Limit level)/2 For baseline level $> 200 \mu\text{g}/\text{m}^3$ , Action level = Limit level	260
1-hour TSP Level in $\mu\text{g}/\text{m}^3$	For baseline level $\leq 384 \mu\text{g}/\text{m}^3$ , Action level = (130% of baseline level + Limit level)/2 For baseline level $> 384 \mu\text{g}/\text{m}^3$ , Action level = Limit level	500

**Table 3.3 Event/Action plan for dust impact**

Event	ET	IEC	IC	DBO Contractor
Exceedance of Action Level				
1. Exceedance for one sample	<ul style="list-style-type: none"> <li>Identify source</li> <li>Inform IEC and DBO Contractor</li> <li>Repeat measurement to confirm findings</li> <li>Increase monitoring frequency to daily</li> </ul>	<ul style="list-style-type: none"> <li>Check monitoring data and DBO Contractor's working methods</li> </ul>	<ul style="list-style-type: none"> <li>Notify DBO Contractor for the identification of cause</li> </ul>	<ul style="list-style-type: none"> <li>Rectify any unacceptable practice</li> <li>Amend working methods if appropriate</li> </ul>
2. Exceedance for two or more consecutive samples	<ul style="list-style-type: none"> <li>Identify source</li> <li>Notify IEC and DBO Contractor</li> <li>Repeat measurements to confirm findings</li> <li>Increase monitoring frequency to daily</li> <li>Discuss with IEC/IC for remedial actions required</li> <li>If exceedance continues, arrange meeting with IEC</li> <li>If exceedance stops, cease additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Review with analysed results submitted by ET</li> <li>Review the proposed remedial measures by DBO Contractor and advise IC accordingly</li> <li>Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>Confirm receipt of notification of exceedance in writing</li> <li>Notify DBO Contractor</li> <li>Require DBO Contractor to propose remedial measures for the analysed dust problem</li> <li>Ensure remedial measures are properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>Submit proposals for remedial actions to IEC within 3 working days of notification</li> <li>Implement the agreed proposals</li> <li>Amend proposal if appropriate</li> </ul>

Exceedance of Limit Level				
<p>1.Exceedance for one sample</p>	<ul style="list-style-type: none"> <li>• Identify source</li> <li>• Inform IEC and DBO Contractor</li> <li>• Repeat measurement to confirm findings</li> <li>• Increase monitoring frequency to daily</li> <li>• Assess effectiveness of DBO Contractor's remedial actions and keep EPD and IEC/IC informed of the results</li> </ul>	<ul style="list-style-type: none"> <li>• Check monitoring data and DBO Contractor's working methods</li> <li>• Discuss with ET Leader and DBO Contractor potential remedial actions</li> <li>• Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Confirm receipt of notification of exceedance in writing</li> <li>• Notify DBO Contractor</li> <li>• Require DBO Contractor to propose remedial measures for the analysed dust problem</li> <li>• Ensure remedial measures are properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Take immediate action to avoid further exceedance</li> <li>• Submit proposals for remedial actions to IEC within 3 working days of notification</li> <li>• Implement the agreed proposals</li> <li>• Amend proposal if appropriate</li> </ul>
<p>2.Exceedance for two or more consecutive samples</p>	<ul style="list-style-type: none"> <li>• Identify source</li> <li>• Inform IEC, IC, and EPD the causes and actions taken for the exceedances</li> <li>• Increase monitoring frequency to confirm findings</li> <li>• Carry out analysis of DBO Contractor's working procedures to determine possible mitigation to be implemented</li> <li>• Assess effectiveness of DBO Contractor's remedial actions and keep IEC, EPD and IC informed of the results</li> <li>• If exceedance stops, cease additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss amongst IC, ET Leader and DBO Contractor on the potential remedial actions.</li> <li>• Review DBO Contractor's remedial actions whenever necessary to assure their effectiveness and advise IC accordingly</li> <li>• Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Confirm receipt of notification of exceedance in writing</li> <li>• Notify DBO Contractor</li> <li>• Require DBO Contractor to propose remedial measures for the analysed dust problem</li> <li>• Ensure remedial measures are properly implemented</li> <li>• If exceedance continues, consider what activity of the work is responsible and instruct DBO Contractor to stop that activity of work until the exceedance is abated</li> </ul>	<ul style="list-style-type: none"> <li>• Take immediate action to avoid further exceedance</li> <li>• Submit proposals for remedial actions to IEC within 3 working days of notification</li> <li>• Implement the agreed proposals</li> <li>• Resubmit proposals if problem still not under control</li> <li>• Stop the relevant activity of works as determined by the IC until the exceedance is abated</li> </ul>



### 3.1.8 Dust Mitigation Measures

The EIA report has recommended dust control and mitigation measures. The DBO Contractor shall be responsible for the design and implementation of these measures:

- Dust emission from construction vehicle movement are confined within the worksites area.
- Watering facilities will be provided at every designated vehicular exit point.
- Good site practice is recommended during construction phase. Covering with impermeable sheet should be provided for the inactive tipping area.

If the above measures are not sufficient to restore the air quality to acceptable levels upon the advice of ET Leader, the DBO Contractor shall liaise with the ET Leader on some other mitigation measures, propose to IC and IEC for approval, and implement the mitigation measures.

## 3.2 Odour

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### 3.2.1 Odour Intensity Analysis

Odour Intensity Analysis is conducted by independent trained personnel / competent persons patrolling and sniffing around the Air Sensitive Receiver to detect any odour at the concerned hours.

The independent trained personnel / competent persons shall :

- have their individual odour threshold of n-butanol in nitrogen gas in the range of 20 to 80 ppb/v required by the European Standard Method (EN 13725).
- be at least 16 years of age and willing and able to follow instructions.
- be free from any respiratory diseases.
- be engaged for a sufficient period to build up and monitor/detect at several monitoring location;
- not be allowed to smoke, eat, drink (except water) or use chewing gum or sweets 30 min before and during odour intensity analysis;
- take great care not to cause any interference with their own perception or that of others by lack of personal hygiene or the use of perfumes, deodorants, body lotions or cosmetics;
- not communicate with each other about the results of their choices.

At least three independent trained personnel / competent persons shall be selected to form a patrol team to conduct the odour intensity analysis, who should participated in a set of screening tests.

Subject to the prevailing weather forecast condition, odour intensity analysis shall be conducted by independent trained personnel / competent persons at the downwind locations. During the analysis, the sequence should start from less odorous locations to stronger odorous locations.

The independent trained personnel / competent persons shall use their nose (olfactory sensors) to sniff odours at different locations. The main odour emission sources and the areas to be affected by the odour nuisance shall be identified.

The perceived odour intensity is to be divided into 5 levels which are ranked in the descending order as follows:

- 0 - Not detected. No odour perceived or an odour so weak that it can not be easily characterised or described;

- 1 - Slight Identifiable odour, and slight chance to have odour nuisance;
- 2 - Moderate Identifiable odour, and moderate chance to have odour nuisance;
- 3 - Strong Identifiable, likely to have odour nuisance;
- 4 - Extreme Severe odour, and unacceptable odour level.

The independent trained personnel / competent persons shall record the findings including odour intensity, odour nature and possible odour sources, and also the local wind speed and direction at each location. In addition, some relevant meteorological data such as daily average temperature, and daily average humidity, on that surveyed day shall be obtained from the Hong Kong Observatory Station for reference.

### 3.2.2 Odour Patrol

Apart from odour intensity analysis, routine odour patrol by competent persons shall also be conducted to detect odour nuisance.

### 3.2.3 Odour Intensity Analysis / Odour Patrol Locations

The odour intensity analysis and odour patrol locations are shown in Table 3.4. The status and locations of air sensitive receivers may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from IC and IEC and agreement from EPD on the proposal. The monitoring location is illustrated in **Drawing No. 24315/13/151**.

**Table 3.4 Description of odour monitoring locations**

AML ID	EIA ASR Ref	Location <sup>[1]</sup>	Land Uses	Monitoring Parameters
AM(O)1	ASR1	Wo Keng Shan Tsuen	Residential	Odour Intensity
AM(O)2	ASR2	Village houses at Junction of Ng Chow Road and Wo Keng Shan Road	Residential	Odour Intensity
AM(O)3	ASR13	Nga Yiu Ha	Residential	Odour Intensity
AM(O)4	ASR14	Ping Yeung	Residential	Odour Intensity
AM(O)5	ASR10	Lin Ma Hang	Residential	Odour Intensity
AM(O)6	ASR27	Tong To Shan Tsuen <sup>[2]</sup>	Only if it is occupied by residents	Odour Intensity

Remark:

[1] Odour odour intensity analysis and odour patrol shall only be conducted for the downwind monitoring locations.

[2] Tong To Shan Tsuen is currently a derelict isolated single house.

### 3.2.4 Event and Action

Table 3.5 shows the Action and Limit levels to be used, and the patrol frequency is listed in Table 3.6. Should non-compliance of the air quality criteria occur, the ET, the IC/IEC and the DBO Contractor shall undertake the relevant action in accordance with the Action Plan in Table 3.7.

**Table 3.5 Action and limit levels for odour nuisance**

Parameters	Action	Limit
Odour Nuisance (from odour intensity analysis or odour patrol)	<ul style="list-style-type: none"> <li>• When two documented complaint are received; or</li> <li>• Odour Intensity of 2 is measured from odour intensity analysis.</li> </ul>	<ul style="list-style-type: none"> <li>• Five or more consecutive genuine documented complaints within a week; or</li> <li>• Odour Intensity of 3 or above is measured from odour intensity analysis.</li> </ul>

**Table 3.6 Odour Intensity Analysis and Odour Patrol Frequency**

Routine Mode	Action Level	Limit Level
<p><b>Odour Patrol :</b> Once every six days during the following period:</p> <ul style="list-style-type: none"> <li>• early morning; and</li> <li>• peak tipping hour (e.g. 11:00am),</li> </ul> <p><b>Odour Intensity Analysis :</b> Quarterly during the following period:</p> <ul style="list-style-type: none"> <li>• early morning; and</li> <li>• peak tipping hour (e.g. 11:00am),</li> </ul>	<p>Daily odour patrol.</p> <p>Weekly odour intensity analysis for 2 period during:</p> <ul style="list-style-type: none"> <li>• early morning; and</li> <li>• peak tipping hour (e.g. 11:00am)</li> </ul>	<p>Daily odour patrol.</p> <p>Daily odour intensity analysis for 2 period during:</p> <ul style="list-style-type: none"> <li>• early morning; and</li> <li>• peak tipping hour (e.g. 11:00am)</li> </ul>

**Table 3.7 Event/Action plan for odour nuisance**

Event	ET	IEC	IC	DBO Contractor
Action Level	<ul style="list-style-type: none"> <li>• Identify source</li> <li>• Inform IEC and DBO Contractor</li> <li>• If nuisance stops or external source has been identified, resume monitoring to routine mode</li> <li>• Recommend precautionary measures</li> </ul>	<ul style="list-style-type: none"> <li>• Review submissions and reports from ET</li> </ul>	<ul style="list-style-type: none"> <li>• Notify DBO Contractor</li> <li>• Ensure implementation of precautionary measures</li> </ul>	<ul style="list-style-type: none"> <li>• Rectify any unacceptable practice</li> <li>• Review the operation of odour enhancement facilities at leachate treatment plants</li> <li>• Amend working methods if appropriate</li> <li>• Carry out precautionary measures</li> </ul>

Event	ET	IEC	IC	DBO Contractor
Limit Level	<ul style="list-style-type: none"> <li>Identify source</li> <li>Inform IEC, and IC, the causes and actions taken for the nuisance</li> <li>Carry out analysis of DBO Contractor's working procedures to determine possible mitigation to be implemented</li> <li>Assess effectiveness of DBO Contractor's remedial actions and keep IEC, EPD and IC informed of the results</li> <li>If nuisance stops or external source has been identified, resume monitoring to routine mode</li> </ul>	<ul style="list-style-type: none"> <li>Discuss amongst IC, ET Leader and DBO Contractor on the potential remedial actions.</li> <li>Review DBO Contractor's remedial actions whenever necessary to assure their effectiveness and advise IC accordingly</li> <li>Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>Confirm receipt of notification of exceedance in writing</li> <li>Notify DBO Contractor</li> <li>Require DBO Contractor to propose remedial measures for the analysed odour nuisance</li> <li>Ensure remedial measures are properly implemented</li> <li>If nuisance continues, instruct DBO Contractor to stop that activity of work suspected to be the origin of the nuisance source until the nuisance is abated</li> </ul>	<ul style="list-style-type: none"> <li>Take immediate action to avoid further nuisance</li> <li>Submit proposals for remedial actions to IEC within 3 working days of notification</li> <li>Proposals include tipping at the far end of the upwind location; thicker daily cover can be arranged in case odour patrol identify potential odour nuisance; and use of immediate soil cover for sewage sludge, animal waste</li> <li>Implement the agreed proposals</li> <li>Resubmit proposals if problem still not under control</li> </ul>

### 3.3 Precautionary Measures During Operational, Restoration and Aftercare Phases

#### 3.3.1 Stack Discharge from ASP, Flare and LFG Power Generator

- The maximum allowable discharge limit for ASP, flare and LFG power generator should be specified in the design specification.
- Owing to the requirement for the installation of stack, the design requirement shall be submitted to IEC and IC for vetting by the DBO Contractor under the Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alternation) Regulations.
- Subject to the subsequent EPD's requirement on chimney installation, once every 3 months regular stack monitoring of vinyl chloride, benzene, TOC, NO<sub>x</sub> and SO<sub>2</sub> shall be carried out to demonstrate compliance during the operations.
- A monthly monitoring report should be prepared by ET and submitted to IEC and IC for approval.

#### 3.3.2 Odour from Leachate Treatment Facilities

For the proposed leachate treatment plant in NENT Landfill Extension, the overall leachate treatment facilities include:

- Adopted updated treatment method such as Sequencing Batch Reactor for future leachate treatment. Provision of ventilated cover for the leachate storage lagoons / tanks



and emissions extracted to suitable odour removal filters with odour removal efficiency of 99%.

- Ferric nitrate or sodium hypochlorite can be added to oxidise the odourous chemical in the leachate. The pH value of leachate can be controlled to a suitable value from future on-site experiment such that the generation of any odourous H<sub>2</sub>S and ammonia can be optimised.
- For the gaseous extraction system, the wind speed immediately above the leachate surface should be kept to minimal (in the order of 1E-3 m/s) such that the odour emission strength from lagoon can be minimised. Suitable treatment system should be provided for odour removal. The ventilated gaseous emission from lagoons should be provided with 5-10 air change per hour for further dilution before discharge.
- The notional centre of the future discharge point (e.g. stack) shall be located at a location with maximum setback distance from the ASRs and further away from the notional centre of the lagoons. The location of discharge point and discharge height should be determined at the detailed design stage to ensure that the odour criterion at the ASRs will not be exceeded.
- The overall arrangement should be investigated in details by the DBO Contractor and agreed with IEC and EPD. As such, the odour emission from the future leachate treatment facilities will be insignificant.

### **3.3.3 Odour from Waste Transfer Activities**

The following are some odour precautionary measures that shall be considered by EPD and FEHD:

- As an improvement measure to enhance to environmental standard for waste transfer, EPD could take the initiative to recommend others to use enclosed type RCVs (dominantly government vehicles and sludge vehicles).
- Clearing / watering of the surface and clearing of the waste water receptor of government RCV is recommended before leaving refuse transfer station or government Refuse Collection Point (FEHD).

### **3.3.4 Precautionary Odour from Waste Tipping Activities**

- The use of alternative daily cover (less permeable layer) instead of inert material should be considered under worst-case weather condition, subject to EM&A Programme.
- The use of immediate daily cover for odorous waste such as sewage sludge, animal waste etc. under critical condition should also be considered, subject to EM&A Programme.
- For the time being, there is no population in the derelict Tong To Shan Tsuen. If there is new residents moving in, thicker daily cover / alternative daily cover should be applied at phase 3 of the extension site such that the emission strength for the night time can be reduced (similar performance as that in the inactive tipping area). Odour patrol at Tong To Shan Tsuen should be arranged during night time / early morning in order to ensure the effectiveness of the measures.
- In accordance with some reference from New Zealand, odour from active tipping area can be much reduced if the waste is covered by sandwich covering material such that it is confined in a solid/semi solid condition. Such covering material will be acted as sandwich protective layers to block the interaction of waste. Only diffusion mode (small scale) will be present. These would be applied during very hot and stable weather condition. Twice daily covering (mid day and close of business) can be arranged in case odour patrol identify potential odour nuisance, subject to EM&A Programme.
- During stable and calm weather condition and subject to EM&A programme, tipping could be arranged to further increase the setback distance.

**3.3.5 VOC Surface Emission**

- The VOC monitoring requirements are discussed in Section 7. Details will be further established in the Landfill Monitoring Plan (LMP) to be developed by the future DBO Contractor based on EM&A Manual for landfill gas monitoring.
- Subject to future engineering design, the arrangement of the landfill gas collection system and surface covering material for inactive tipping area shall be reviewed by DBO Contractor every 5 year to identify any modern technology/arrangement (covering material, LFG well spacing and locations) and the latest WHO/USEPA health-risk criteria. A working team shall be formulated to review all processes, control practice and extraction system in order to maximise the efficiency of the system. A review report should be prepared by the DBO Contractor for the submission to IC and IEC on the implementation/arrangement of LFG extraction system. The first review report should be submitted to IC and IEC for agreement before commencement. With a good system to collect LFG (high extraction efficiency), surface release of VOC to the nearby environment can be much reduced or utilised.
- Maintain a slightly negative pressure within the entire tipping area (by suction). Minimise any potential leakage of LFG to the surrounding by increase the number of gas-extraction wells. Improve the extraction efficiency by checking/reinstate gas wells with abnormally low extraction rate due to blockage/soil movement or sedimentation.
- Increase the coverage of inactive tipping area with HDPE/plastic sheet which can enhance the anaerobic decomposition (reduce air getting in and VOC leaking out).
- EM&A will be conducted at ASR to establish the future VOC ambient level one year before (as baseline) and one year after the commissioning of NENT extension. This monitoring work should be carried out in a frequency once every 3 month during the period when the ASP and flare are not in operation (only have the contribution from surface emission). Benzene and vinyl chloride are the key monitoring parameters. By comparing the monitoring data at the boundary and at ASR, the cause of VOC and the general downwind dispersion effect (dilution effect) from the boundary to the ASR can be identified. This monitoring should be repeated by the DBO Contractor once every 5 year and the findings should be incorporated into the landfill gas collection system review report as mentioned above.
- The monitoring location is listed in Table 3.4 and illustrated in Drawing No. 24315/13/151. This off-site VOC monitoring report shall be submitted to IC and IEC for vetting.

**Table 3.8 Off-site Surface gas monitoring locations at ASRs**

AML ID	EIA ASR Ref	Location	Land Uses	Monitoring Indicator
AM(V)1	ASR1	Wo Keng Shan Tsuen (West of NENT Extension)	Residential	Benzene and Vinyl Chloride
AM(V)2	ASR3	Cheung Shan Monastery (South of NENT Extension)	Religions	Benzene and Vinyl Chloride
AM(V)3	ASR10	Lin Ma Hang (North of NENT Extension)	Residential	Benzene and Vinyl Chloride
AM(V)4	ASR27	Tong To Shan Tsuen (North-east of NENT Extension)	Only if it is occupied by residents	Benzene and Vinyl Chloride

## 4 Noise Monitoring

### 4.1 Monitoring Parameters

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#### 4.1.1 Construction Noise

Construction noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level ( $L_{eq}$ ).  $Leq_{30min}$  shall be used as the monitoring parameter for the time period between 0700 and 1900 hours on normal weekdays. For all other time periods,  $Leq_{5min}$  shall be employed for comparison with the Noise Control Ordinance (NCO) criteria. As supplementary information for data auditing, statistical results such as  $L_{10}$  and  $L_{90}$  shall also be obtained for reference.

#### 4.1.2 Operational and Traffic Noise

The noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level over a period of 30 minutes ( $L_{Aeq, 30mins}$ ) and A-weighted 10% of time over a period of one hour ( $L_{A10, 1hr}$ ) for operational noise and operational traffic noise, respectively. As supplementary information for data auditing, statistical results such as  $L_{A10}$ ,  $L_{Aeq}$  and  $L_{A90}$  shall also be obtained for reference.

### 4.2 Monitoring Equipment

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In accordance with the Technical Memorandum (TM) issued under the Noise Control Ordinance (NCO), sound level meters in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement, the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration level from before and after the noise measurement agree to within 1.0dB.

The ET Leader shall be responsible for the provision, installation and maintenance of the monitoring equipment. He shall ensure that sufficient noise monitoring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled. The location of equipment installation should be proposed by the ET Leader and agreed with the IC and EPD in consultation with the IEC.

Noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding 5m/s or wind with gusts exceeding 10m/s. The wind speed shall be checked with a portable wind speed meter capable of measuring the wind speed in m/s.

### 4.3 Monitoring Location

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The ET shall carry out noise monitoring during the construction and operational phases at 3 monitoring stations as shown in **Table 4.1** and **Drawing No. 24315/13/251**. The status and locations of NSRs may change after issuing this EM&A Manual. In such cases, the ET Leader should propose updated monitoring locations and seek approval from EPD.

**Table 4.1 Noise monitoring locations**

Monitoring ID	Location	Type of Monitoring	Monitoring Parameters	Supplementary Information
NM1	Wo Keng Shan Tsuen	Construction & Operation	L <sub>Aeq</sub> , 30mins	L <sub>A10</sub> and L <sub>A90</sub>
NM2	Lin Ma Hang	Construction & Operation	L <sub>Aeq</sub> , 30mins	L <sub>A10</sub> and L <sub>A90</sub>
NM3	Cheung Shan Monastery	Traffic Noise	L <sub>A10</sub> , 1hr	L <sub>Aeq</sub> and L <sub>A90</sub>

When alternative monitoring locations are proposed, the monitoring locations should be chosen based on the following criteria:

- At locations close to the major site activities which are likely to have noise impacts;
- Close to the noise sensitive receivers;
- For monitoring locations in the vicinity of the sensitive receivers, care should be taken to avoid disturbance to the occupants during monitoring.

The monitoring station shall normally be at a point 1m from the exterior of the sensitive receivers building facade and be at a position 1.2m above the ground. If there is problem with access to the normal monitoring position, an alternative position may be chosen, and a correction to the measurements shall be made. For reference, a correction of +3dB(A) shall be made to the free field measurements. The ET Leader shall agree with the IEC on the monitoring positions and the corrections adopted. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring shall be carried out at the same positions.

#### **4.4 Baseline Monitoring**

The ET shall carry out baseline noise monitoring prior to the commencement of the operation of landfill. The continuous baseline monitoring shall be carried out daily for a period of at least two weeks in a sample period of 5 minutes or 30 minutes. A schedule on the baseline monitoring shall be submitted to the IC and IEC for approval before the monitoring starts.

In exceptional case, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with the IC, IEC and EPD to agree on an appropriate set of data to be used as a baseline reference and submit to ER for approval.

#### **4.5 Construction Noise**

During normal construction working hour (0700-1900 Monday to Saturday), monitoring of Leq<sub>30min</sub> noise levels (as 6 consecutive Leq<sub>5min</sub> readings) shall be carried out at the agreed monitoring locations once every week.

If a school exists near the construction activity, noise monitoring shall be carried out at the monitoring stations for the schools during the school examination periods. The ET Leader shall liaise with the school's personnel and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

In case of non-compliance with the construction noise criteria, more frequent monitoring as specified in the Event and Action Plan shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.



A schedule on the compliance monitoring shall be submitted to the IEC and IC for approval before the monitoring starts. Sample data sheet for construction noise measurements is given in **Appendix C2**.

#### **4.6 Operational Noise**

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During normal operational working hours, monitoring of  $L_{Aeq, 30min}$  noise levels (as six consecutive  $L_{Aeq, 5min}$  readings) shall be carried out at the agreed monitoring locations once every week in accordance with the methodology in the TM.

Other noise sources such as road traffic and construction activities may make a significant contribution to the overall noise environment. Therefore, the results of noise monitoring activities shall take into account such influencing factors, which may not be present during the baseline monitoring period.

In case of non-compliance with the operational noise criteria, more frequent monitoring as specified in the Event and Action Plan shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the operational activities.

#### **4.7 Traffic Noise**

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During normal operational working hours, monitoring of  $L_{A10, 1hr}$  noise levels shall be carried out at the agreed monitoring locations once every week in accordance with the methodology in the Section III of the "Calculation of Road Traffic Noise, 1998".

The operational traffic noise monitoring will be measured in term of the A-weighted  $L_{10}$  within the peak traffic hour for each designated noise monitoring location. Measurements were paused if noise detected from other non-traffic activities became dominant.

In case of non-compliance with the traffic noise criteria, more frequent monitoring as specified in the Event and Action Plan shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the operational activities.

#### 4.8 Event and Action Plan

The Action and Limit levels for construction, operational and traffic noise are defined in **Tables 4.2-4.4**. Should non-compliance of the criteria occur, actions in accordance with the Event and Action Plan in **Tables 4.5-4.6** shall be carried out.

**Table 4.2 Action and limit levels for construction noise**

Time Period	Action Level	Limit Level
0700 - 1900 hours on normal weekdays	When one documented complaint is received	75 dB(A)*

If works are to be carried out during restricted hours, the conditions stipulated in the construction noise permit issued by the Noise Control Authority have to be followed.

\* Reduce to 70dB(A) for schools and 65dB(A) during school examination periods.

**Table 4.3 Action and limit levels for operational noise**

Time Period	Action Level	Limit Level
0700-1900 on all days	When one documented complaint is received	60 dB(A) *
1900-2300 on all days		60 dB(A) *
2300-0700 on all days		50 dB(A) *

\* Only apply to operational noise without road traffic and construction activities noise.

**Table 4.4 Action and limit levels for traffic noise**

Time Period	Action Level	Limit Level
Hotel, hostels & All domestic premises including temporary housing accommodation	When one documented complaint is received	70 dB(A)
Schools & Place of public Worship		65 dB(A)

Table 4.5 Event and action plan for construction noise

Event	ET	IEC	IC	DBO Contractor
Exceedance of Action Level	<ul style="list-style-type: none"> <li>Identify source, investigate the causes of exceedance and propose remedial measures;</li> <li>Notify IEC and DBO Contractor;</li> <li>Report the results of investigation to IEC, IC and DBO Contractor;</li> <li>Discuss with DBO Contractor and formulate remedial measures;</li> <li>Increase monitoring frequency to check mitigation effectiveness.</li> </ul>	<ul style="list-style-type: none"> <li>Review the analysed results submitted by ET;</li> <li>Review the proposed remedial measures by DBO Contractor and advise IC accordingly;</li> <li>Supervise the implementation of remedial measures.</li> </ul>	<ul style="list-style-type: none"> <li>Confirm receipt of notification of failure in writing;</li> <li>Notify DBO Contractor;</li> <li>Require DBO Contractor to propose remedial measures for the analysed noise problem;</li> <li>Ensure remedial measures are properly implemented.</li> </ul>	<ul style="list-style-type: none"> <li>Submit noise mitigation proposals to IEC;</li> <li>Implement noise mitigation proposals.</li> </ul>
Exceedance of Limit Level	<ul style="list-style-type: none"> <li>Identify source;</li> <li>Inform IEC, IC, EPD and DBO Contractor;</li> <li>Repeat measurements to confirm findings;</li> <li>Increase monitoring frequency;</li> <li>Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented;</li> <li>Inform IEC, IC and EPD the causes and actions taken for exceedances;</li> <li>Assess effectiveness of DBO Contractor's remedial actions and keep IEC, EPD and IC informed of the results;</li> <li>If exceedance stops, cease additional monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Discuss amongst IC, ET, and DBO Contractor on the potential remedial actions;</li> <li>Review DBO Contractor's remedial actions whenever necessary to assure their effectiveness and advise IC accordingly;</li> <li>Supervise implementation of remedial measures.</li> </ul>	<ul style="list-style-type: none"> <li>Confirm receipt of notification of failure in writing;</li> <li>Notify DBO Contractor;</li> <li>Require DBO Contractor to propose remedial measures for the analysed noise problem;</li> <li>Ensure remedial measures properly implemented;</li> <li>If exceedance continues, consider what portion of the work is responsible and instruct DBO Contractor to stop that portion of works until the exceedance is abated.</li> </ul>	<ul style="list-style-type: none"> <li>Take immediate action to avoid further exceedance;</li> <li>Submit proposals for remedial actions to IEC within 3 working days of notification;</li> <li>Implement the agreed proposals;</li> <li>Resubmit proposals if problem still not under control;</li> <li>Stop the relevant portion of works as determined by IC until the exceedance is abated.</li> </ul>

**Table 4.6 Event and action plan for operational and traffic noise**

Event	ET	IEC	IC	DBO Contractor
Exceedance of Action Level	<ul style="list-style-type: none"> <li>• Notify IEC and DBO Contractor</li> <li>• Carry out investigation</li> <li>• Report the results of investigation to IEC and the DBO Contractor</li> <li>• Discuss with the DBO Contractor and formulate remedial measures</li> <li>• Increase monitoring frequency to check mitigation measures</li> </ul>	<ul style="list-style-type: none"> <li>• Review with analysed results submitted by ET</li> <li>• Review the proposed remedial measures by DBO Contractor and advise IC accordingly</li> <li>• Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Confirm receipt of notification of exceedance in writing</li> <li>• Notify DBO Contractor</li> <li>• Require DBO Contractor to propose remedial measures for the analysed noise problem</li> <li>• Ensure remedial measures are properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Submit noise mitigation proposals to IEC</li> <li>• Implement noise mitigation proposals</li> </ul>
Exceedance of Limit Level	<ul style="list-style-type: none"> <li>• Identify source</li> <li>• Notify IEC, IC, EPD and DBO Contractor</li> <li>• Repeat measurement to confirm findings</li> <li>• Increase monitoring frequency</li> <li>• Carry out analysis of DBO Contractor's working procedures to determine possible mitigation to be implemented</li> <li>• Inform IEC, IC, and EPD the causes and actions taken for the exceedances</li> <li>• Assess effectiveness of DBO Contractor's remedial actions and keep IEC, EPD and IC informed of the results</li> <li>• If exceedance stops, cease additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss amongst IC, ET Leader and DBO Contractor on the potential remedial actions.</li> <li>• Review DBO Contractor's remedial actions whenever necessary to assure their effectiveness and advise IC accordingly</li> <li>• Supervise the implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Confirm receipt of notification of exceedance in writing</li> <li>• Notify DBO Contractor</li> <li>• Require DBO Contractor to propose remedial measures for the analysed noise problem</li> <li>• Ensure remedial measures are properly implemented</li> <li>• If exceedance continues, consider what activity of the work is responsible and instruct DBO Contractor to stop that activity of work until the exceedance is abated</li> </ul>	<ul style="list-style-type: none"> <li>• Take immediate action to avoid further exceedance</li> <li>• Submit proposals for remedial actions to IEC within 3 working days of notification</li> <li>• Implement the agreed proposals</li> <li>• Resubmit proposals if problem still not under control</li> <li>• Stop the relevant activity of works as determined by the IC until the exceedance is abated</li> </ul>



#### **4.9 Environmental Mitigation Measures**

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The DBO Contractor shall be responsible for implementation of the noise control and mitigation measures during operational phase, which shall include, but not limited to, the following:

- Quiet equipment and construction method should be employed;
- Only well-maintained plant shall be operated on site and plant shall be serviced regularly during the construction work;
- Machines and plant that may be in intermittent use (such as breakers) shall be shut down between work periods or should be throttled down to a minimum;
- Mobile plant shall be sited as far away from NSRs as possible;
- Material stockpiles and other structures shall be effectively utilised, where practicable, to screen noise from on-site construction activities;
- Silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works.

## 5 Water Quality Monitoring

### 5.1 Introduction

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Potential water pollution sources arising from construction activities include sources mainly from land-based activities, such as construction site runoff; sewage effluent due to workforce on site; accidental spillage of chemical; drainage diversion; and groundwater seepage.

Potential water pollution sources arising from operational include sources mainly from land-based activities, such as seepage of leachate, accidental Leakage of leachate and erosion.

The EIA Report has assessed the water quality impacts caused by the construction and operation of NENT Landfill Extension. Mitigation measures have been recommended in the EIA to ensure compliance with the relevant legislative requirements. These mitigation measures are summarised in following sections. An implementation schedule of the recommended mitigation measures is presented in **Appendix C3**.

### 5.2 Precautionary / Mitigation Measures during Construction and Operation Phases

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#### 5.2.1 Construction Phase

##### 5.2.1.1 Construction Site Runoff

In accordance with the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), and DSD Technical Circular TC14/2000, construction phase precautionary measures as presented in **Appendix C3** shall be implemented where necessary. By adopting the above precautionary measures with Best Management Practices (BMPs) it is anticipated that the impacts of runoff from the construction site will be reduced to satisfactory levels before discharges.

The construction runoff discharged from the landfill site shall fully comply with the standards stated in Section 5.2 of the EIA report, otherwise the discharge shall be collected and conveyed to the on-site leachate treatment plant.

##### 5.2.1.2 Sewage from Workforce

Portable chemical toilets and sewage holding tanks will be provided for handling the sewage generated by the workforce. A licensed contractor will be employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.

##### 5.2.1.3 Accidental Spillage of Chemical

Any service workshops and maintenance facilities will be located within a bunding area, and sumps and oil interceptors will be provided. Maintenance of equipment involving activities with potential for leakage and spillage will only be undertaken within the areas appropriately equipped to control these discharges.

#### 5.2.2 Operational Phase

##### 5.2.2.1 Contingency Plan on Accidental Leakage of Leachate

###### Existing Contingency Plan for Groundwater Contamination

The existing Contingency Plan is comprehensive and well-developed and will be used as basis for developing the Contingency Plan for the extension site. The parameters to be monitored include groundwater level and groundwater quality. The objective of the monitoring programme is to ensure that the trigger levels below are not exceeded.

Ammonia Nitrogen : 5 mg/L

COD : 30 mg/L

In the event that the above trigger levels are exceeded, the DBO Contractor will implement a Corrective Action Programme, which shall include:

- groundwater interception and diversion; and
- groundwater extraction (by active pumping of leachate from leachate and groundwater collection layers) and treatment prior to discharge.

#### **Proposed Modifications to Contingency Plan for Groundwater Contamination**

Potential actions to be taken in case of identification of groundwater contamination should also include:

- Installation of additional ground-water monitoring well;
- Increased frequency of ground-water quality testing;
- Installation of ground-water extraction wells to remove contaminated groundwater for treatment;
- Installation of subsurface barriers, such as bentonite;
- Detailed investigation of the potential impact to be performed within six months of the first detection of the justified impact.

#### **Contingency Plan for Surface Water Contamination**

Surface water monitoring will be conducted to keep the ammonia-nitrogen and COD below the following trigger levels:

Ammonia Nitrogen :	0.5 mg/L
COD :	30 mg/L
Suspended Solid :	20 mg/L.

In the event that any one of the above parameters was exceeded, the landfill operation should implement a Corrective Action Programme. The key elements shall include:

- Surface water interception and temporary storage of the contaminated surface water;
- Installation of surface barriers, such as sand bund along the surface water channel / site boundary to avoid overflow off-site.
- Active pumping of the contaminated surface water to the leachate lagoons / leachate recirculation system / on-site leachate treatment plant;
- Additional monitoring locations will be selected to determine the pollution source;
- Installation of surface barriers, such as intercepting bund to separate the active and inactive tipping area.
- Change of working methods to prevent surface water contamination; and
- Implementation of diversionary works.

##### **5.2.2.2 Erosion Control**

The DBO Contractor shall devise a soil erosion control plan during the detailed design stage so as to define the site-specific measures and procedures (including the specific operation plan, implementation frequency, monitoring procedures, maintenance schedules, etc). Such requirement shall be specified in contract documents. **Appendix C3** summarizes the most popular erosion control methods for reference.

##### **5.2.2.3 Surface Water Drainage System**

A temporary surface water drainage system to manage runoff will be adopted during construction and operation. It consists of perimeter channels around the site perimeter. It will collect surface water from higher elevations to lower elevations and ultimately to the discharge point. Details of surface water drainage system are included in **Appendix C3**.

The surface flow discharge from the landfill site shall fully comply with the standards stated in Section 5.2 of the EIA report, otherwise the contaminated surface flow shall be collected and disposed of to the on-site leachate treatment plant.

### **5.3 Leachate Monitoring**

The DBO Contractor shall develop and operate a programme of monitoring which shall record the progressive generation of leachate at the NENT Landfill Extension in accordance with the following objectives:

- To determine the level of leachate within the landfill;
- To determine the quality of leachate arising from the landfill;
- To determine the quantity of leachate arising from the landfill and being treated;
- To monitor the quantity and quality of treated leachate from the leachate treatment works before discharging into leachate pipeline connecting to Shek Wu Hui Sewage Treatment Plant;
- To ascertain the landfill characteristics and effectiveness of the leachate treatment works.

The leachate monitoring programme shall commence at the start of landfill operations and continue until the issue of the Aftercare Certificate. The programme shall be developed with in-built flexibility to allow for modification during the development of the leachate treatment works and any modifications to the monitoring of the quality and quantity of leachate generated.

#### **5.3.1 Equipment**

Routine sampling and on-site measurements of leachate quality shall be carried out with appropriate equipment which include:

- Portable thermometer, pH and electrical conductivity (EC) meter
- Sample bottle of glass or PET of volume not less than 1 litre
- Flowmeters

At the leachate collection point, the submersible pump shall be used to discharge leachate flow from the leachate removal chamber. Level sensors shall be incorporated into the side slope riser pipe for pump control and measurement of leachate level. In addition, a dipstick and measuring tape shall be used to determine (in-situ) normal leachate levels if the level sensor is not operative.

#### **5.3.2 Calibration and Maintenance**

The DBO Contractor shall ensure that all equipment are calibrated and maintained according to manufacturer's instructions. Routine maintenance shall be carried out in strict accordance with the manufacturer's requirements. Where calibration intervals are not specified by the equipment manufacturer, the length of time between calibration periods shall not be greater than 6 months.

An inspection procedure shall be established to ensure that the frequency of maintenance is regularised for each equipment. Results from the monitoring programme shall be used to assist in the ongoing operation of the leachate treatment works to ensure that the facility is being operated under the optimum conditions, and that the leachate discharge complies with the trigger levels specified in Section 5.3.8.

#### **5.3.3 Procedures**

The DBO Contractor shall monitor leachate levels within the landfill using calibrated submersible level sensors incorporated into the side slope riser pipe.

Quantity of raw leachate shall be monitored using in-line flow meters installed in the pipe. The flow meters shall be designed and constructed to determine the volume and rate of leachate leaving the landfill site to an accuracy and precision of within +/- 1%.

At the same locations, the leachate shall also be monitored periodically to assess leachate quality produced within operational areas and after treatment. This shall be achieved using in-line sampling valves/taps. The design and construction of these valves/taps shall be such



that samples of leachate of between 1 and 25 litres can be readily and easily obtained without sampling rates being too high resulting in unacceptably-high levels of splashing or too low making the duration of sampling unacceptably long.

The DBO Contractor shall use the groundwater drainage layer to detect any leachate escaping through the liner system. The detection system shall involve daily sampling at the groundwater discharge point (shown as Leachate Leakage Detector) and the groundwater monitoring boreholes.

#### 5.3.4 Analysis Parameters

All leachate samples shall be collected and transported to a HOKLAS accredited laboratory as soon after sampling as possible. Appropriate pre-treatment of samples shall be prepared in respect of the analytical parameters, with due regard to its holding times.

Leachate quality shall be monitored as a feedback to the operation for optimisation of the leachate treatment works and to establish its trend over the life of the landfill. The programmes shall generate data to support the establishment of a procedure for the necessary treatment and safe disposal of effluent from NENT Landfill Extension.

The following parameters shall be measured in accordance with the standards contained within the Specification:

Table 5.1 Suite 1 - Leachate Monitoring :

Programme A			Programme B		
Parameters	Detection Limit	Frequency	Parameters	Detection Limit	Frequency
Temperature *	0.1°C	Weekly basis initially and then monthly when settled values are obtained for the first 3 years of NENT Landfill Extension operation	Mg	50 µg/L	Monthly basis initially and then 3 monthly Intervals when settled values are obtained for the first 3 years of NENT Landfill Extension operation
pH *	0.1		Ca	50 µg/L	
Electrical conductivity *	1 µS/cm		K	50 µg/L	
COD	10 mg/L		Fe	50 µg/L	
BOD <sub>5</sub>	3 mg/L		Ni	1 µg/L	
TOC	1 mg/L		Zn	10 µg/L	
SS	0.1 mg/L		Mn	1 µg/L	
Ammonia-nitrogen	0.2 mg/L		Cu	1 µg/L	
Nitrate	0.5 mg/L		Pb	1 µg/L	
Nitrite	0.5 mg/L		Cd	0.2 µg/L	
Total Nitrogen	0.4 mg/L				
Sulphate	5 mg/L				
Phosphate	0.01 mg/L				
Chloride	0.5 mg/L				
Sodium	50 µg/L				
Alkalinity	1 mg/L				
Volatile fatty Acids	2 mg/L				

\* On-site measurement

Table 52 Suite 2 - Leachate Monitoring

Parameters	Detection Limit	Parameters	Detection Limit	Frequency
Temperature	0.1°C	Phosphate	0.01 mg/L	Quarterly Basis after the first 3 years of NENT Landfill Extension operation
pH	0.1	Chloride	0.5 mg/L	
COD	10 mg/L	Sodium	50 µg/L	
BOD <sub>5</sub>	3 mg/L	Alkalinity	1 mg/L	
SS	0.1 mg/L	Fe	50 µg/L	
Ammonia-nitrogen	0.2 mg/L	Zn	10 µg/L	
Nitrate	0.5 mg/L	Cu	1 µg/L	
Total Nitrogen	0.4 mg/L	Cd	0.2 µg/L	
Sulphate	5 mg/L			

Suite 1 (Programme A and Programme B) shall be used to establish the quality of leachate from each collection point (i.e., before and after treatment) for the first 3 years of NENT Landfill Extension operation, and Suite 2 shall be used for routine monitoring thereafter.

For leachate leakage detection, the DBO Contractor shall analyse the samples taken at the groundwater discharge point for ammonia-nitrogen, pH and conductivity. If necessary, COD shall be tested when high ammonia-nitrogen is detected at the groundwater discharge point. Samples shall be stored and preserved according to the guidelines of the approved accredited laboratory.

**5.3.5 Frequency and Locations of Sampling**

The DBO Contractor shall take raw leachate samples and treated leachate samples. The frequency and sampling locations summarized in **Table 5.3**.

**Table 5.3 Frequency and Locations of Sampling**

<b>Program</b>	<b>Frequency</b>	<b>Location</b>
Suite 1, Programme A	Weekly intervals initially and then monthly when settled values are obtained	At new leachate Collection Points (i.e prior to discharging points at raw leachate lagoon for raw leachate monitoring and final effluent holding lagoon for partially treated leachate monitoring)
Suite 1, Programme B	At monthly intervals and then three monthly intervals when settled values are obtained for the first three years of NENT Landfill Extension operation	
Suite 2	At quarterly intervals after Suite 1 programme B	

The DBO Contractor shall monitor levels of leachate continuously using calibrated submersible pressure transducers via data retrieving equipment. Daily records of leachate production shall be maintained via data logging flow meters for all abstraction of liquid from the site and leachate quantities leaving the site.

The DBO Contractor shall determine the locations of leachate monitoring points and submit the proposed plan to the Independent Consultant for approval.

**5.3.6 Results**

All sample containers shall be clearly marked, and identified with relevant sampling information. In addition, all monitoring results and observations made at time of sampling shall be recorded in a field data sheet specifically allocated to that sampling task. The following information shall be recorded on each sampling visit:

- Sampling point;
- Data and time of sample collection;
- Name of technician carrying out the sampling;
- Weather conditions and ambient temperature;
- General appearance, condition and temperature of the water body;
- Sampling device and method used;
- Sample preservation used;
- Storage requirements adopted;
- Space for listing analytical determinations.

**5.3.7 Leachate Leakage Detection**

Facilities to detect leakage within a 24-hr period shall be placed in the manner and positions specified and be monitored daily for the presence of leachate or contaminated water.

### 5.3.8 Trigger Levels

The DBO Contractor shall operate a programme of monitoring with the following objectives:

- Determine the level of leachate within the landfill;
- Determine the quality of leachate from the landfill;
- Determine the quantity of leachate from the landfill.

The DBO Contractor shall monitor the levels of leachate continuously at the leachate collection point through the use of calibrated submersible level sensors via data retrieving equipment. The level of leachate at any point within the landfill shall not exceed 1m height above the top of the primary barrier of the landfill liner system.

The standards for discharge of treated leachate from the leachate treatment works into the pipeline leading into Shek Wu Hui Sewage Treatment Works (SWHSTW) are given in Table 1 of the Water Pollution Control Ordinance (WPCO) Technical Memorandum – Standards for Effluent Discharged into Drainage and Sewerage System, Inland and Coastal Waters prepared by the EPD, with the exception for the following discharge limits.

Total Nitrogen :	200 mg/L	COD :	2000 mg/L
BOD :	400 mg/L	Ammonia-nitrogen :	5 mg/L
SS :	400 mg/L		

Treated leachate shall be discharged to the leachate pipeline leading to the SWHSTW. The leachate generated by the NENT Landfill Extension has been estimated. Under normal meteorological condition (i.e. with an average annual rainfall of 1,875 mm, data taken from Ta Kwu Ling Station from 1999 to 2005), the peak leachate flow rate from restored NENT Landfill and NENT Landfill Extension (under fully operation in Year 10) is estimated to be  $(265+860 =) 1,105 \text{ m}^3/\text{day}$  in wet season, which is within the design capacity of the existing leachate treatment plant (i.e.  $1,200 \text{ m}^3/\text{day}$ ). Nevertheless, daily records shall also be made for the quantity of leachate production.

### 5.3.9 Corrective Action

If the trigger levels in **Section 5.3.8** are exceeded, the DBO Contractor shall implement a Corrective Action Programme, which shall include:

- Leachate extraction;
- Phased development and closure to minimise the active area footprint;
- Temporary geosynthetic covers to minimize infiltration in active cells;
- Run-on and runoff control systems for active and closed areas;
- Low permeability final cover system to minimise infiltration during post-closure;

In event that the DBO Contractor detects leachate leakage (i.e. the trigger level is exceeded at the groundwater discharge point), the liquid shall be treated at the leachate treatment plant prior to discharge to the leachate pipeline leading to SWHSTW.

## 5.4 Groundwater Monitoring

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### Groundwater Level

#### 5.4.1 Introduction

Groundwater levels shall be monitored over the working life of the site to determine the following information:

- Natural seasonal variation in groundwater levels;
- Effects of any ground water abstraction;
- Identification of hydraulic gradients;
- Variation caused by the construction, operation or aftercare.

#### **5.4.2 Equipment**

A portable dip meter, not affected by condensation, shall be used to measure water depth and checked before use. The dip meter shall comprise a graduated tape and sonic indicator of water level.

#### **5.4.3 Procedures**

Water level measurements shall be carried out prior to any purging or sampling from monitoring holes.

The DBO Contractor shall take groundwater level measurements relative to a permanent fixed datum at a measured elevation at each location, situated and marked on the monitoring borehole casing or cover. Recorded levels shall be expressed as metres relative to Principal Datum, and the levels checked 3 times prior to recording the measurements.

#### **5.4.4 Frequency and Locations of Sampling**

All manual groundwater level measurements shall be carried out at least once a month.

In the event that automatic measuring equipment is installed, the associated data loggers shall be interrogated / downloaded at least on a monthly basis. The automatic monitoring equipment shall be calibrated monthly and periodic manual water level measurements shall be carried out to corroborate the measurements.

Monthly groundwater monitoring shall be carried out at specified points ED1-ED35 in accordance with **Drawing No. 24315/13/504** unless otherwise approved by the IC.

#### **5.4.5 Results**

All manual water level measurements shall be recorded relative to both monitoring borehole datum and Principal Datum. All automatic monitoring equipment shall be in a form that can be input to computer and displayed in numerical or graphical form. Results shall include site name; unique monitoring borehole reference or location code; date and water level in metres below monitoring borehole datum and to Principal Datum.

### **Groundwater Quality**

#### **5.4.6 Equipment**

The criteria for selection of appropriate equipment shall depend upon the purpose of the sampling exercise, the site characterisation and the parameters that are to be analysed. This shall be assessed using the following criteria:

- Required sampling accuracy and precision
- Sampling frequency;
- Sampler construction material;
- Required head;
- Required discharge rate;
- Reliability and ease of maintenance, including availability of spares.

Teflon and/or stainless steel samplers (e.g. bailers) shall be used to sample groundwater.

Where sampling relies on the sample being pumped to the surface via tubing, the tubing used shall be Teflon, Teflon lined, or polypropylene. Bladder pumps shall be used to purge and to sample. Groundwater may be pumped from depths in excess of 100m below ground level, due to the depth to groundwater and the topographic level of the site.

#### **5.4.7 Calibration and maintenance**

Before each purging process, field meters shall be calibrated according to manufacturer specifications and the calibration results recorded in a calibration log file. All sampling equipment shall be thoroughly decontaminated as per standard sampling protocol prior to use.

#### 5.4.8 Procedures

The DBO Contractor shall purge a monitoring borehole before a sample is taken in order that representative groundwater is sampled. This process shall be combined with field monitoring of determinants such as electrical conductivity, pH and temperature, so that stable sampling conditions can be achieved. If the water is contaminated it shall be contained and treated as leachate, otherwise abstracted groundwater shall be discharged to the surface water drainage system.

Samples shall be stored and preserved according to the guideline of approved accredited laboratory. Representative groundwater sample shall be collected, in approved receptacles as follows:

- Sampling containers shall be pre-rinsed with the water being collected, except in the case where specific determinations require preservatives in pre-prepared bottles;
- Glass containers shall be used for receipt of samples for organic analysis;
- Polyethylene containers shall be used for other determinants, except trace metals determinants such as mercury;
- Water shall be poured into sampling bottles carefully until filled completely, unless a specific volume is required by the analytical laboratory;
- A minimum of one litre sample shall be taken, unless otherwise specified;
- On-site measurement of EC, pH and temperature shall be carried out;
- On completion of sampling, portable equipment shall be removed from the borehole, and cleaned prior to use at next installation.

All sample bottles shall be labelled, samples shall be kept at for degrees centigrade and sent to the laboratory within specified holding times for the analytical methods. Samples shall be sent to the laboratory with appropriate chain-of-custody documentation.

Analysis of samples shall be carried out in accordance with methods described in American Society for Testing and Material (ASTM) or American Public Health Association (APHA) – American Water Works Association (AWWA) – Water Pollution Control Federation (WPCF).

#### 5.4.9 Results

All sample containers shall be clearly marked to show the site name, location and date of sample collection. All results shall be presented as following:

- Site name;
- Unique sampling location reference;
- Time and date of the sampling;
- Name of the sampling technician;
- Weather conditions and air temperature;
- Appearance, condition and temperature of the water body;
- Sampling device used;
- On-site measurements of EC, pH and temperature;
- Volume of water purged prior to sampling;
- Physical description of the sample.

#### 5.4.10 Analysis Parameters

The DBO Contractor shall measure the parameters according to the **Table 5.4** in monthly basis. In the event of contamination being detected in the monthly monitoring programme, additional groundwater monitoring shall be carried out in weekly basis.



**Table 5.4 Groundwater Monitoring**

Parameters	Detection Limit	Normal Frequency	Additional Frequency
Temperature	0.1°C	Monthly basis	
pH	0.1	Monthly basis	Weekly Basis
Electrical conductivity	1 µS/cm	Monthly basis	Weekly Basis
COD	10 mg/L	Monthly basis	Weekly Basis
BOD <sub>5</sub>	3 mg/L	Monthly basis	Weekly Basis
SS	0.1 mg/L	Monthly basis	Weekly Basis
Ammonia-nitrogen	0.2 mg/L	Monthly basis	Weekly Basis
Nitrate	0.5 mg/L	Monthly basis	-
TKN	0.4 mg/L	Monthly basis	-
Sulphate	5 mg/L	Monthly basis	-
Sulphite	2 mg/L	Monthly basis	-
Phosphate	0.01 mg/L	Monthly basis	-
Chloride	0.5 mg/L	-	Weekly Basis
Iron	50 µg/L	-	Weekly Basis
Zinc	10 µg/L	-	Weekly Basis
Coliform Count	1 cfu/ 100mL	Monthly basis	Weekly Basis

**5.4.11 Trigger Levels**

The DBO Contractor shall propose a permanent monitoring network at the site to include the following:

- Detailed information on the hydrogeological regime;
- Details on seasonal groundwater level fluctuations and short-term variations in certain areas;
- Detailed baseline groundwater quality information;
- Detailed pumping test data for areas down gradient of the site where contaminants are likely to migrate.

The DBO Contractor shall monitor groundwater around the site to ensure that the following trigger levels are not exceeded **Table 5.1**.

**5.4.12 Corrective Action**

In the event that the above trigger levels are exceeded, the DBO Contractor shall implement a Corrective Action Programme, which shall include:

- Groundwater extraction and, if necessary, treatment prior to discharge;
- Groundwater interception and diversion.

**5.5 Surface Water Monitoring****5.5.1 Introduction**

The DBO Contractor shall carry out surface water monitoring from the commencement of the works until the issue of the Aftercare Certificate in accordance with the following objectives:

- To assess the performance of the registered design, where: surface water leaves the site and/or the landfill boundary; surface water leaves an operational area; and surface water leaves areas of potential contamination e.g., waste reception area, vehicle and wheel washing, haul route, vehicle servicing, etc.
- To ensure no long-term deterioration in surface water quality adjacent to the site;
- To provide data for the design and to monitor the effectiveness of any remedial measures which may be necessary in the event of excessive leachate migration or liner failure.

Surface water monitoring stations shall be established in and around the site as part of the monitoring programme.

### 5.5.2 Equipment

For monitoring surface water quality, the DBO Contractor shall use the following sampling and measuring equipment:

- Varying water sample containers, as appropriate to the type of analysis being determined, fabricated from polyethylene, polypropylene, polycarbonate, aluminium, stainless steel or glass
  - Glass containers for organic constituents, but where major constituents of glass are to be analysed (e.g. sodium, potassium, boron, silicon and trace metallic impurities), glass containers shall not be used.
  - Polyethylene containers shall not be used for trace metallic impurities such as mercury.
- Silicon sieve/disposable filters for removal of suspended solids
- Thermometer with a range of 0-50°C
- Digital pH meter
- Electrical conductivity meter

A clamp, pole or string shall be attached to the bottle if the water poses a threat to the sampling technician or if direct contact is likely to be made with skin. However, in all situations, gloves shall be worn as a matter of routine when sampling potentially-contaminated water.

The following equipment or the approved equivalents shall be provided for monitoring flow:

- IS32 flow monitor complete with Druck transducer capable of measuring parameters of depth and velocity at specified intervals, with trip mode built-in.
- Velocity calibrator – Montec 3013 portable Doppler measurement for in-situ calibrations of velocity. A 1.25m logging wand shall be used for recording in-situ measurements.
- Monitoring software – specifically designed for use with IS32 and Montec 3013, to produce depth, velocity and discharge graphs, as well as tabulated data.

### 5.5.3 Calibration and Maintenance

Clean, pre-conditioned/washed sample containers shall be used during the sampling programme. Sample containers shall be used only once with the exception of glass containers appropriately decontaminated at the analytical laboratory prior to use. All sampling equipment including open-mouthed collection vessels (buckets and cans) and sieves shall be decontaminated prior to use between sample points to prevent cross contamination. Decontamination procedures involve the use of laboratory grade detergent and rinsing in de-ionized water. Sample bottles that contain chemical preservatives shall not be rinsed or cleansed in any way.

Thermometers shall be rinsed with de-ionized water and then wiped with disposable towels immediately after use before being replaced in the carrying case.

All flow measuring equipment shall be calibrated according to the manufacturer's specifications.

### 5.5.4 Procedures

The DBO Contractor shall undertake sampling of surface water quality with reference to the following documents:

- British Standard Institution (BSI) BS6068: 1981 Water Quality Sampling Section 6.1. Guidance on the Design of Sampling Programmes
- International Standard Organisation (ISO) ISO 5667-6 1990 Guidance on Sampling of Rivers and Streams

- BSI, BS 6068 1983 Water Quality Section 6.2 Guidance on Sampling Techniques. Health and Safety Executive
- BSI, BS 6068: 1986 Water Quality Section 6.3 Guidance on the Preservation and Handling of Samples (International Standards Organisation ISO 5667/3 – 1985 Water quality – Sampling – Part 3: Guidance on the Preservation and Handling of Samples).

Before sampling, the flow rate of the stream/river shall be determined and the water and air temperature, pH and electrical conductivity shall be measured and recorded.

All the precautions outlined in the Specification for avoiding contamination during sampling shall be taken, for example, pre-rinsing sampling containers (excluding those containers which are preserved by certain type of chemicals) with the surface water to be collected. In addition, appropriate health and safety precautions including the wearing of protective waterproof gloves shall be followed.

In general, samples shall be collected from within 500mm of the water surface. Samples shall be collected within an open mouthed vessel with the lip pointing upstream. The sample shall be filtered as appropriate. Alternatively the sample shall be collected directly into the sample container. Sampling of the surface film layer shall be avoided during the sampling programme.

During sample collection, care shall be taken so that air is not introduced into the samples thereby altering the relative compositions of the determinants. Once the sample bottle is filled to the top with no remaining air space the lid shall be securely screwed on. Where samples are to be preserved with acid or alkalis prior to transport to the laboratory, the sample bottles shall be filled to the level specified by the analytical laboratory.

Samples shall be transported to the laboratory for analysis as soon as possible after the sample is collected, since the longevity of some of the sample determinants is limited. All samples shall be stored at 4°C and transported to the laboratory within 48 hours from sampling.

Analyses shall be carried out in accordance with methods described in ASTM or APHA – AWWA – WPCF Standard.

Flow measurements shall also be taken continuously using automatic logging equipment.

#### 5.5.5 Analysis Parameters

The DBO Contractor shall measure the all parameters according to **Table 5.5** in monthly basis. In the event of contamination being detected in the monthly monitoring programme, additional surface water monitoring shall be carried out in weekly basis.

**Table 5.5 Surface Water Monitoring**

Parameters	Detection Limit	Normal Frequency	Additional Frequency
pH	0.1	Monthly basis	Weekly Basis
Electrical conductivity	1 $\mu$ S/cm	Monthly basis	Weekly Basis
Alkalinity	1 mg/L	Monthly basis	-
COD	10 mg/L	Monthly basis	Weekly Basis
BOD5	3 mg/L	Monthly basis	Weekly Basis
TOC	1 mg/L	Monthly basis	Weekly Basis
SS	0.1 mg/L	Monthly basis	Weekly Basis
Ammonia-nitrogen	0.2 mg/L	Monthly basis	Weekly Basis
TKN	0.4 mg/L	Monthly basis	-
Nitrate	0.5 mg/L	Monthly basis	-
Sulphate	5 mg/L	Monthly basis	-
Sulphite	2 mg/L	Monthly basis	-
Phosphate	0.01 mg/L	Monthly basis	-
Chloride	0.5 mg/L	Monthly basis	-
Sodium	50 $\mu$ g/L	Monthly basis	-
Mg	50 $\mu$ g/L	Monthly basis	-

Ca	50 µg/L	Monthly basis	-
K	50 µg/L	Monthly basis	-
Fe	50 µg/L	Monthly basis	Weekly Basis
Ni	1 µg/L	Monthly basis	-
Zn	10 µg/L	Monthly basis	Weekly Basis
Mn	1 µg/L	Monthly basis	-
Cu	1 µg/L	Monthly basis	-
Pb	1 µg/L	Monthly basis	-
Cd	0.2 µg/L	Monthly basis	-
Coliform Count	1 cfu/ 100mL	Monthly basis	Weekly Basis
Oil and Gease	5 mg/L	Monthly basis	-

Surface water flow shall be monitored continuously using automatic data logging equipment. Following periods of heavy rainfall, flow shall be monitored weekly and more frequently to determine peak discharge rates.

#### 5.5.6 Locations of Sampling

Monthly surface water monitoring shall be carried out at specified points WM1 (Upstream of Lin Ma Hang) and WM2 (Ping Yuen River, i.e existing SP1 monitoring station) in accordance with **Drawing No. 24315/13/504** unless otherwise approved by the IC. The sampling points shall be readily accessible and sampling shall be obtained from a flow that is moderate and steady. Turbulent flowing streams or stagnant pools shall be avoided.

#### 5.5.7 Results

Upon completion of each sampling exercise, the sample containers shall be clearly labelled with site name; sampling location reference; date and time of collection and sample number.

In addition, the sampling technician shall record any abnormality which may affect water quality in their record notebooks. The sampling record shall include the following details:

- Sampling site and sampling point;
- Date and time of collection;
- Name of sampling technician;
- Weather conditions and air temperature;
- Appearance, condition and temperature of the water body;
- Sampling method and sampling device used;
- Sample preservation;
- Storage requirements;
- List of parameters (with space for the analytical results).

#### 5.5.8 Trigger Levels

The DBO Contractor shall conduct the surface water monitoring programme in order to keep ammonia-nitrogen and COD below the following trigger levels:

Ammonia-nitrogen : 0.5mg/L

COD : 30 mg/L

In addition, suspended solids concentrations for surface waters leaving the site shall not exceed 20mg/L.

### 5.5.9 Corrective Action

In the event that these trigger levels are exceeded, the DBO Contractor shall implement a Corrective Action Programme, which shall include:

- Sampling upstream into landfill to trace the source;
- Surface water interception and treatment prior to discharge;
- Changes to working methods to prevent surface water contamination;
- Diversionary works.

Where analytical results indicate the presence of contamination, additional monitoring locations shall be selected to determine the pollution source. The DBO Contractor shall implement procedures in accordance with the corrective action plan to mitigate any contamination sources identified, or discharge the surface water to the leachate treatment plant.

### 5.6 Event and Action Plan

The Action and Limit levels for surface and ground water quality are defined in **Table 5.6** and **Table 5.7**. Should non-compliance of the criteria occur, action in accordance with the Action Plan in **Table 5.8** shall be carried out.

**Table 5.6 Action and Limit Levels for Surface Water Quality**

Parameters		Action	Limit
Construction	DO in mg L <sup>-1</sup> (Surface, Middle & Bottom)	<u>Surface and Middle</u> 5 percentile of baseline data for surface and middle layer  <u>Bottom</u> 5 percentile of baseline data for bottom layer	<u>Surface and Middle</u> 4 mg L <sup>-1</sup> or 1%-ile of baseline data for surface and middle layer  <u>Bottom</u> 2 mg L <sup>-1</sup> or 1%-ile of baseline data for bottom layer
	pH (depth averaged), Turbidity in NTU (depth-averaged), SS in mg L <sup>-1</sup> (depth-averaged)	95 percentile of baseline data or 120% of upstream control station's pH, Turbidity, SS at the same tide of the same day	99 percentile of baseline or 130% of upstream control station's pH, Turbidity, SS at the same tide of the same day
Operation	COD, Ammonia-nitrogen	---	Ammonia-nitrogen: 0.5mg/L COD: 30 mg/L
	SS in mg L <sup>-1</sup>	---	20mg/L

- Notes:
1. "depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
  2. For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
  3. For turbidity, SS, Ammonia-nitrogen, COD, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.
  4. For pH, non-compliance of the water quality limits occurs when monitoring result is outside the specified range.
  5. All the figures given in the table are used for reference only and the EPD may amend the figures whenever it is considered as necessary.

**Table 5.8 Action and Limit Levels for Ground Water Quality**

Parameters	Action	Limit	Remark
COD, Ammonia-nitrogen	---	COD: 30 mg/L Ammonia-nitrogen: 5mg/L	For COD, Ammonia-nitrogen, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.



**Table 5.9 Event and Action Plan for Water Quality**

Event	ET	IEC	IC	DBO Contractor
Action level being exceeded by one sampling day	Identify source(s) of impact; Inform IEC, DBO contractor; Check monitoring data, all plant, equipment and DBO Contractor's working methods. Repeat measurement on next day of exceedance.	Check monitoring data and DBO Contractor's working methods.	Confirm receipt of notification of non-compliance in writing; Notify Contractor.	Rectify unacceptable practice; Amend working methods if appropriate.
Action level being exceeded by two or more consecutive sampling days	Identify source(s) of impact; Inform IEC, DBO contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Action level; Repeat measurement on next day of exceedance.	Check monitoring data and DBO Contractor's working method; Discuss with ET and DBO Contractor on possible remedial actions; Review the proposed mitigation measures; Supervise the implementation of mitigation measures.	Discuss with IEC on the proposed mitigation measures; Ensure mitigation measures are properly implemented; Assess the effectiveness of the implemented mitigation measures.	Rectify unacceptable practice; Check all plant and equipment and consider changes of working methods; Submit proposal of additional mitigation measures to IEC within 3 working days of notification; Implement the agreed mitigation measures.
Limit level being exceeded by one sampling day	Identify source(s) of impact; Inform IEC, IC and DBO contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with IEC, IC and Contractor; Ensure mitigation measures are implemented;	Check monitoring data submitted by ET and Contractor's working method; Discuss with ET and Contractor on possible remedial actions; Review the proposed mitigation measures submitted by Contractor and advise the IC accordingly.	Confirm receipt of notification of failure in writing; Discuss with IEC, ET and Contractor on the proposed mitigation measures; Request Contractor to review the working methods.	Take immediate corrective actions to avoid further exceedance; Submit proposal of mitigation measures to IEC within 3 working days; Implement the agreed mitigation measures; Submit further mitigation measures if problem still not under control;
Limit level being exceeded by two or more consecutive sampling days	Identify source(s) of impact; Inform IEC, IC, EPD Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with IEC, ICR and Contractor; Ensure mitigation measures are implemented; Ensure mitigation measures are implemented;	Check monitoring data submitted by ET and Contractor's working method; Discuss with ET and Contractor on possible remedial actions; Review the Contractor's mitigation measures whenever	Discuss with IEC, ET and Contractor on the proposed mitigation measures; Request Contractor to critically review the working methods; Make agreement on the mitigation measures and ensure mitigation measures are	Take immediate corrective actions to avoid further exceedance; Submit proposal of mitigation measures to IEC within 3 working days; Implement the agreed mitigation measures; Resubmit proposals if problem still not under control;

Event	ET	IEC	IC	DBO Contractor
		necessary to assure their effectiveness; Supervise the implementation of mitigation measures.	properly implemented; Consider and instruct, if necessary, to slow down or stop that activity of work until exceedance is abated.	Slow down or to stop relevant activity until exceedance is abated.

## 6 Waste Management

### 6.1 Introduction

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It will be the DBO Contractor's responsibility to ensure that all wastes produced during the NENT Landfill Extension are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements.

The major waste material generated during construction activities has been identified to be construction and demolition (C&D) material and recommended to be audited at regular intervals (at least weekly) to ensure that proper storage, transportation and disposal practices will be implemented.

Monitoring of waste management practices will ensure that these solid wastes generated during construction will not be disposed into the nearby coastal waters. The DBO Contractor will be responsible for the implementation of any mitigation measures to minimise waste or redress problems arising from the waste materials.

### 6.2 Waste Control and Mitigation Measures

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#### *Construction Phase*

Mitigation measures for waste management are summarised below. With the appropriate handling, storage and removal of waste arisings during the construction phase as defined below, the potential to cause adverse environmental impacts would be minimised. The EMIS of the recommended mitigation measures is presented in **Appendix C**.

#### Good Site Practices and Waste Reduction Measures

It is expected that adverse impacts from waste management would not arise, provided that good site practices are strictly followed. Recommendations for good site practices during construction include:

- Nomination of approved personnel to be responsible for good site practices and making arrangements for collection of all wastes generated on-site and effective disposal;
- Training of site personnel for cleanliness, proper waste management procedures including chemical waste handling, and waste reduction, reuse and recycling concepts;
- Provision of sufficient waste collection points and regular collection for disposal;
- Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors;
- Appropriate waste management should be implemented in accordance with the ETWB TC(W) No 19/2005; and
- Recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed.

A trip-ticket system should be implemented in accordance with WBTC No 31/2004 for proper record of the quantity of C&D material generated on-site. Construction Waste Disposal Charging Scheme under the Waste Disposal Ordinance also applies to control the disposal of construction waste. Good management and control will prevent the generation of significant amounts 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 include:

- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- Separate labelled bins should be provided to segregate aluminium cans from other general refuse generated by the work force and to encourage collection of aluminium cans by individual collectors;
- Any unused chemicals or those with remaining functional capacity should be recycled;
- Maximising the use of reusable steel formwork to reduce the amount of C&D material;
- Prior to disposal of C&D waste, it is recommended that wood, steel and other metals should be separated for re-use and/or recycling to minimise the quantity of waste to be disposed of to landfill;
- Proper storage and site practices should be implemented to minimise the potential for damage or contamination of construction materials;
- Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste; and
- Minimise excessive ordering of concrete, mortars and cement grout by doing careful check before ordering.

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

#### C&D Material

As the design has adopted a C&D material balance approach, the impact on the handling, collection, transportation and disposal of C&D 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.

#### Chemical Wastes

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.

#### 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.

#### 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. Co-disposal of this sludge in designated trenches should be considered to reduce its hazardous impact.

## 7 Landfill Gas Monitoring

### 7.1 Background

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The qualitative risk assessment for landfill gas (LFG) hazards associated with the construction, operation, restoration and aftercare phases indicated that the overall risks to the receivers within the NENT Landfill Extension site was categorised as 'High' and that to the receivers outside the NENT Landfill Extension site was 'Medium'.

The sensitive receivers falling within the newly proposed 250m Consultation Zone may be prone to LFG potential risk and appropriate protective and precautionary measures including engineering design and monitoring programme have been proposed to reduce such risk to acceptable levels. With these measures in place, no adverse impact is anticipated. LFG monitoring should be conducted throughout various phases of NENT Landfill Extension with the following key objectives:

- To ensure the safety and health of workers during the construction stage of landfill extension;
- To determine the performance and effectiveness of LFG mitigation measures and control systems for preventing uncontrolled LFG migration, with respect to the LFG risk on properties, residents and vegetation;
- To establish a system for assessment and monitoring of any potential ecological stress in the vicinities of the site;
- To establish a monitoring regime for buildings within the site services routes and other enclosed areas providing a warning system for detection of potential build-up of hazardous LFG; and
- To ascertain the characteristics of the landfill and estimate the quantity and quality of the LFG production in order to assess the potential for future utilisation.

This EM&A Manual specifies the basic requirements for LFG monitoring in NENT Landfill Extension, including the monitoring locations, parameters, equipment, procedures, frequency, reporting format, Action and Limit (A/L) Levels, Event and Action Plan (EAP), and Emergency and Contingency Plan (ECP), etc. Further details of LFG monitoring requirements should be established in the Landfill Monitoring Plan (LMP) to be developed by the future DBO Contractor based on this EM&A Manual.

### 7.2 General Requirements

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The LFG monitoring programme should include on-site and off-site monitoring at the agreed period of time and frequency. On-site and off-site LFG monitoring during different phases of landfill development should cover:

- Quantity and quality of extracted LFG at individual gas well heads;
- Quantity of LFG automatically monitored at LFG pumping station;
- Fixed surface and borehole locations along the landfill site boundary and at potential sources of concern;
- Monitoring safe level of LFG concentration, and implementation of sufficient mitigation measures when entering confined spaces within the landfill site; and
- Off-site monitoring for LFG.

LFG monitoring should be conducted in monthly basis at designated monitoring locations and gas monitoring boreholes, supplemented by monthly site surveys of the surrounding



environment including natural cracks and fissures, service drains and ducts, area with sign of vegetation death, and any below ground enclosed spaces, which include normal bulk gas using portable instrument verified by gas sampling and laboratory analyses. If the monitoring results indicate evidence of gas migration, the monitoring frequency should be increased accordingly, with the implementation of appropriate mitigation measures under the EAP.

LFG monitoring should commence at the start of construction works through the operation, restoration and until completion of aftercare phases. The measured LFG results should be checked for compliance against pre-defined A/L Levels in this EM&A Manual and the LMP. In case exceedance of compliance level was detected at any locations, the EAP should be triggered for necessary action to be taken.

If abnormally high LFG levels are detected at off-site sensitive receivers, the ECP should be strictly followed to timely trigger the listed action without delay, which includes evacuation of occupants, provision of forced ventilation to the concerned sensitive receiver, investigation of potential source of LFG, increase LFG extraction rate on-site for minimise leakage etc. Details of the procedures will be documented in the ECP.

### **7.3 Monitoring Parameters**

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A suite of LFG monitoring parameters include:

- Monitoring borehole: Methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>), oxygen (O<sub>2</sub>), flammable gas
- Surface gas location: CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>
- Gas well head: CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, flammable gas, volatile organic compounds (VOC)
- Off-site location: VOC

### **7.4 Monitoring Equipment**

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#### ***Monitoring for Construction Works***

Intrinsically safe portable gas detectors should be used during excavation or when working in any confined spaces, which have the potential for presence of LFG and risk of explosion or asphyxiation. The monitoring equipment should alarm, both audibly and visually, when the concentrations of the following gases were exceeded:

- CH<sub>4</sub>: >10% Lower Explosion Limit (LEL);
- CO<sub>2</sub>: >0.5%; and
- O<sub>2</sub>: <18% by volume.

#### ***Monitoring at Designated Locations***

Pre-entry and routine monitoring should be conducted at boreholes, gas well heads, utilities' manholes and chambers throughout the landfill extension development. The LFG monitoring should be conducted regularly. The LFG monitoring instrument should:

- Comply with EPD's Landfill Gas Hazard Assessment – Guidance Note as intrinsically safe;
- Be capable of continuous monitoring of CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, barometric pressure and gas pressure measurement;
- Normally operate in diffusion mode unless required for spot sampling, when it should be capable of operating by means of an aspirator or pump;
- Have low battery, fault and over range indication incorporated;

- Store monitoring data and be capable of being down-loaded directly; and
- Measure within these ranges: methane 0-100% LEL & 0-100% v/v; oxygen 0-25% v/v; carbon dioxide 0-100% v/v; barometric pressure mBar (absolute); gas pressure (relative to atmosphere) pascals; and temperature 0-100°C.

Proper gas sampling devices such as stainless steel gas cylinders or Tedlar bags should be used for collection of ambient gas samples at specified surface and off-site locations and delivered to laboratory for testing using gas chromatography analysis.

All buildings within the NENT Landfill Extension site should be monitored for the presence of LFG with a permanent detection system with the following features:

- Detector heads to be located within buildings;
- Main control box which houses individual control devices for each detector head;
- Central control panel to alert site personnel, audibly and visually, when gas concentration reached or exceeded threshold levels; and
- Dial-out facility to enable appropriate personnel to be alerted if detectors are triggered outside operation hours.

#### **Calibration and Maintenance**

All portable instrument should be calibrated and serviced according to the manufacturer's instructions. Calibration gases should be used for checking portable instrument for methane and carbon dioxide detection before and after use. Instrument for monitoring oxygen should be calibrated against normal expected air concentrations. Any significant variations in instrument performance outside that expected through normal drift should be noted with the instrument calibration timely corrected.

### **7.5 Monitoring Locations**

During the construction works within the NENT Landfill Extension site with excavation of 1m deep or more, LFG concentrations should be monitored before entry and periodically during the progress of works. If drilling is required, the procedures for safety management and working procedures as stipulated in EPD's Landfill Gas Hazard Assessment – Guidance Note should be strictly adopted.

Throughout the landfill extension development, when service voids, manholes or inspection chambers within the project site are entered for maintenance, monitoring and a checklist system of safety requirements should be performed before entry in accordance with the Code of Practice on Safety and Health at Work in Confined Spaces.

The proposed LFG monitoring locations including designated boreholes and surface locations, gas wells, and off-site locations for NENT Landfill Extension development are shown in **Drawing No. 24315/13/504**, which are subject to changes depending on the design and modification by the future DBO Contractor. Detailed requirements of LFG monitoring should be established in the LMP by the DBO Contractor.

### **7.6 Monitoring Frequency**

LFG monitoring should be conducted in monthly basis at designated monitoring locations and gas monitoring boreholes, supplemented by monthly site surveys of the surrounding environment including natural cracks and fissures, service drains and ducts, area with sign of vegetation death, and any below ground enclosed spaces.

If the monitoring results indicate evidence of gas migration, the monitoring frequency should be increased accordingly, with the implementation of appropriate mitigation measures under the EAP.

The monitoring frequency should be reviewed throughout the on-going development of NENT Landfill Extension and revised as necessary based on the LFG monitoring data. Detailed requirements of LFG monitoring frequency should be established in the LMP by the DBO Contractor.

## **7.7 Monitoring Procedures**

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### ***Surface Gas Emission***

- Walkover survey for the whole site area should be undertaken at a slow pace with the inlet tube of the probe only a few centimeters above ground level.
- Measurements will be taken in areas off-site and/or beyond the landfill boundary where there is visible vegetation stress or die-back which may be caused by depletion of soil oxygen and accumulation of toxic gases or vapors in the root zone.
- Survey of the capping, focusing upon cracks or areas of settlement, surface drains, sub-surface service entries to buildings and any other enclosed spaces should be taken.

### ***Monitoring Borehole***

- The sampling port should be connected to the gas monitoring probe.
- The gas analyser should be turned on to sample the gas for about one minute.
- The sampling port should be removed and the temperature probe should be inserted into the gas monitoring probe to record the temperature.
- Results should be recorded on a log sheet.
- Pressure (within installations, relative to atmospheric pressure) should be monitored at any monitoring probe where methane was detected on the previous monitoring occasion. The order of monitoring should be pressure, followed by flammable gas (CH<sub>4</sub>), O<sub>2</sub>, CO<sub>2</sub> and temperature.
- Bulk samples of LFG should be drawn from gas monitoring probes with tubing connected directly to a 10L Tedlar bag and sent for laboratory analysis.

### ***Well Head***

- Proper hoses should be connected from the GEM-500 to the wellhead.
- Black striped Tygon hose with the external filter/water trap assembly should be attached to the static port on the GEM-500.
- Almond-coloured male quick connect should be placed on the end of this tubing to read the static pressure on the Accu-Flo wellhead.
- Clear Tygon hose should be connected to the impact port of the GEM-500. A chrome plated brass male fitting should be placed on the end of the clear tubing. This chrome fitting should be used to measure the impact pressure at the wellhead.
- Gas analyser should be turned on and gas should be sampled for 60 seconds.
- Results should be recorded on a log sheet.
- Pressure (within installations, relative to atmospheric pressure) should be monitored at any monitoring probe where CH<sub>4</sub> was present on the previous monitoring occasion. The order of monitoring will be pressure, followed by flammable gas (CH<sub>4</sub>), O<sub>2</sub>, CO<sub>2</sub> and temperature.
- Bulk samples of LFG should be drawn from gas monitoring probes with tubing connected directly to a 10L Tedlar bag and sent for laboratory analysis.

**Site Building and Confined Space**

- Permanent gas detection system should be installed at each on-site building for the continuous and automatic monitoring of gas ingress into the building.
- The effectiveness of the system will further be monitored by inspection of main gas detector panel every 4 hours; inspection of air inlets to ensure no blockages, daily; and monitoring of all maintenance holes, ducts and confined spaces both inside and within close proximity to the Landfill Site Boundary for flammable gas and carbon dioxide, monthly.
- The gas detection system will be set for alarm (audible and visual) if
  - \* CH<sub>4</sub> rises to 20% LEL; or
  - \* CO<sub>2</sub> rises to 1.5% by volume; or
  - \* O<sub>2</sub> falls to 18% by volume.

**Off-site Location**

VOCs

- A sample list of VOC monitoring parameter is listed in **Appendix D**.
- Prior to sampling, the sampler should be attached to the canister by tubing.
- The canister valve should be opened and the canister pressure gauge should be recorded.
- Ambient air should be pumped into the canister by the sampler’s diaphragm pump. The flow rate should be maintained at about 67mL/min for 3 hours in order to fill the 6L canister to 2 atm. The system timer should be programmed to activate and deactivate the sample collection.
- After sampling, the canister valve should be closed and the final sample pressure should be recorded on the sampling data sheet.
- Monitoring for VOCs should not be carried out if it is raining.

CH<sub>4</sub>

- A sample-collecting air bag should be situated within an airtight drum. The bag should be opened to the atmosphere and a vacuum should be applied to the inside of the drum by means of a vacuum pump. The negative pressure causes the air bag to inflate, drawing in an atmospheric air sample. The bag should then be sealed immediately.
- Sample containers should be labeled and delivered to the accredited laboratory as soon as is practicable.

**7.8 A/L Levels and EAP**

The A/L Levels and relevant EAP for LFG detected in excavation, utilities and enclosed on-site areas are summarised in **Table 7.1**.

**Table 7.1 A/L Levels and EAP for LFG**

Parameter	Level	Action
Oxygen (O <sub>2</sub> )	Action Level <19% O <sub>2</sub>	Ventilate trench/void to restore O <sub>2</sub> to >19%
	Limit Level <18% O <sub>2</sub>	Stop works Evacuate personnel/prohibit entry Increase ventilation to restore O <sub>2</sub> to >19%
Methane (CH <sub>4</sub> )	Action Level >10% LEL*	Prohibit hot works Increase ventilation to restore CH <sub>4</sub> to <10% LEL
	Limit Level >20% LEL	Stop works Evacuate personnel/prohibit entry Increase ventilation to restore CH <sub>4</sub> to <10% LEL
Carbon dioxide (CO <sub>2</sub> )	Action Level** >0.5%** CO <sub>2</sub>	Ventilate to restore CO <sub>2</sub> to < 0.5%
	Limit Level >1.5% CO <sub>2</sub>	Stop works Evacuate personnel / prohibit entry Increase ventilation to restore CO <sub>2</sub> to <0.5%

\* LEL: Lower Explosive Limit – concentrations in air below which there is not enough fuel to continue an explosion.  
 \*\* This Action Level of CO<sub>2</sub> at 0.5% is set for reference only, assuming no CO<sub>2</sub> emission from a particular location. Depending on the baseline CO<sub>2</sub> levels, the Action Level at a particular location will be changed.

## 7.9 Mitigation Measures

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The protection and precautionary measures to minimise LFG hazards for the areas within and outside the landfill extension site during construction, operation, restoration and aftercare phases are summarised in the EMIS in **Appendix C**.

Due to the close proximity to the existing NENT Landfill site, the mitigation measures within landfill extension site generally encompass specific protection against hazards of exposure to LFG e.g. ignition, explosion, asphyxiation, toxicity, etc when undertaking construction activities including excavation and trenching.

During operation, restoration and aftercare phases, due care for strict implementation protection measures should be taken when operations within service voids, manholes and inspection chambers need to be exercised within the landfill extension site. All new-built permanent building structures within the landfill extension site should be installed with specific gas protection measures.

For new developments outside the landfill extension site but within the 250m Consultation Zone, the owner of the development is required to conduct an LFG hazard assessment and submit the assessment report to the EPD for consultation and vetting in accordance with ProPECC PN 3/96 and LFG Guidance Note. The owner of the development should:

- Carry out an LFG hazard assessment to evaluate the degree of risk associated with the proposed development;
- Design suitable precautionary/ protection measures to render the proposed development as safe as reasonably practicable;
- Ensure that the precautionary/ protection measures to be fully implemented according to the design; and
- Establish a maintenance and monitoring programme to ensure the continued performance of implemented protection measures.



## 8 Landscape and Visual Monitoring

### 8.1 Introduction

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The EIA study has recommended landscape and visual mitigation measures to be undertaken during the construction and operational phases, as well as the restoration and aftercare phases of the project. This section outlines the EM&A requirements of these measures to mitigate the landscape and visual impacts.

### 8.2 Monitoring Details

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The design, implementation and maintenance of landscape mitigation measures should be checked to ensure that they are fully implemented and that potential conflicts between the proposed landscape measures and other works and operational requirements are timely resolved without compromise to the intention of the proposed mitigation measures.

#### *Baseline Monitoring*

Photographic records of the project site should be taken at the time when the DBO Contractor take over the site, which should be approved by the IC. The approved photographic records should be submitted to the Project Proponent, ET, IEC and EPD.

#### *Monitoring Locations and Frequency*

In order to monitor the landscape and visual impact after providing mitigation measures effectively, all the specified and affected LCAs, LRs and VSRs should be monitored. Photographical records should be taken for the monitoring locations monthly from the commencement of works. Those records are recommended to be stated in the Specification and DBO Contractor's monthly progress report.

#### *Design Phase*

The mitigation measures proposed in the EIA study to mitigate the landscape and visual impacts should be embodied into the detailed engineering design and landscape design drawings and contract documents. Designs should be checked to ensure that the mitigation measures are fully incorporated and that potential conflicts with civil, geo-technical, structural, drainage, underground utilities and operational requirements are resolved prior to construction and operation of the project. The Project Proponent should develop a detailed management programme to mitigate the landscape and visual impacts.

#### *Construction and Operational Phases*

Measures to mitigate the landscape and visual impacts during the construction and operational phases should be checked to ensure compliance with the intended aims of the measures. The progress of the engineering works should be regularly reviewed on site to identify the earliest practical opportunities for the landscape works to be undertaken. The event and action plan for landscape and visual monitoring during the construction and operational phases is summarised in **Table 7.1**.

#### *Restoration and Aftercare Phases*

Measures to mitigate landscape and visual impacts during the restoration and aftercare phases should be checked to ensure compliance with the intended aims of the measures. The success of all planting works intended to mitigate the visual and landscape impact should be monitored, including long-term maintenance of the restoration planting works under the detailed management programme. The event and action plan for landscape and visual monitoring during the restoration and aftercare phases is summarised in **Table 7.2**.

**Table 8.1 Summary of event and action plan for landscape and visual monitoring during construction and operational phases**

	ET	IEC	IC	DBO Contractor
Design checking	<ul style="list-style-type: none"> <li>• Check final design conforms to the requirements of EP and prepare report</li> </ul>	<ul style="list-style-type: none"> <li>• Check report.</li> <li>• Recommend remedial design if necessary</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake remedial design if necessary</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure compliance with EP requirements</li> </ul>
Exceedance on one occasion	<ul style="list-style-type: none"> <li>• Identify source of impact</li> <li>• Inform IEC and IC</li> <li>• Discuss remedial actions with IEC, IC and DBO Contractor</li> <li>• Monitor remedial actions until rectification has been completed</li> </ul>	<ul style="list-style-type: none"> <li>• Check report</li> <li>• Check DBO Contractor's working method</li> <li>• Discuss with ET and DBO Contractor on possible remedial measures</li> <li>• Advise IC on effectiveness of proposed remedial measures</li> <li>• Check implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Notify DBO Contractor</li> <li>• Ensure remedial measures are properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Amend working methods</li> <li>• Rectify damage and undertake any necessary replacement</li> </ul>
Repeated Exceedance(s)	<ul style="list-style-type: none"> <li>• Identify source of impact</li> <li>• Inform IEC and IC</li> <li>• Increase monitoring frequency</li> <li>• Discuss remedial actions with IEC, IC and DBO Contractor</li> <li>• Monitor remedial actions until rectification has been completed</li> <li>• If exceedance stops, cease additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Check monitoring report</li> <li>• Check DBO Contractor's working method</li> <li>• Discuss with ET and DBO Contractor on possible remedial measures</li> <li>• Advise IC on effectiveness of proposed remedial measures</li> <li>• Supervise implementation of remedial measures</li> </ul>	<ul style="list-style-type: none"> <li>• Notify DBO Contractor</li> <li>• Ensure remedial measures are properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Amend working methods</li> <li>• Rectify damage and undertake any necessary replacement</li> </ul>

**Table 8.2 Summary of event and action plan for landscape and visual monitoring during restoration and aftercare phases**

	Maintenance Agency	Management Agency
Exceedance	<ul style="list-style-type: none"> <li>• Identify source of impact</li> <li>• Discuss remedial actions with Management Agency.</li> <li>• Monitor remedial actions until rectification has been completed.</li> </ul>	<ul style="list-style-type: none"> <li>• Check report.</li> <li>• Discuss with Maintenance Agency possible remedial measures.</li> <li>• Supervise implementation of remedial measures.</li> </ul>

## 9 Cultural Heritage Monitoring

### 9.1 Introduction

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The EIA study has recommended the built heritage mitigation measures arising from the NENT Landfill Extension project. This section outlines the specific EM&A requirements of these measures.

### 9.2 Monitoring Requirements

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Details of the EM&A programme for impacted cultural heritage resources will be provided in this section, with the full methodology for the recording and preparation of the archives for both the cultural landscape features (boulder paths and boulder terraces) and the graves being summarised (**Drawing No. 24315/13/606**). The resources listed below should be preserved by detailed record. It is the responsibility of the DBO Contractor that all mitigation recommendations are fully implemented and the results approved by the Antiquities and Monuments Office (AMO) of the Leisure and Cultural Services Department (LCSD) prior to any construction works.

It should be noted that site of abandoned graves will require no mitigation measures and that the study area is extremely overgrown with dense ground covering vegetation and the potential for the presence of more historical graves exists. As a result, it is recommended that whenever a grave is found during the construction phase, the AMO should be contacted immediately and the works in the immediate vicinity of the grave should be stopped until it is inspected by the AMO.

### 9.3 Ngong Tong (North and West of Shek Tsai Ha Road: Western & Central Section)

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#### *Boulder Path 1*

The southern section of the path should be surveyed and mapped to determine if any sections of the path will fall within the extension boundary of the finalised layout plan. If any sections are found to be within the extension boundary then preservation by detailed record should be undertaken and fulfill the AMO requirements.

#### *Graves*

G2, G4, G5, G6, G7, G8, G14, G15, G25, G26, G27, G28 and G31 should be preserved by detailed record to fulfill the AMO requirements.

### 9.4 Tong To Shan (North of Shek Tsai Ha Road: east section)

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#### *Boulder Path 2*

The southern section of the path should be surveyed and mapped to determine if any sections of the path fall within the extension boundary of the finalised layout plan. If any sections are found to be within the extension boundary then preservation by detailed record should be undertaken to fulfill the AMO requirements.

## 9.5 AMO requirements for Survey and Preservation

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### Graves

1. The requirement for the recording of grave inscriptions should include rubbing of grave inscriptions to be conducted, the inscriptions to be rewritten in a tabular format with proper cross-referencing (e.g. item numbers, photos).
2. The requirements for the cartographic survey of historic graves should include:
  - The following plans are required:
    - Site plans showing the relative locations of the graves and their associated cultural/ fung shui landscape (if any) concerned to 1:100 or as appropriate;
    - Plan(s) showing all structural walls and built-in fittings to 1:50;
    - Elevations of each face of the graves to 1:50;
    - At least two cross sections through the graves showing the architectural characters of the graves to 1:50;
    - Architectural details including decorations on the "stone head", spirit stone tablet, chimneys, inscriptions and couplets, plaster decoration and ornamental features, mouldings, brick construction patterns and any other items of historical or conservation interest to scale 1:10 or 1:5;
    - Plan, elevation and cross section of any important fittings within/ surrounding the graves, particularly relating to its ceremonial use, to appropriate scale;
    - Construction details should be noted such as types of brick bonding, joints in granite features, etc, to scale 1:10 or as appropriate;
    - The number of courses of brickwork to each wall should be recorded on the appropriate drawings;
    - All the plans (apart from details) should have North point.
  - Drawings should be annotated with descriptions of the building materials used in the construction of the principal elements.
  - A full set of the cartographic records has to be submitted to the AMO on or before the date mutually agreed.
3. The requirements for photographic survey of historic graves should include:
  - All the photographic recording should be done in both colour slides and negatives. The following recordings are required:
    - The historic grave, its associated structures and their immediate surrounding environment including important trees, types of paving, and villages concerned etc. Aerial-photos in oblique angles showing the characteristics of the site such as the associated cultural/ fung shui landscape are required.
    - Details of the graves with the following shots:
      - (a) Identification picture including the surrounding area;
      - (b) General views of the graves from all sides, including the top;
      - (c) Oblique view of the graves;
      - (d) Close up of the important details including calligraphy, e.g. decorations on the stone head, spirit stone tablet, paving, inscriptions and couplets, plaster decoration and ornamented features, mouldings, brick construction patterns, and any other items of historical or conservation interest.

- All the photos (size in 5" x 7") and slides should be properly captioned in both Chinese and English, and easily referenced to their location on key drawings and should be numbered and cross-referenced for easy retrieval and duplication.
  - A full set of photographic records should be submitted to the AMO on or before the date mutually agreed for inclusion in the photographic archive of the AMO.
4. Format of the detailed survey of graves to be agreed with AMO before the commencement of the recording.

#### ***Cultural Landscape Features***

1. The requirements for cartographic survey of section of boulder paths to be directly impacted by project should include:
  - The following plans are required:
    - Site plans showing the relative locations of the path to 1:1000 or as appropriate;
    - Plan(s) showing all structural elements to 1:50;
    - All the plans (apart from details) should have North point.
  - Drawings should be annotated with written descriptions of the recorded features
  - A full set of cartographic records should be submitted to the AMO on or before the date mutually agreed.
2. The requirements for photographic survey of boulder paths should include:
  - All the photographic recording should be done in both colour photographs and negatives. The following recordings are required:
    - General views of the boulder path, including its immediate surrounding environment.
    - Details of the boulder path with the following shots:
      - (a) Identification picture;
      - (b) Views of the boulder path from all sides, including the top.
  - All the photos (size in 5" x 7") and slides should be properly captioned in both Chinese and English, and easily referenced to their location on key drawings and should be numbered and cross-referenced for easy retrieval and duplication.
  - A full set of the photographic records should be submitted to the AMO on or before the date mutually agreed for inclusion in the photographic archive of the AMO.



## 10 Ecological Monitoring

### 10.1 Introduction

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The EIA stipulated that ecological monitoring should be undertaken throughout the design, construction, operation, restoration and aftercare phases of NENT Landfill Extension to ensure that all mitigation measures should be fully complied with. The objectives of design audit for ecology are to ensure that the design for ecological mitigation specified in the EIA Report will be conducted to ensure that such designs are ecologically feasible and effective.

The EM&A objectives for ecology during the construction, operation, restoration should be to ensure that the ecological contract works and construction mitigation procedures recommended are carried out as specified and are effective. The construction and operational phase ecological EM&A should be carried out as part of the overall EM&A programme.

The purposes of ecological monitoring and audit are:

- To verify the accuracy of the predictions of the ecological assessment study;
- To detect unpredicted ecological impacts arising from the proposed project;
- To monitor the effectiveness of the mitigation measures; and
- To recommend action plans in response to unpredicted impacts, and/ or failed mitigation

The performance of monitoring and audit from an ecological prospective should be integrated with the overall monitoring and audit plan for the project as a whole. The information on the commencement and programme of the engineering works should enable the ecological monitoring to be prepared with considerations of seasonality factors.

### 10.2 Ecological Mitigation Measures

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Mitigation measures required for the Project to minimise ecological impacts and to preserve ecological resources will be specified in the Environmental Permit. Ecological mitigation measures to be implemented during the construction phase and operation phase include the following:

- Transplantation of four plant species of conservation interest within the project area prior to site clearance. They are *Aquilaria sinensis*, *Rhododendron simsii*, *Endospermum chinense*, and *Arundina graminifolia*. Their locations are shown in **Drawing No. 24315/13/702**.
- Regular site audit and good site practices to avoid encroachment onto the nearby natural habitats and disturbance to wildlife. These are listed in various sections (including air, water, noise, waste sections) of the EIA and the other sections of this EM&A Manual.

Ecological mitigation measures to be implemented during the restoration and aftercare phases should include woodland compensatory planting and monitoring. The objective of compensatory planting is to mitigate for vegetation loss. The ratio of compensation, species composition, and schedule of planting should follow the mitigation measures specified in **Section 8** of the EIA Report.

To ensure the survival and establishment of the compensatory planting, a 10 year ecological monitoring extending to the aftercare phase, i.e. year 2021-2031, is proposed. Apart from the standard practices and regular maintenance covered by the landscape contract, monitoring of survival, height, health condition of species planted will be monitored.

Good site practices should be implemented to avoid encroachment onto the nearby natural habitats and disturbance to wildlife. Examples are detailed in various sections of the EIA report and include:

- Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural habitats.
- Restriction of construction activities to the work areas that would be clearly demarcated.
- Resinstatement of the work areas immediately after completion of the works.
- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- Machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- Plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;
- Silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;
- Mobile plant should be sited as far away from NSRs as possible and practicable;
- Material stockpiles, site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities;
- Use of "quiet" plant and working methods
- Construction phase mitigation measures in the Practice Note for Professional Persons on Construction Site Drainage.
- Design and set up of the temporary on-site drainage system will be undertaken by the DBO Contractor prior to the commencement of construction.
- Design and incorporation of silt/sediment traps in the permanent drainage channels to enhance deposition rates and regular removal of repositied silt and grit.
- Minimization of surface excavation works during the rainy seasons (April to September), and in particular, control of silty surface runoff during storm events, especially for areas located near steep slopes.
- Regular inspection and maintenance of all drainage facilities and erosion and sediment control structures to ensure proper and efficient operation at all times and particularly following rainstorms.
- Provision of oil interceptors in the drainage system downstream of any oil/fuel pollution sources.

### **10.3 Monitoring and Audit for Ecology**

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The ecological monitoring and audit programme should be implemented as set out in this EM&A Manual. Two major components should be included and samples and measurements should be taken as summarised in **Table 10.1**:

- Survey and transplantation of the four plant species of conservation interest before site clearance; and
- 10-year ecological monitoring of compensatory woodland planting during the restoration and after-care phases.

**Table 10.1 Ecological monitoring and audit requirements**

Monitoring parameter	Frequency, Duration and Response
<b>Transplantation of plant species of conservation interest before commencement of works</b>	
Survey of plant species of conservation interest within the Project Area	Once a month during March – June prior to Site Clearance to locate and mark the individuals. Site preparation work for tree transplantation at least ½ year before transplantation. Select sites for transplantation.
Transplantation of tree, shrubs and herbs	During early wet season to enhance survival (April to June)
Monitoring of survival and growth of transplanted species	Monitoring should be conducted at least twice a month during the first three months and once a month in the following nine months to ensure survival. The need of any further monitoring will be reviewed according to the monitoring results after the 12-month monitoring.
<b>Ecological monitoring of woodland compensatory planting during restoration and aftercare phases</b>	
Monitoring of survival, growth and health conditions of planted trees	A total of 10 years. Quarterly during the first two years and every six months during the following three years of Phase 1 on exotic trees. Quarterly during the first two years and every six months during the following three years of Phase 2 on native trees. The need of any further monitoring will be reviewed according to the monitoring results after the 10-year monitoring.

**Survey and Transplantation of Plant Species**

Preparation work for transplantation of trees and shrubs should be conducted in accordance to ETWB TC(W) No. 3/2006 – Tree Preservation, which specifies that when tree transplantation is required, the project office should allow at least 12 months in advance for consultation to obtain approval, sourcing of receptor location, and preparation works for transplanting operation.

The surveys conducted under this EIA identified at least four plant species of conservation interest within the Project area that would have been directly impacted by the proposed landfill extension. The group tree surveys recorded 2 no. of *Aquilaria sinensis* and 3 no. of *Endospermum chinense*, while the ecological surveys recorded 2 no. of *Rhododendron simsii* and about 10 no. of *Arundina graminifolia*. To minimise the ecological impacts, the affected individuals would be transplanted to suitable nearby habitats prior to the construction phase as far as practicable. A detailed vegetation survey covered the affected habitats would be conducted prior to the commencement of site clearance works by a suitably qualified botanist /ecologist. The aim of the survey is to update, identify and record the location and number, health condition and suitability for transplantation of the affected individuals in order to provide details for the transplantation scheme. Locations of the species of conservation interest should be referred to but not be limited to those as shown in **Drawing No. 24315/13/702**. The vegetation survey should be conducted once per month during the flowering seasons of the orchid and shrub (March to June) for easy identification of monitoring locations. Each identified individual should be tagged. The requirements of detailed vegetation survey will be specified in the NENT Landfill Extension Contract.

According to the LVIA, due to the fact that the habitats are located to slopes inaccessible to vehicles and machineries, the majority of them may not be likely to be preserved by transplanting. However, it is recommended to preserve among them, some which are of rare and precious species (e.g. *Aquilaria sinensis*, *Endospermum chinense*) by transplanting as far as technically and financially feasible. Feasibility and suitability of transplanting the affected plant species of conservation interest would be carefully studied and suitable receptor sites would be identified by the transplantation scheme. Examples of the potential

receptor sites for *Aquilaria sinensis* and *Endospermum chinese* will be fringe of Ling Ma Hang Woodland immediately to the north of the Project Area, while potential receptor site for *Rhododendron simsii* and *Arundina chinensis* will be grassland habitat along the southeast boundary of the Project Area. Proximity of the receptor sites to the Project Area will allow access for transplantation and monitoring while avoiding potential disturbance inside the Project Site due to earth work.

To ensure good preparation of the transplantation work, the transplantation scheme should be formulated during the detailed design stage for this Project based on the information collected during the detailed vegetation survey. It should include careful selection of receptor sites, detailed transplantation methodology, and should be implemented and supervised by a suitably qualified botanist/ horticulturist. A monitoring programme should be set out to monitor the survival and evaluate the successfulness of transplantation. The health and condition of individuals of the transplanted plant species of conservation interest should be monitored during the first 12 months after transplantation. Monitoring should be conducted at least twice a month during the first three months and once a month in the following nine months to ensure survival.

During construction, operation, restoration and aftercare phases, routine site inspection should be conducted on a weekly basis to audit the mitigation measures on disturbance on habitats adjacent to the work areas. Monitoring of transplantation should be audited as part of the site audit programme.

**Ecological Monitoring of Compensatory Woodland**

A qualified botanist/ecologist who forms a member of ET should review the detailed design of the compensatory planting in order to provide details for ecological monitoring scheme. He/she should oversee the planting work and conduct subsequent monitoring. The survival and health conditions of individuals of the selected plant species should be monitored over the 10-year period. Since planting will be conducted in phases in 5 years where native species will be planted in Years 3 to 5, ecological monitoring should be conducted by phases to ensure the survival of native species.

The Trigger and Action Levels and Event Action Plan for monitoring of compensatory woodland planting are defined in **Table 10.2**.

The implementation of mitigation measures and ecological works, DBO Contractor's compliance with environmental requirements, and effectiveness of site mitigation measures during construction, operation, restoration and aftercare phases should be monitored and audited as detailed in the EM&A programme. The details of the ecological monitoring plans should be developed by the ecologist of the ET and agreed by EPD and AFCD prior to commencement of construction works.

**Table 10.2 Trigger and Action Levels and Event Action Plan for monitoring of compensatory woodland planting**

Parameter	Trigger and Action level	Event Action Plan
Mortality*	Trigger Level: > 20% of mortality of any sampled planted species or overall survival.	If the Trigger Level is exceeded the ET Leader should inform DBO Contractor and IEC) immediately. Frequency of monitoring should increase to closely monitor the survival and results reported to the DBO Contractor.
	Action Level: > 30% of mortality of any of each transplanted species.	If the Trigger Level is exceeded the ET Leader should inform all parties (DBO Contractor, EPD, AFCD and IEC) immediately. The DBO Contractor should propose alternative plan and work out the solution (e.g. replacement planting) according to the requirements of EPD and AFCD. Once the solution has been identified and agreed with all parties the DBO Contractor should implement the solution.

\* Total defoliation with no evidence of regeneration (such as presence of leaf buds, stem buds)

# 11 Environmental Audit

## 11.1 Site Inspection

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Site inspection provides a direct means to initiate and enforce the specified environmental protection and pollution control measures. These should be undertaken routinely to inspect construction activities to ensure these measures are implemented properly. Site inspection is one of the most effective tools to enforce the environmental requirements on-site.

The ET Leader should be responsible to formulate the environmental site inspection requirements, deficiency and action reporting system, and to conduct the site inspection works. Within 21 days of the commencement of construction works, the ET Leader should submit a proposal for site inspection and deficiency and action reporting procedures to the DBO Contractor for agreement and the IEC and IC for approval. The ET's proposal for rectification should be made known to the IEC.

Regular site inspections should be carried out at least once per week. The areas of inspection should not be limited to the environmental situation, pollution control and mitigation measures within the site. The inspection should also include a review of the environmental situations outside the works area which would likely to be affected, directly or indirectly, by the works activities. The ET Leader should make reference to the following information when conducting site inspection:

- Recommendations in EIA Report on the environmental protection and pollution control mitigation measures;
- Works progress and programme;
- Individual works methodology and proposals, including proposal on the associated pollution control measures;
- DBO Contract specifications on environmental protection requirements;
- Relevant environmental protection and pollution control legislation; and
- Previous site inspection results.

The DBO Contractor should keep the ET Leader updated with all relevant information on the construction contract necessary to carry out the site inspections. All inspection findings and associated recommendations for improvements to the environmental protection and pollution control works should be submitted to the IEC and DBO Contractor within 24 hours after inspection. The DBO Contractor should follow the procedures and time-frame as recommended in the site inspection and the deficiency and action reporting system formulated by the ET Leader to report on any remedial measures implemented subsequently. Ad-hoc site inspections should be carried out if significant environmental problems were identified. Inspections may also be required subsequent to receipt of environmental complaints or as part of the investigation work as specified in the EAP for the EM&A programme.

## 11.2 Compliance with Environmental Requirements

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There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control legislation in Hong Kong with which construction activities should comply. All works method statements submitted by the DBO Contractor to the IC for approval should be sent to the ET Leader for review and vetting to ensure sufficient environmental protection and pollution control measures have been included. The EMIS is included in **Appendix C**.



The ET Leader should review the progress and programme of the project works to check that relevant environmental legislation has not been violated and that any foreseeable potential for violating the laws should be avoided. The DBO Contractor should regularly copy the relevant documents to the ET Leader so that proper audit and checking should be conducted. Such documents should at least include the updated works progress reports, works programme, correspondences for application of different environmental licenses/permits under the environmental protection legislation, and copies of all valid environmental licenses/permits. Site diary should be available for ET Leader's inspection upon request.

The ET Leader should advise the IEC and DBO Contractor of any non-compliance and non-conformance with the contractual and legislative requirements on environmental protection and pollution control for follow-up action. If the ET Leader's review concluded that the current status on environmental license/permit application and environmental protection and pollution control preparation works may result in potential violation of the specified requirements, the ET Leader should advise immediately inform the DBO Contractor and IC accordingly. Upon receipt of such advice, the DBO Contractor should take immediate action to rectify the situation. The IC should follow up with the cases to ensure that appropriate action has been taken to satisfy contractual and legal requirements.

### **11.3 Environmental Complaints**

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All environmental complaints should be referred to the ET Leader for further action. The ET Leader should undertake the following procedures upon receipt of any complaints:

- Log the complaint and date of receipt into the complaint database and inform the IEC immediately;
- Investigate the complaint to determine its validity and assess whether the source of problem would be due to the project works activities;
- Identify the mitigation measures in consultation with the IEC if the complaint was valid and due to the project works;
- Advise the DBO Contractor if further mitigation measures were required;
- Review the DBO Contractor's response to the identified complaint, mitigation measures and updated situation;
- If the complaint was transferred from the EPD, submit the interim report to the EPD on the status of the complaint investigation and follow-up action within the time frame as assigned by the EPD;
- Conduct additional monitoring and audit to verify the situation if necessary and review the circumstances leading to the complaint to avoid no recurrence;
- Report the investigation findings and subsequent action to the complainant. If the source of complaint was originated from the EPD, the findings should be reported within the timeframe as assigned by the EPD; and
- Record the environmental complaint, investigation, subsequent action taken and investigation findings in the monthly EM&A reports.

## 12 Reporting

### 12.1 General

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Reports should be provided in an electronic medium upon agreement of the format for submission to the EPD. All the monitoring data (baseline and impact) should also be submitted on diskettes or other agreed media. The formats of monitoring data to be submitted should be separately agreed. The types of reports that the ET Leader should prepare and submit include Baseline Monitoring Report, Monthly EM&A Reports, Quarterly EM&A Summary Report, Annual EM&A Review Report, and Final EM&A Review Report during the completion and cessation of each project phases.

### 12.2 Baseline Monitoring Report

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The ET Leader should prepare and submit a Baseline Environmental Monitoring Report within 10 working days of completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report should be submitted to the DBO Contractor, IEC, IC, Project Proponent and EPD. The ET Leader should liaise with the relevant parties on the exact number of copies they require. The report format and baseline monitoring data format should be agreed with the EPD prior to submission. The Baseline Monitoring Report should include at least the following:

- Up to half a page executive summary;
- Brief project background;
- Drawings showing baseline monitoring locations;
- Monitoring results (both hard and soft copies) together with: monitoring methodology, name of laboratory and types of equipment used and calibration details, parameters monitored, monitoring locations, date, time, frequency and duration, and quality assurance (QA) / quality control (QC) results and detection limits;
- Details of influencing factors including major activities being carried out on-site, weather conditions and other factors during the monitoring period which might affect results;
- Determination of the Action and Limit Levels for each monitoring parameter and statistical analysis of the baseline data, the analysis should conclude if there is any significant difference between control and impact stations for the parameters monitored;
- Revisions for inclusion in the EM&A Manual; and
- Comments, recommendations and conclusions.

### 12.3 Impact EM&A Reports

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The results and findings of all phases of EM&A programme should be recorded in the Monthly, Quarterly, Annual and Final EM&A Reports prepared by the ET. The EM&A reports should be submitted within 10 working days of the end of each reporting month, with the first Monthly EM&A Report due the month after commencement of construction works. Each EM&A report should be submitted to the DBO Contractor, IEC, IC, Project Proponent and EPD. Prior to submission of the first Monthly EM&A Report, the ET Leader should liaise with all parties for the required number of copies and format of the report in both hard copy and electronic medium. The ET leader should also review the number, parameter and location for impact monitoring on six-monthly basis, or as needed, so as to cater any changes in the baseline condition and surrounding environment.

### **First Monthly EM&A Report**

The first Monthly EM&A Report should include at least the following:

- Executive summary (1-2 pages): Exceedances of A/L Levels, complaint log, notifications of summons and successful prosecutions, reporting changes, and future key issues;
- Brief project information: Project organisation e.g. key personnel, their contact names and telephone numbers, project programme, management structure, and works undertaken during the month;
- Environmental performance status: Works undertaken during the month with illustrations (e.g. location of works, daily excavation rate, etc) and drawings showing the project area, environmental sensitive receivers and impact monitoring and control/ reference locations (with co-ordinates);
- Brief summary of EM&A requirements: All monitoring parameters, environmental quality performance limits (A/L Levels), EAP, environmental mitigation measures as recommended in the EIA Report, and contractual environmental requirements;
- Implementation status of mitigation measures: Advice on the implementation status of environmental protection and pollution control/mitigation measures as recommended in EIA Report;
- Monitoring results (in both hard and soft copies) with the following information: Monitoring methodology, name of laboratory and types of equipment/instrument deployed and calibration details, parameters monitored, monitoring locations, date, time, frequency and duration, weather conditions, other factors affecting the monitoring results, and QA/QC results and detection limits;
- Non-compliance, complaints and notifications of summons and successful prosecutions: Record of all non-compliance or exceedances of the environmental quality performance limits (A/L Levels), complaints received (written or verbal) for each media e.g. locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary, notification of summons and successful prosecutions for breaches of current environmental protection/pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary, reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures, and description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance; and
- Other information: Account of future key issues as reviewed from the works programme and method statements, advice on waste management status, and comments on effectiveness and efficiency of mitigation measures, recommendations on any improvement in the EM&A programme, and conclusion.

### **Subsequent Monthly EM&A Reports**

Subsequent monthly EM&A reports should include the following:

- Executive summary (1-2 pages): Breaches of A/L Levels, complaints log, notifications of summons and successful prosecutions, reporting changes, and future key issues;
- Brief project information: Project organisation e.g. key personnel, their contact names and telephone numbers, project programme, management structure, and works undertaken during the month;
- Environmental performance status: Works undertaken during the month with illustrations (e.g. location of works, daily excavation rate, etc) and drawings showing the project area, environmental sensitive receivers and impact monitoring and control/ reference locations (with co-ordinates);

- Implementation status of mitigation measures: Advice on the implementation status of environmental protection and pollution control/mitigation measures as recommended in EIA Report;
- Monitoring results (in both hard and soft copies) with the following information: Monitoring methodology, name of laboratory and types of equipment/instrument deployed and calibration details, parameters monitored, monitoring locations, date, time, frequency and duration, weather conditions, other factors affecting the monitoring results, and QA/QC results and detection limits;
- Non-compliance, complaints and notifications of summons and successful prosecutions: Record of all non-compliance or exceedances of the environmental quality performance limits (A/L Levels), complaints received (written or verbal) for each media e.g. locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary, notification of summons and successful prosecutions for breaches of current environmental protection/pollution control legislation, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary, reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures, and description of the actions taken in the event of non-compliance and deficiency reporting and follow-up procedures related to earlier non-compliance;
- Other information: Account of future key issues as reviewed from the works programme and method statements, advice on waste management status, and comments on effectiveness and efficiency of mitigation measures, recommendations on any improvement in the EM&A programme, and conclusion of the reporting month; and
- Appendix: A/L levels, graphical plots of trends of monitored parameters at key stations over the past 4 reporting periods for representative monitoring stations annotated against the major activities being carried out on site during the period, weather conditions during the period, and any other factors that might affect the monitoring results, monitoring schedule for the present and next reporting period, cumulative statistics on complaints, notifications of summons and successful prosecutions, and outstanding issues and deficiencies.

#### **Quarterly EM&A Summary Reports**

Quarterly EM&A Summary Report of around 5 pages should include the following information:

- Executive summary (1-2 pages);
- Brief project information including a synopsis of the project organisation, works programme, contacts of key personnel of the EM&A programme, and synopsis of works undertaken during the reporting quarter;
- Brief summary of EM&A requirements e.g. monitoring parameters, environmental quality performance limits (A/L Levels), and environmental mitigation measures as recommended in the EIA Report;
- Advice on implementation status of environmental protection and pollution control/mitigation measures as recommended in the EIA Report and summarised in the updated EMIS;
- Drawings showing the project area, environmental sensitive receivers and the monitoring and control locations;
- Graphical plots of trends in monitored parameters over the past four months (the last month of the previous quarter and the reporting quarter) for representative monitoring locations annotated against: major activities being carried out on-site, weather conditions, and other factors which might affect the monitoring results during the reporting quarter;

- Advice on the waste management status;
- Summary of non-compliance or exceedances of the environmental quality performance limits (A/L Levels);
- Brief review of the reasons for and implications of the non-compliance, e.g. review of pollution sources and working procedures;
- Summary description of action taken in the event of non-compliance and follow-up procedures related to any earlier non-compliances;
- Summarised records of all complaints received (written or verbal) for each media, liaison and consultation undertaken, follow-up action and procedures taken;
- Comments (e.g. a review of the effectiveness and efficiency of environmental mitigation measures and performance of the environmental management system of the overall EM&A programme), recommendations (e.g. improvement in the EM&A programme) and conclusion for the reporting quarter; and
- Project Proponent's contacts and any hotline telephone number for the public to make enquiries.

### **Annual EM&A Review Reports**

The Annual EM&A Report should include at least the following information:

- Executive summary (1-2 pages);
- Drawings showing the project area, environmental sensitive receivers and monitoring and control locations;
- Brief project information including a synopsis of the project organisation, contacts of key personnel of the EM&A programme, and synopsis of work undertaken during the past 12 months;
- Brief summary of EM&A requirements e.g. environmental mitigation measures as recommended in the EIA Report, environmental impact hypotheses tested, environmental quality performance limits (A/L Levels), all monitoring parameters, and EAP;
- Summary of the implementation status of environmental protection and pollution control/mitigation measures as recommended in the project EIA Report and summarised in the updated EMIS;
- Graphical plots and statistical analysis of the trends of monitored parameters annotated against major activities carried out on-site, weather conditions and other factors which might affect the monitoring results during the reporting year;
- Summary of non-compliance or exceedances of the environmental quality performance limits (A/L Levels);
- Review of the reasons for and implications of non-compliances including the pollution sources and working procedures as appropriate;
- Description of actions taken in the event of non-compliances;
- Summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, follow-up action and procedures taken;
- Summary record of notifications of summons and successful prosecutions for breaches of the current environmental protection / pollution control legislation, locations and nature of the breaches, investigation follow-up actions taken and results;
- Review of the validity of EIA predictions and identification of shortcomings in EIA recommendations, and



- Comments (e.g. a review of the effectiveness and efficiency of environmental mitigation measures and performance of the environmental management system of the overall EM&A programme); and
- Recommendations and conclusions (e.g. review of success of the overall EM&A programme to cost-effectively identify deterioration and to initiate prompt effective rectification action when necessary) of the reporting year.

### **Final EM&A Review Report**

The Final EM&A Review Reports should be submitted prior to the completion and cessation of each project phases including the Construction and Operation, Restoration, and Aftercare Phases. The report should include at least the following information:

- Executive summary (1-2 pages);
- Drawings showing the project area, environmental sensitive receivers and monitoring and control locations;
- Brief project information including a synopsis of the project organisation, contacts of key personnel of the EM&A programme, and synopsis of work undertaken during the entire reporting project phase;
- Brief summary of EM&A requirements e.g. environmental mitigation measures as recommended in the EIA Report, environmental impact hypotheses tested, environmental quality performance limits (A/L Levels), all monitoring parameters, and EAP;
- Summary of the implementation status of environmental protection and pollution control/mitigation measures as recommended in the project EIA Report and summarised in the updated EMIS;
- Graphical plots and statistical analysis of the trends of monitored parameters annotated against major activities carried out on-site, weather conditions and other factors which might affect the monitoring results during the entire reporting project phase;
- Summary of non-compliance or exceedances of the environmental quality performance limits (A/L Levels);
- Review of the reasons for and implications of non-compliances including the pollution sources and working procedures as appropriate;
- Description of actions taken in the event of non-compliances;
- Summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, follow-up action and procedures taken;
- Summary record of notifications of summons and successful prosecutions for breaches of the current environmental protection / pollution control legislation, locations and nature of the breaches, investigation follow-up actions taken and results;
- Review of the validity of EIA predictions and identification of shortcomings in EIA recommendations, and
- Comments (e.g. a review of the effectiveness and efficiency of environmental mitigation measures and performance of the environmental management system of the overall EM&A programme); and
- Recommendations and conclusions (e.g. review of success of the overall EM&A programme to cost-effectively identify deterioration and to initiate prompt effective rectification action when necessary) of the entire reporting project phase.

## **12.4 Data Keeping**

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No site-based documents such as monitoring field records, laboratory analysis records, site inspection forms, etc should be required to include in the monthly EM&A reports. However, any such documents should be well kept by the ET Leader ready for inspection on request. All relevant information should be clearly and systematically recorded. All monitoring data should also be recorded in magnetic media form, with the soft copy readily available on request. The data format should be agreed with the EPD. All documents and data should be kept for at least 1 year following the project completion.

## **12.5 Interim Notification of Environmental Exceedances**

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With reference to the EAP, when the environmental quality performance limits (i.e. A/L Levels) are exceeded, the ET Leader should immediately notify the IEC, IC, Project Proponent and EPD, as appropriate. The notification should be followed up with advice to the IEC and EPD on the results of the investigation, proposed action and outcome of action taken, with necessary follow-up proposals.

APPENDIX A  

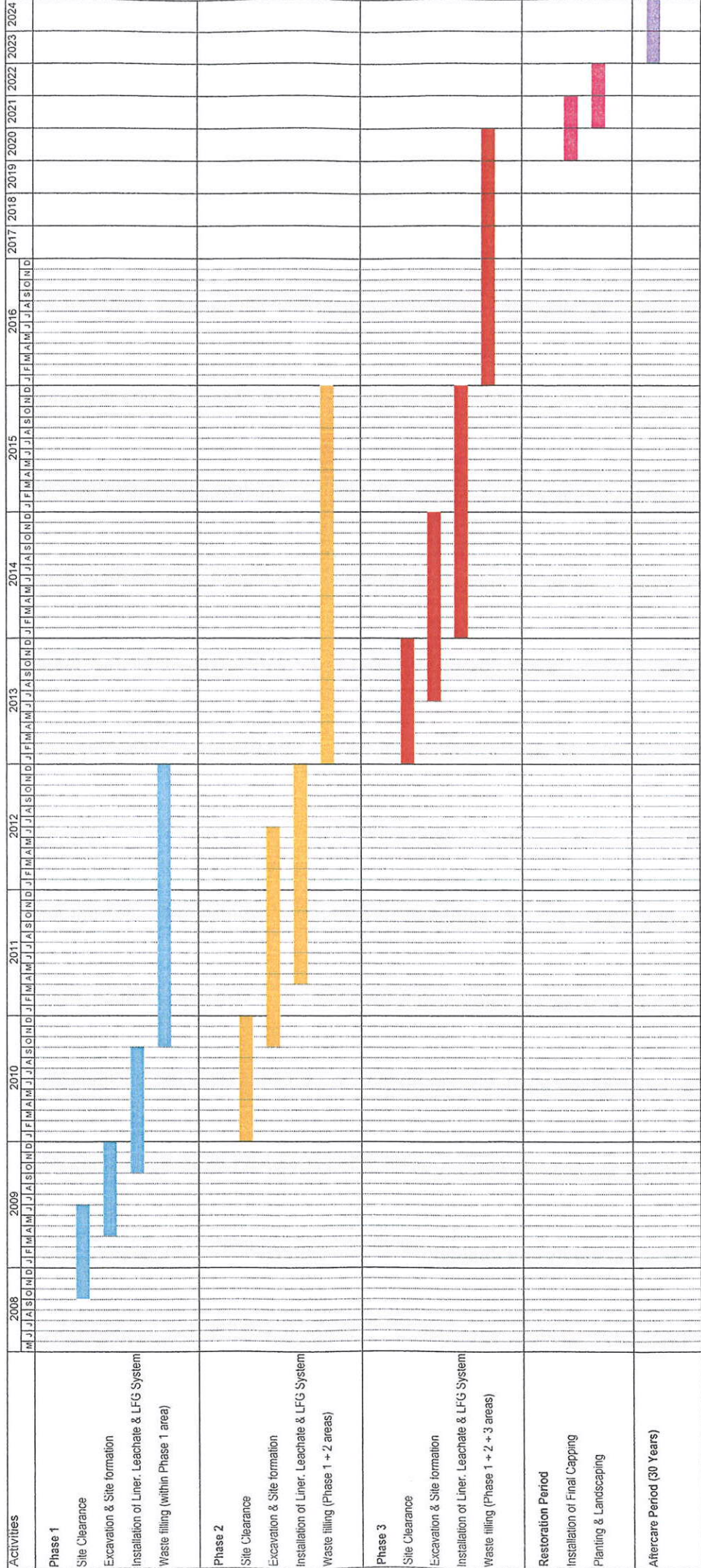
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**Tentative Outline  
Programme**

## NENT LANDFILL EXTENSION TENTATIVE OUTLINE PROGRAMME



### NENT LANDFILL EXTENSION :



Notes : The Landfill Extension will start receiving waste only when the existing NENT Landfill has ceased operation. The commencement of NENT Landfill Extension has yet to be determined as it depends on the actual waste disposal rate in the forthcoming period.

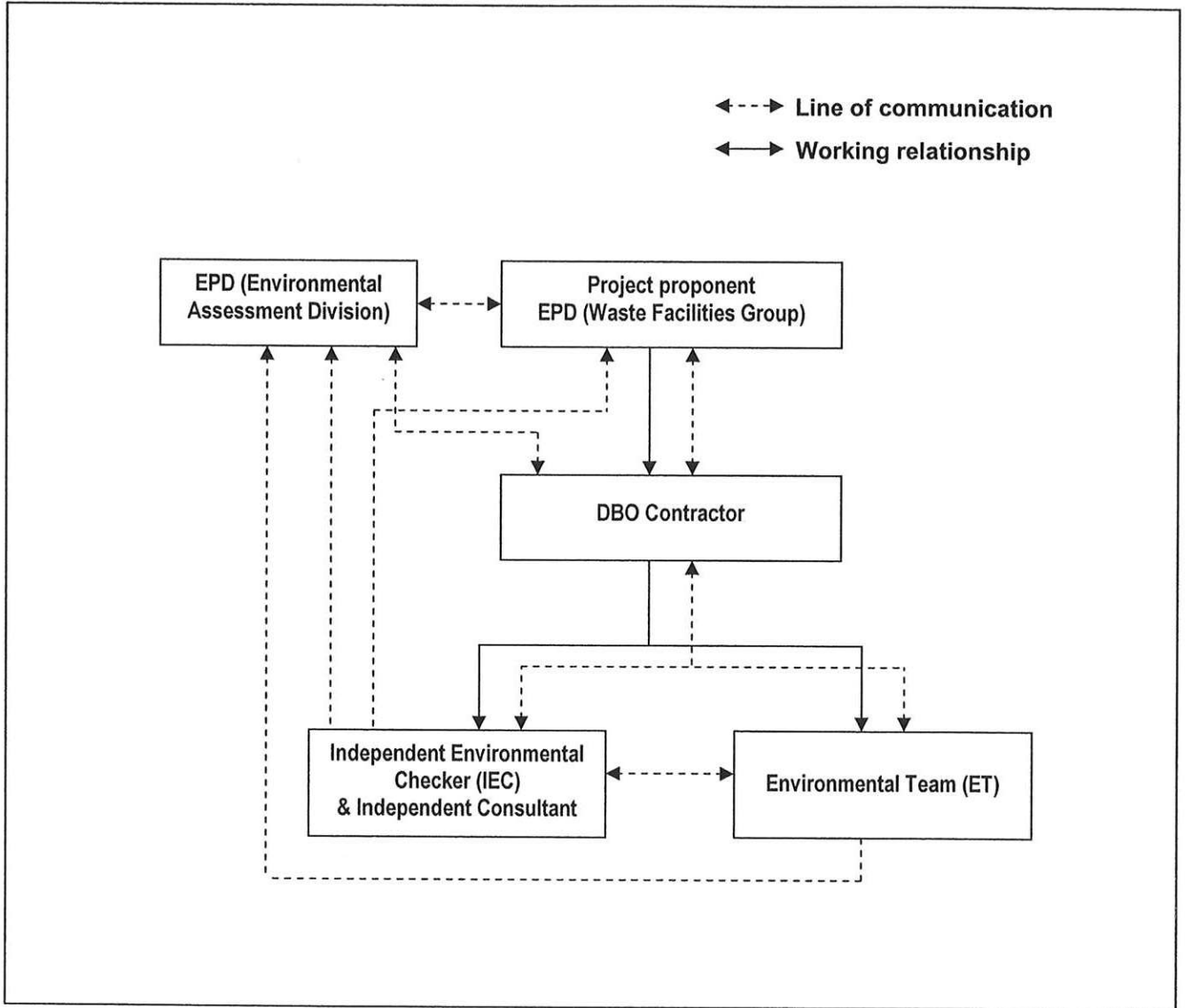
APPENDIX B

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**Project Organisation**



# Project organisation on EM&A responsibilities



APPENDIX C  

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**Environmental  
Mitigation  
Implementation  
Schedule**

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref.	Recommended Precautionary / Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of the Recommended Measures & Main Concerns to address	Who to implement the measures?	Location of the measures	When to implement the measures?	What requirements or standards for the measures to achieve?
<b>Air Quality</b>						
S3.8.1	<p>The contractor shall follow the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation.</p> <ul style="list-style-type: none"> <li>Dust emission from construction vehicle movement is confined within the work sites area.</li> <li>Watering facilities will be provided at every designated vehicular exit point.</li> <li>Good site practice is recommended during construction phase. Covering with impermeable sheet should be provided for the inactive tipping area.</li> </ul>	<p>Good construction site practices to control the dust impact at the nearby sensitive receivers to within the relevant criteria.</p>	DBO Contractor	Entire NENT Landfill Extension site	Construction and Restoration phases	<ul style="list-style-type: none"> <li>To control the dust impact to within the HKAQO and TM-EIA criteria (Ref. 1-hr and 24hr TSP levels are <math>500 \mu\text{g}/\text{m}^3</math> and <math>260 \mu\text{g}/\text{m}^3</math> respectively)</li> </ul>
S3.8.2	<p>The following measures shall be exercised for stack discharge from Ammonia Stripping Plant (ASP), Flare and LFG Power Generator.</p> <ul style="list-style-type: none"> <li>The maximum allowable discharge limit and pollutant removal efficiency for ASP, flare and LFG power generator should be specified in the design specification.</li> <li>Owing to the requirement for the installation of stack, the design requirement shall be submitted to IEC and IC for vetting by the DBO Contractor.</li> <li>Subject to the subsequent EPD's requirement on chimney installation, once every 3 months regular stack monitoring of vinyl chloride, benzene, TOC, NOx and SO<sub>2</sub> shall be carried out to demonstrate compliance during the operations.</li> <li>A monthly monitoring report should be prepared by ET and submitted to IEC and IC for approval.</li> </ul>	<p>Minimize the release of harmful air pollutant to the atmosphere</p>	DBO Contractor	Flare, ASP and LFG Power Generator of NENT Extension	Operational and Restoration phases	<ul style="list-style-type: none"> <li>TM-EIA, Annex 4</li> </ul>

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref.	Recommended Precautionary / Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of the Recommended Measures & Main Concerns to address	Who to implement the measures?	Location of the measures	When to implement the measures?	What requirements or standards for the measures to achieve?
S3.8.2	<p>The following measures shall be exercised for the VOC surface emission:</p> <ul style="list-style-type: none"> <li>The arrangement of the landfill gas collection system and surface covering material for inactive tipping area shall be reviewed by DBO Contractor every 5 year to identify any modern technology/arrangement (covering material, LFG well spacing and locations). A working team shall be formulated to review all processes, control practice and extraction system in order to maximize the efficiency of the system. A review report should be prepared by the DBO Contractor for the submission to IC and IEC on the implementation/arrangement of LFG extraction system. The first review report should be submitted to IC and IEC for agreement before commencement. With a good system to collect LFG (high extraction efficiency), surface release of VOC to the nearby environment can be much reduced or utilised.</li> <li>Maintain a slightly negative pressure within the entire tipping area (by suction). Minimise any potential leakage of LFG to the surrounding by increase the number of gas-extraction wells. Improve the extraction efficiency by checking/reinstate gas wells with abnormally low extraction rate due to blockage/soil movement or sedimentation.</li> <li>Increase the coverage of inactive tipping area with HDPE/plastic sheet which can enhance the anaerobic decomposition (reduce air getting in and VOC leaking out).</li> <li>Detail sampling and measurement of VOCs in 3-monthly intervals should be conducted for more data to assess the landfill performance.</li> </ul>	Minimize the release of harmful VOC to the environment	DBO Contractor	Active, Inactive and Restored Tipping areas	Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>TM-EIA, Annex 4</li> </ul>

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref.	Recommended Precautionary / Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of the Recommended Measures & Main Concerns to address	Who to implement the measures?	Location of the measures	When to implement the measures?	What requirements or standards for the measures to achieve?
S3.8.2	<p>The following design options shall be considered in the future leachate treatment plants:</p> <ul style="list-style-type: none"> <li>Adopted updated treatment method such as Sequencing Batch Reactor for future leachate treatment. Provision of ventilated cover for the leachate storage lagoons / tanks and emissions extracted to suitable odour removal filters with odour removal efficiency of 99%.</li> <li>Ferric nitrate or sodium hypochlorite can be added to oxidise the odorous chemical in the leachate. The pH value of leachate can be controlled to a suitable value from future on-site experiment such that the generation of any odorous H<sub>2</sub>S and ammonia can be optimised.</li> <li>For the gaseous extraction system, the wind speed immediately above the leachate surface should be kept to minimal (in the order of 1E-3 m/s) such that the odour emission strength from lagoon can be minimised. Suitable treatment system should be provided for odour removal. The ventilated gaseous emission from lagoons should be provided with 5-10 air change per hour for further dilution before discharge.</li> <li>The notional centre of the future discharge point (e.g. stack) shall be located at a location with maximum setback distance from the ASRs and further away from the notional centre of the leachate storage lagoons / tanks. The location of discharge point and discharge height should be determined at the detailed design stage to ensure that the odour criterion at the ASRs will not be exceeded.</li> <li>The overall arrangement should be investigated in details by the DBO Contractor and agreed with IEC and EPD.</li> </ul>	<p>Environmental Enhancement to improve the air quality and visual impact to nearby sensitive receivers</p>	<p>EPD(WFG)/ DBO Contractor</p>	<p>Lagoons (Existing and Future leachate treatment plants)</p>	<p>Operational and Restoration phases</p>	<ul style="list-style-type: none"> <li>Environmental Enhancement</li> </ul>



**Environmental Mitigation Implementation Schedule**  
**NENT Landfill Extension**

EIA Ref.	Recommended Precautionary / Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of the Recommended Measures & Main Concerns to address	Who to implement the measures?	Location of the measures	When to implement the measures?	What requirements or standards for the measures to achieve?
S3.8.2	<p>The following are some odour precautionary measures that shall be considered by EPD and FEHD:</p> <ul style="list-style-type: none"> <li>• As an improvement measure to enhance to environmental standard for waste transfer, EPD could take the initiative to recommend others to use enclosed type RCV in the long run (dominantly government and sludge types).</li> <li>• Clearing / watering of the surface and clearing of the waste water receptor of government RCV is recommended before leaving refuse transfer station or government Refuse Collection Point (FEHD).</li> </ul>	<p>Environmental Enhancement to improve the odour impact during the transit of waste</p>	<p>EPD(WFG) and FEHD</p>	<p>Government RCV from RTS and RCP</p>	<p>Operational phase</p>	<ul style="list-style-type: none"> <li>• Environmental Initiative</li> </ul>
S3.8.2	<p>The Contract shall exercise adequate precautionary measures to minimize any potential odor nuisance from tipping activities:</p> <ul style="list-style-type: none"> <li>• The use of alternative daily cover (less permeable layer) instead of inert material should be considered.</li> <li>• The use of immediate daily cover for odorous waste such as sewage sludge, animal waste etc. under critical condition should also be considered.</li> <li>• For the time being, there is no population in the derelict Tong To Shan Tsuen. If there is new resident moving into this derelict village, thicker daily cover / alternative daily cover should be applied at phase 3 of the extension site such that the emission strength can be reduced. Site walk should be conducted once every three months to the Tong To Shan Tsuen to verify whether there is new resident moving in during the operational stage. Once, there is any new resident, night time / early morning odour patrol at Tong To Shan Tsuen should be arranged to ensure the effectiveness of the measures.</li> <li>• During very hot and stable weather condition, thicker daily cover can be arranged in case odour patrol identify potential odour nuisance,</li> <li>• During stable and calm weather, tipping could be arranged to further increase the setback distance.</li> </ul>	<p>Minimize the potential odour impact for tipping area to nearby sensitive receivers</p>	<p>DBO Contractor</p>	<p>Tipping areas</p>	<p>Operational phase</p>	<ul style="list-style-type: none"> <li>• TM-EIA, Annex 4</li> <li>• Odour patrol with 2 Odour Intensity or below at ASR without causing potential odour nuisance</li> </ul>

Notes :  
Entire NENT Landfill Extension site includes Office, Waste Reception Area, Leachate Treatment Works, LFG Treatment Works, Active, Inactive and Restored Tipping Areas.

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of the Recommended Measures & Main Concerns to address	Who to implement the measures?	Location of the measures	When to implement the measures?	What requirements or standards for the measures to achieve?
<b>Construction Noise</b>							
S4	N1	<p>1) Use of good site practices to limit noise emissions by considering the following:</p> <ul style="list-style-type: none"> <li>only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;</li> <li>machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;</li> <li>plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;</li> <li>silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;</li> <li>mobile plant should be sited as far away from NSRs as possible and practicable;</li> <li>material stockpiles, mobile container site officer and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.</li> </ul>	Control construction airborne noise by means of good site practices	DBO Contractor	Entire construction site	Construction phase	<ul style="list-style-type: none"> <li>Noise Control Ordinance</li> </ul>
S4	N2	2) Select "Quiet plants" which comply with the BS 5228 Part 1 or TM standards.	Reduce the noise levels of plant items	DBO Contractor	Entire construction site	Construction phase	<ul style="list-style-type: none"> <li>Noise Control Ordinance &amp; its TM</li> <li>Annex 5, TM-EIA</li> </ul>
<b>Operational Noise</b>							
S4	N3	3) Select "Quiet plants" which comply with the BS 5228 Part 1 or TM standards.	Reduce the noise levels of plant items	DBO Contractor	Entire construction site	Operational and Restoration phases	<ul style="list-style-type: none"> <li>Noise Control Ordinance &amp; its TM</li> <li>Annex 5, TM-EIA</li> </ul>

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

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<b>Construction Runoff</b>							
S5.8.1	S5.2.1	<p><u>Construction Site Runoff</u></p> <ul style="list-style-type: none"> <li>At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed with internal drainage works and erosion and sedimentation control facilities implemented. Channels (both temporary and permanent drainage pipes and culverts), earth bunds or sand bag barriers should be provided on site to direct stormwater to silt removal facilities.</li> <li>The dikes or embankments for flood protection should be implemented around the boundaries of earthwork areas. Temporary ditches should be provided to facilitate the runoff discharge into an appropriate watercourse, through a site/sediment trap. The sediment/silt traps should be incorporated in the permanent drainage channels to enhance deposition rates.</li> <li>The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions.</li> <li>Construction works should be programmed to minimize surface excavation works during the rainy seasons (April to September). All exposed earth areas should be completed and vegetated as soon as possible after earthworks have been completed, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means.</li> <li>The overall slope of the site should be kept to a minimum to reduce the erosive potential of surface water flows, and all trafficked areas and access roads protected by coarse stone ballast. An additional advantage accruing from the use of crushed stone is the positive traction gained during prolonged periods of inclement weather and the reduction of surface sheet flows.</li> <li>All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit should be removed regularly and disposed of by spreading evenly over stable, vegetated areas.</li> </ul>	Control construction runoff and erosion from site surface, drainage channel, stockpiles, barging facility, wheel washing facilities, etc to minimize water quality during construction stage	DBO Contractor	Entire construction site	Construction phase	<ul style="list-style-type: none"> <li>ProPECC PN 1/94</li> <li>Water Pollution Control Ordinance</li> </ul>

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<b>Construction Runoff (Cont'd)</b>							
S5.8.1	S5.2.1	<p>Measures should be taken to minimise the ingress of site drainage into excavations. If the excavation of trenches in wet periods is necessary, they should be dug and backfilled in short sections wherever practicable. Water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.</p> <ul style="list-style-type: none"> <li>Open stockpiles of construction materials (for example, aggregates, sand and fill material) of more than 50 m<sup>3</sup> should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.</li> <li>Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm runoff being directed into foul sewers.</li> <li>Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecasted, and actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events, especially for areas located near steep slopes.</li> <li>All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing bay should be provided at every construction site exit. Wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfall toward the wheel-wash bay to prevent vehicle tracking of soil and silty water to public roads and drains.</li> <li>Oil interceptors should be provided in the site drainage system downstream of any oil/fuel pollution sources. The oil interceptors should be emptied and cleaned regularly to prevent the release of oil and grease into the storm water drainage system after accidental spillage. A bypass should be provided for the oil interceptors to prevent flushing during heavy rain.</li> </ul>	Control construction runoff and erosion from site surface, drainage channel, stockpiles, barging facility, wheel washing facilities, etc to minimize water quality during construction stage	DBO Contractor	Entire construction site	Construction phase	<ul style="list-style-type: none"> <li>ProPECC PN 1/94</li> <li>Water Pollution Control Ordinance</li> </ul>

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<b>Construction Runoff (Cont'd)</b>							
S5.8.1	S5.2.1	<ul style="list-style-type: none"> <li>Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts. Requirements for solid waste management are detailed in Section 9 of this Report.</li> <li>All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching water sensitive receivers nearby.</li> <li>To prevent pollution risks arising from works area (waste reception area) and haul roads, intercepting bund or barrier along the roadside should be constructed.</li> </ul>	Control construction runoff and erosion from site surface, drainage channel, stockpiles, barging facility, wheel washing facilities, etc to minimize water quality during construction stage	DBO Contractor	Entire construction site	Construction phase	<ul style="list-style-type: none"> <li>ProPECC PN 1/94</li> <li>Water Pollution Control Ordinance</li> </ul>
S5.8.1	S5.2.1	<p><u>Sewage Effluent from Workforce</u></p> <ul style="list-style-type: none"> <li>Portable chemical toilets and sewage holding tanks are recommended for handling the construction sewage generated by the workforce. A licensed contractor should be employed to provide appropriate and adequate portable toilets and be responsible for appropriate disposal and maintenance.</li> <li>Notices will be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the nearby environment during the construction phase of the Project.</li> <li>Regular environmental audit on the construction site can provide an effective control of any malpractices and can achieve continual improvement of environmental performance on site.</li> </ul>	Control sewage effluent arising from the sanitary facilities provided for the on-site construction workforce	DBO Contractor	On-site sanitary facilities	Construction phase	<ul style="list-style-type: none"> <li>ProPECC PN 1/94</li> <li>Water Pollution Control Ordinance</li> <li>Waste Disposal Ordinance</li> </ul>
S5.8.1	S5.2.1	<p><u>Accidental Spillage of Chemical</u></p> <p>Any service workshop and maintenance facilities shall be located within a bunded area, and sumps and oil interceptors shall be provided. Maintenance of equipment involving activities with potential for leakage and spillage will only be undertaken within the areas.</p>	Control of chemical leakage	DBO Contractor	Service workshop and maintenance facilities	Construction phase	<ul style="list-style-type: none"> <li>ProPECC PN 1/94</li> <li>Water Pollution Control Ordinance</li> <li>Waste Disposal Ordinance</li> </ul>
<b>Operational Water Quality</b>							
S5.8.2	S5.2.2	<ul style="list-style-type: none"> <li>Formulate contingency Plan on Accidental Leakage of Leachate</li> <li>Design Contingency Plan for Groundwater Contamination</li> <li>Design Contingency Plan for Surface Water Contamination</li> </ul>	Control contamination to surface and ground water	DBO Contractor	Drainage system	Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>TM-water</li> <li>Water Pollution Control Ordinance</li> </ul>



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S5.8.2	S5.2.2	Hydroseeding will be applied on the surface of stockpiled soil and on temporary soil covers for inactive tipping areas to prevent soil erosion during rainy season.	Control contamination to surface and ground water	DBO Contractor	Drainage system	Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• TM-water</li> <li>• Water Pollution Control Ordinance</li> </ul>
S5.8.2	S5.2.2	Monitoring of the surface water discharges and groundwater discharge under the environmental monitoring programme.	Control run off and underground water leakage	DBO Contractor	Surface and underground water system	Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• Water Pollution Control Ordinance</li> <li>• TM-water</li> </ul>
<b>Erosion Control Measures</b>							
S5.8.2	S5.2.2	<p><u>Erosion Control Measures</u></p> <p>a. Preserve Natural Vegetation This Best Management Practices will involve preserving natural vegetation to the greatest extent possible during the construction process, and after construction where appropriate. Maintaining natural vegetation is the most effective and inexpensive form of erosion prevention control.</p> <p>b. Provision of Buffer Zone A buffer zone consists of an undisturbed area or strip of natural vegetation or an established suitable planting adjacent to a disturbed area that reduces erosion and runoff. The rooted vegetation holds soils acts as a wind break and filters runoff that may leave the site.</p> <p>c. Seeding (Temporary/Permanent) A well-established vegetative cover is one of the most effective methods of reducing erosion. Vegetation should be established on construction sites as the slopes are finished, rather than waiting until all the grading is complete. Besides, Hydroseeding will be applied on the surface of stockpiled soil and on temporary soil covers for inactive tipping areas to prevent soil erosion during rainy season.</p> <p>d. Ground Cover Ground Cover is a protective layer of straw or other suitable material applied to the soil surface. Straw mulch and/or hydromulch are also used in conjunction with seeding of critical areas for the establishment of temporary or permanent vegetation. Ground cover provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures.</p>	Erosion control	DBO Contractor	Drainage system	Construction, Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• ProPECC PN 1/94</li> <li>• Water Pollution Control Ordinance</li> </ul>

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S5.8.2	S5.2.2	<p>e. Hydraulic Application</p> <p>Hydraulic application is a mechanical method of applying erosion control materials to bare soil in order to establish erosion-resistant vegetation on disturbed areas and critical slopes. By using hydraulic equipment, soil amendments, mulch, tackifying agents, Bonded Fiber Matrix (BFM) and liquid co-polymers can be uniformly broadcast, as homogenous slurry, onto the soil. These erosion and dust control materials can often be applied in one operation.</p> <p>f. Sod</p> <p>Establishes permanent turf for immediate erosion protection and stabilizes rainageways.</p> <p>g. Matting</p> <p>There are numerous erosion control products available that can be described in various ways, such as matting, blankets, fabric and nets. These products are referred as matting. A wide range of materials and combination of materials are used to produce matting including, but not limited to: straw, jute, wood fiber, coir (coconut fiber), plastic netting, and Bonded Fiber Matrix. The selection of matting materials for a site can make a significant difference in the effectiveness of the Best Management Practices.</p> <p>h. Plastic Sheeting</p> <p>Plastic Sheeting will provide immediate protection to slopes and stockpiles. However, it has been known to transfer erosion problems because water will sheet flow off the plastic at high velocity. This is usually attributable to poor application, installation and maintenance.</p> <p>i. Dust Control</p> <p>Dust Control is one preventative measure to minimize the wind transport of soil, prevent traffic hazards and reduce sediment transported by wind and deposited in water resources.</p>	Erosion control	DBO Contractor	Drainage system	Construction, Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• ProPECC PN 1/94</li> <li>• Water Pollution Control Ordinance</li> </ul>

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<b>Surface Water Drainage System</b>							
S5.8.2	S5.2.2	<p>Temporary surface water drainage system will be provided to manage runoff during construction and operation. This system will consist of channels as constructed around the perimeter of the site area. This system will collect surface water from the areas of higher elevations to those of lower elevations and ultimately to the point of discharge. Erosion will therefore be minimised.</p> <p>The temporary surface water drainage system will include the use of a silt fence around the soil stockpile areas to prevent sediment from entering the system. Regular cleaning will be carried out to prevent blockage of the passage of water flow in silt fence.</p> <p>Intermediate drainage system will be installed for filled cell/phase. The major purpose of the intermediate drainage system is to prevent the clean surface water run-off from the filled phases coming into contact with the waste mass in active cell and to prevent excessive surface water infiltration through the intermediate cover, thus contribute to increasing volume of leachate. The intermediate drainage system will collect the clean surface water run-off and divert it to the permanent discharge channels connected to the public drainage system.</p> <p>In addition, surface flow from the haul road (especially near the wheel washing facility) will be collected to a dry weather flow interceptor and conveyed to the on-site leachate treatment plant for further treatment.</p>	Surface Water Management / Control run off	DBO Contractor	Surface water system	Construction, Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• Water Pollution Control Ordinance</li> <li>• TM-water</li> </ul>

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<b>Groundwater Regime</b>							
S5.8.2	S5.2.2	<p>1) Adopt precautionary / mitigation measures:</p> <ul style="list-style-type: none"> <li>• Provision of adequate water supply for irrigation purposes for the operational lifetime of the landfill extension, i.e. 10 to 12 years;</li> <li>• Installation of a network of monitoring stations to keep track of the stream flow volumes. Should monitoring of stream flow indicate insufficient quantities to provide sufficient water for irrigation downstream, a contractual requirement for the landfill operator to "tank in" water from an external source could be imposed. This is the system currently in place for the existing NENT Landfill;</li> <li>• Diversion of flow from other catchments. The surface runoff generated in the catchments with abandoned agricultural lands could be collected and conveyed to the active agricultural lands;</li> <li>• Formation of new extraction wells that extend deeper down within the aquifer;</li> <li>• Provision of Piped Water Supply; and</li> <li>• Artificial recharge by surface spreading, spray irrigation or pumping water directly into the ground via vertical shafts.</li> </ul>	Control and maintain ground water yield	DBO Contractor	Entire construction site and villages around the site	Operational, Restoration and Aftercare phases	<ul style="list-style-type: none"> <li>• TM-EIAO, Annexes 6 and 14</li> <li>• HKPSG</li> </ul>

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<i>Waste Management</i>							
S 6	WM1	<p><u>C&amp;D Materials</u></p> <p>Implement proper waste management measures during construction phase as stipulated in the Environmental Management Plan (EMP) in accordance with the ETWB TC(W) No. 19/2005 Environmental Management in Construction Sites.</p> <p>Implement a trip-ticket system to ensure that the movement of C&amp;D materials are properly documented and verified in accordance with ETWB TC(W) No.31/2004. Copies/counterfoils from trip-tickets (with quantities of C&amp;D Materials off-site) should be kept for record purposes.</p> <p>Appropriate waste management should be implemented in accordance with the ETWB TC(W) No 19/2005.</p> <p>Make provisions in Contract documents to allow and promote the use of recycled aggregates where appropriate. Ensure material balance in terms of excavated C&amp;D materials in the design of NENT landfill extension project. The contract specifications should specify no excavated materials should be removed from the landfill extension site, but should be fully reused.</p> <p>Careful design, planning and good site management to minimise over-ordering and waste materials such as concrete, mortars and cement grouts. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic fencing should be considered to increase the potential for reuse.</p> <p>The DBO Contractor should recycle as much as possible the C&amp;D waste on-site through proper waste segregation on-site. Concrete and masonry should be used as general fill and steel reinforcement bars can be used by scrap steel mills. Proper areas should be designated for waste segregation and storage wherever site conditions permit. Maximise the use of reusable steel formwork to reduce the amount of C&amp;D material.</p> <p>Maintain temporary stockpiles and reuse excavated fill material for backfilling and reinstatement. On-site sorting and segregation facility of all type of wastes is considered as one of the best practice in waste management and hence, should be implemented in all projects generating construction waste. The sorted public fill and C&amp;D waste should be properly reused.</p>	<p>Good site practice to minimise C&amp;D waste generation and reuse/recycle all C&amp;D on-site as far as possible</p>	<p>DBO Contractor</p>	<p>Entire construction site</p>	<p>Construction phase</p>	<p>Waste Disposal Ordinance ETWB TC(W) No.19/2005  ETWB TC(W) No.31/2004  ETWB TC(W) No.19/2005</p>



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S 6	WM1	<p><u>C&amp;D Materials (Cont'd)</u></p> <p>Excavated slope, stockpiled material and bund walls should be covered by tarpaulin until used in order to prevent wind-blown dust during dry weather, and to reduce muddy runoff during wet weather. Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers.</p> <p>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.</p> <p>Nomination of approved personnel to be responsible for good site practices and making arrangements for collection of all wastes generated on-site and effective disposal.</p> <p>Training of site personnel for cleanliness, proper waste management procedures including chemical waste handling, and waste reduction, reuse and recycling concepts.</p> <p>Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors.</p> <p>Prior to disposal of C&amp;D waste, wood, steel and other metals should be separated for re-use and/or recycling to minimise the quantity of waste to be disposed of to landfill. Proper storage and site practices should be implemented to minimise the potential for damage or contamination of construction materials.</p> <p>Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste. Minimise excessive ordering of concrete, mortars and cement grout by doing careful check before ordering.</p>	<p>Good site practice to minimise C&amp;D waste generation and reuse/recycle all C&amp;D on-site as far as possible</p>	<p>DBO Contractor</p>	<p>Entire construction site</p>	<p>Construction phase</p>	<p>Waste Disposal Ordinance</p> <p>ETWB TC(W) No.19/2005</p> <p>ETWB TC(W) No.31/2004</p> <p>ETWB TC(W) No.19/2005</p>
S6	WM2	<p><u>Chemical Waste</u></p> <p>Chemical waste that is produced, as defined by Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation, should be handled in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.</p> <p>Plant/equipment maintenance schedule should be designed to optimise maintenance effectiveness and to minimise the generation of chemical wastes. Where possible, chemical wastes (e.g. waste lube oil) should be recycled by licensed treatment facilities</p>	<p>Ensure proper disposal of chemical waste generated on-site to minimise the associated hazards on human health and environment</p>	<p>DBO Contractor</p>	<p>Entire construction site</p>	<p>Construction, Operation, Restoration and Aftercare phases</p>	<p>Waste Disposal (Chemical Waste) (General) Regulation</p> <p>Code of Practice on the Packaging, Labelling and Storage of Chemical Waste</p>

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S 6	WM2	<p><u>Chemical Waste (Cont'd)</u></p> <p>Containers used for storage of chemical wastes should 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 liters unless the specification has been approved by the EPD. Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulation.</p> <p>The storage area for chemical wastes should be clearly labelled and used solely for storage of chemical waste, enclosed with at least 3 sides, having an impermeable floor and bund of sufficient capacity to accommodate 110% of volume of the largest container or 20 % of total volume of waste stored in that area, whichever is the greatest, having adequate ventilation, being covered to prevent rainfall entering, and being arranged so that incompatible materials are adequately separated.</p> <p>Chemical waste should be collected by licensed waste collectors and disposed of at licensed facility, e.g. Chemical Waste Treatment Centre.</p>	<p>Ensure proper disposal of chemical waste generated on-site to minimise the associated hazards on human health and environment</p>	DBO Contractor	Entire construction site	Construction, Operation, Restoration and Aftercare phases	<p>Waste Disposal (Chemical Waste General) Regulation</p> <p>Code of Practice on the Packaging, Labelling and Storage of Chemical Waste</p>
S 6	WM3	<p><u>General Refuse</u></p> <p>General refuse generated on-site should be properly stored in enclosed bins or compaction units separately from construction and chemical wastes.</p> <p>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</p> <p>Reputable waste collector should 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. Burning of refuse on construction sites is prohibited by law.</p> <p>Aluminum cans should be separated from general waste stream and collected by recyclers. Proper collection bins should be provided on-site to facilitate the waste sorting.</p>	<p>Minimise generation of general refuse to avoid odour, pest and visual nuisance</p>	DBO Contractor	Entire construction site	Construction, Operation, Restoration and Aftercare phases	Waste Disposal Ordinance

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S 6	WM3	<p><u>General Refuse (Cont'd)</u></p> <p>Office waste paper should be recycled if the volume warrant collection by recyclers. Participation in community waste paper recycling programme should be considered by the DBO Contractor, including waste paper, aluminum cans, plastic bottles, waste batteries, etc.</p>	Minimise generation of general refuse to avoid odour, pest and visual nuisance	DBO Contractor	Entire construction site	Construction, Operation, Restoration and Aftercare phases	Waste Disposal Ordinance
S6	WM4	<p><u>Sludge from Leachate Treatment Works</u></p> <p>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.</p>	Proper management of sludge arising from leachate treatment works to minimise the associated hazards on human health and environment	DBO Contractor	Leachate Treatment Works	Construction, Operation, Restoration and Aftercare phases	Waste Disposal Ordinance

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<b>LFG</b>							
<i>Within NENT Landfill Extension</i>							
S7	LFG1	Special LFG precautions should be taken due to close proximity of NENT landfill extension site to existing landfill to avoid potential hazards of LFG exposure (ignition, explosion, asphyxiation, toxicity).	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire NENT Landfill Extension site	Construction phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)  F&IU (Confined Spaces) Regulations  Code of Practice on Safety and Health at Work in Confined Spaces
S7	LFG2	Prominent safety warning signs should be erected on-site to alert all personnel and visitors of LFG hazards during excavation works.					
S7	LFG3	No smoking or burning should be permitted on-site.					
S7	LFG4	Prominent 'No smoking' and 'No Naked Flames' signs should be erected on-site.					
S7	LFG5	No worker should be allowed to work alone at any time in excavated trenches or confined areas on-site.					
S7	LFG6	Adequate fire fighting equipment should be provided on-site.					
S7	LFG7	Construction equipment should be equipped with vertical exhaust at least 0.6m above ground installed with spark arrestors.					
S7	LFG8	Electrical motors and extension cords should be explosion-proof and intrinsically safe for use on-site.					
S7	LFG9	'Permit to Work' system should be implemented.					
S7	LFG10	Welding, flame-cutting or other hot works should be conducted only under 'Permit to Work' system following clear safety requirements, gas monitoring procedures and presence of qualified persons to supervise the works.					
S7	LFG11	For piping assembly or conduit construction, all valves and seals should be closed immediately after installation to avoid accumulation and migration of LFG. If installation of large diameter pipes (diameter >600mm) is required, the pipe ends should be sealed on one side during installation. Forced ventilation is required prior to operation of installed pipeline. Forced ventilation should also be required for works inside trenches deeper than 1m.					

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<i>Within NENT Landfill Extension (Cont'd)</i>							
S7	LFG12	Frequency and location of LFG monitoring within excavation area should be determined prior to commencement of works. LFG monitoring in excavations should be conducted at no more than 10mm from exposed ground surface.	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire NENT Landfill Extension site	Construction phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)  F&IU (Confined Spaces) Regulations  Code of Practice on Safety and Health at Work in Confined Spaces
S7	LFG13	For excavation works, LFG monitoring should be conducted (1) at ground surface prior to excavation, (2) immediately before workers entering excavations, (3) at the beginning of each half-day work, and (4) periodically throughout the working day when workers are in the excavation.					
S7	LFG14	Any cracks on ground level encountered on-site should be monitored for LFG periodically. Appropriate action should be taken in accordance with the action plan in Table 7.6 of EIA Report.					
S7	LFG15	LFG precautionary measures involved in excavation and piping works should be provided in accordance with LFG Guidance Note and included in Safety Plan of construction phase. Temporary offices or buildings should be located where free LFG has been proven or raised clear of ground at a separation distance of at least 500mm.					
S7	LFG16	For large development such as NENT landfill extension, a Safety Officer trained in the use of gas detection equipment and LFG-related hazards should be present on-site throughout the groundwork phase. The Safety Officer should be provided with an intrinsically safe portable instrument appropriately calibrated and capable of measuring the following gases: <ul style="list-style-type: none"> <li>• CH<sub>4</sub>: 0-100% LEL and 0-100%/v</li> <li>• CO<sub>2</sub>: 0-100%</li> <li>• O<sub>2</sub>: 0-21%</li> </ul>					
S7	LFG17	Periodically during groundwork construction, the works area should be monitored for CH <sub>4</sub> , CO <sub>2</sub> and O <sub>2</sub> using appropriately calibrated portable gas detection equipment. The monitoring frequency and areas should be established prior to commencement of groundwork either by Safety Officer or appropriately qualified person. Routine monitoring should be carried out in all excavations, manholes, chambers and any other confined spaces that may have been created by temporary storage of building materials on-site. All measurements in excavations should be made with monitoring tube located not more than 10mm from exposed ground surface.					



**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<i>Within NENT Landfill Extension (Cont'd)</i>							
S7	LFG18	For excavations deeper than 1m, measurements should be conducted: <ul style="list-style-type: none"> <li>At ground surface before excavation commences;</li> <li>Immediately before any worker enters the excavation;</li> <li>At the beginning of each working day for entire period the excavation remains open; and</li> <li>Periodically throughout the working day whilst workers are in excavation.</li> </ul>	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire NENT Landfill Extension site	Construction phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)  F&IU (Confined Spaces) Regulations  Code of Practice on Safety and Health at Work in Confined Spaces
S7	LFG19	For excavations between 300mm and 1m, measurements should be conducted: <ul style="list-style-type: none"> <li>Directly after excavation has been completed; and</li> <li>Periodically whilst excavation remains open.</li> </ul>					
S7	LFG20	For excavations less than 300mm, monitoring may be omitted at the discretion of Safety Officer or appropriately qualified person.					
S7	LFG21	Where any service voids, manholes and inspection chambers within landfill extension site are entered for maintenance and LFG monitoring, all safety requirements should be followed.	To minimise the risk of LFG hazards to personnel in landfill site	DBO Contractor	Entire NENT Landfill Extension site	Operation, Restoration and Aftercare phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97)  F&IU (Confined Spaces) Regulations  Code of Practice on Safety and Health at Work in Confined Spaces
S7	LFG22	Buildings onsite should be incorporated with passive system relying on natural air movement to prevent gas build-up and active system requiring energy input to mechanically move air to protect against LFG build-up. Design measures for sub-surface building services should include generic measures e.g. gas barriers, gas vents and strategic routing of any service utilities away from potential LFG migration pathways.					
S7	LFG23	Any new-built permanent building structures within the landfill extension site, forced ventilation and gas detection system with audible alarm should be installed. When the internal atmosphere is detected with >10% of CH <sub>4</sub> , forced ventilation should be triggered automatically. No person should be allowed to enter or remain in any confined areas when CO <sub>2</sub> levels >1.5%/v or O <sub>2</sub> levels <18%/v were detected. Access to confined spaces in the landfill extension site should be controlled to only authorised persons.					
S7	LFG24	Specific gas protection measures which can be applied to building services have been in Appendix 7.1 of EIA Report. They generally include gas barriers, gas vents, location of service entries above ground, and service conduits passing through Consultation Zone.					

**Environmental Mitigation Implementation Schedule**  
**NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<b>Landscape and Visual Impact</b>							
<b>Construction and Operation Phases</b>							
S8	LV1	<p><b>Advanced screening tree planting</b></p> <ul style="list-style-type: none"> <li>Early planting using fast growing trees and tall shrubs at strategic locations within site to block major view corridors to the site from the VSRs, and to locally screen haul roads, excavation works and site preparation works.</li> <li>Roadside planter and shrub planting design in front of Cheung Sha Temple.</li> </ul>	<p>To minimise the impact on existing vegetation retained by personnel in construction site</p> <p>To provide initiation on permanent landscape and visual mitigation measures</p>	DBO Contractor	Entire construction site	Construction and Operation phases	<p>ETWB TC(W) No. 3/2006 – Tree Preservation</p> <p>ETWB TC(W) No. 2/2004 - Maintenance of Vegetation and Hard Landscape Features</p> <p>WBTC No. 26/99 – Maintenance of Man-made Slopes and Emergency Repair on Stability of Land</p>
S8	LV2	<p><b>Boundary Green Belt planting</b></p> <ul style="list-style-type: none"> <li>Considerable planting belts proposed around the site perimeter and the construction of temporary soil bunds will screen the landfill operations to a certain degree. Fast growing and fire resistant plant species will be used.</li> </ul>					
S8	LV3	<p><b>Temporary landscape treatment as green surface cover</b></p> <ul style="list-style-type: none"> <li>For certain areas where landfiling operations would have to be suspended temporarily for periods of years, simple temporary landscape treatment such as hydroseeding should be considered. During construction and operational phases, grass hydroseeding or synthetic covering material of green colour should also be used as a temporary slope cover if applicable.</li> </ul>					
S8	LV4	<p><b>Existing tree preservation</b></p> <ul style="list-style-type: none"> <li>Transplant existing trees and vegetation, which are identified as ecologically significant in Ecological Impact Assessment and as rare tree species recorded in the tree survey, under circumstances where technically feasible. For all affected trees, the principle of avoidance of tree felling and tree transplanting of tree before felling should apply whenever possible. A tree felling application should be submitted to DLO and be approved before any trees are felled or transplanted.</li> </ul>					

**Environmental Mitigation Implementation Schedule**  
**NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<b>Restoration and Aftercare Phases</b>							
S8	LV5	<p><b>Sensible final contour grading</b></p> <ul style="list-style-type: none"> <li>The final landfill will provide a structurally stable and visually interesting landform, which is visually compatible with surrounding landscape and contoured to simulate adjacent undeveloped area. Introduction and continuation of natural features such as spurs, ridges and valleys will be considered where appropriate.</li> </ul>	To minimise the visual impact on landfill.	DBO Contractor	Entire construction site	Restoration and Aftercare phases	ETWB TC(W) No. 3/2006 – Tree Preservation ETWB TC(W) No. 2/2004 – Maintenance of Vegetation and Hard Landscape Features
S8	LV6	<p><b>Sufficient cover soil of landfill final capping</b></p> <ul style="list-style-type: none"> <li>Sufficient cover soil of landfill final capping will be placed above the low-permeable layer and drainage layer, so as to sustain the proposed planting. The cover soil layer should be a minimum of 500mm in thickness for grassland, a minimum of 700mm for shrubland and 1000mm for woodland. Immediately after the completion of localized earthworks for the cover soil layer, the soil surface should be stabilized and greened by grass hydro-seeding prior to subsequent landscape planting.</li> </ul>	To provide site preparation for compensatory planting under the requirements of mitigation measures.	DBO Contractor	Entire construction site	Restoration and Aftercare phases	WBTC No. 26/99 – Maintenance of Man-made Slopes and Emergency Repair on Stability of Land
S8	LV7	<p><b>Landscape planting and maintenance</b></p> <ul style="list-style-type: none"> <li>Planting and maintenance to allow vegetation establishment to match the natural vegetation of the surroundings.</li> <li>Planting layout to establish a coherent pattern of woodland, shrubland and grassland vegetation.</li> <li>To compensate for the loss of existing trees, 26.83 ha (43% of the waste boundary) will be planted with woodland mix progressively in phases. Assuming tree seedlings/whips planting at 1.5m spacing in staggered pattern, there will be about 148,100 nos. of tree seedlings/ whipsplanted. In addition, 19 ha of shrubland mix planting and 17.55 ha of grassland are proposed.</li> </ul>	To minimise the landscape and visual impact on the affected planting areas and provide permanent landscape planting under the mitigation measures	DBO Contractor	Entire construction site	Restoration and Aftercare phases	

**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<b>Landscape and Visual Impact</b>							
<b>Construction and Operation Phases</b>							
S9	CH1	Preservation by Detailed Record for relevant sections of BP1 (Relevant sections to be determined by survey)	To provide detailed recording and creation of archival records of the cultural heritage resources before they are demolished;	DBO Contractor (must engage a qualified person to undertake the preservation by record)	Entire NENT Landfill Extension Site	Prior to the Construction Phase (AMO approval of Mitigation Measures obtained prior to the removal of the graves)	The preservation by Detailed Record must fulfill the following AMO requirements;  <i>Requirements for Recording of Grave Inscriptions;</i>  <i>Requirements for Cartographic Survey of Historic Graves;</i>  <i>Requirements for Photographic survey of Historic Graves</i>  <i>Requirements for Cartographic Survey of Section of Boulder Paths to be directly Impacted by the Project</i>  <i>Requirements of Photographic Survey of Section of Boulder paths to be Directly Impacted by the Project</i>
S9	CH2	Preservation by Detailed Record for Graves; G2, G4, G5, G6, G7, G8, G14, G15, G25, G26, G27, G29 and G30					
S9	CH3	Preservation by Detailed Record for relevant sections of BP2 (Relevant section to be determined by survey)					

**Environmental Mitigation Implementation Schedule**  
**NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<b>Ecology</b>							
<b>General Protection Measures:</b>							
S10	E1	Restriction of construction activities to the work areas that would be clearly demarcated.	To minimise environmental impacts and therefore potential ecological impacts within and near the construction site	DBO Contractor	Entire construction site	Construction Phase	Practice Note for Professional Persons (ProPECC), Construction Site Drainage (PN1/94)  Code of Practice on the Packaging, Labeling and Storage of Chemical Wastes, EPD (1992)  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. 15/2003 Waste Management on Construction Sites
S10	E2	Resinstatment of the work areas immediately after completion of the works.					
S10	E3	Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme.					
S10	E4	Machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum.					
S10	E5	Plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs.					
S10	E6	Silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works.					
S10	E7	Mobile plant should be sited as far away from NSRs as possible and practicable.					
S10	E8	Material stockpiles, site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.					
S10	E9	Use of "quiet" plant and working methods.					
S10	E10	Construction phase mitigation measures in the Practice Note for Professional Persons on Construction Site Drainage.					



**Environmental Mitigation Implementation Schedule  
NENT Landfill Extension**

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
<b>General Protection Measures (Cont'd) :</b>							
S10	E11	Design and set up of the temporary on-site drainage system will be undertaken by the contractor prior to the commencement of construction.	To minimise environmental impacts and therefore potential ecological impacts within and near the construction site	DBO Contractor	Entire construction site	Construction Phase	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
S10	E12	Design and incorporation of silt/sediment traps in the permanent drainage channels to enhance deposition rates and regular removal of reposit silt and grit.					
S10	E13	Minimization of surface excavation works during the rainy seasons (April to September), and in particular, control of silty surface runoff during storm events, especially for areas located near steep slopes.					
S10	E14	Regular inspection and maintenance of all drainage facilities and erosion and sediment control structures to ensure proper and efficient operation at all times and particularly following rainstorms.					
S10	E15	Provision of oil interceptors in the drainage system downstream of any oil/fuel pollution sources.					
<b>Specific Mitigation Measures:</b>							
S10	E17	Survey and transplantation of the four plant species of conservation interest before site clearance, including <i>Aquilaria sinensis</i> , <i>Rhododendron simsii</i> , <i>Endospermum chinense</i> , and <i>Arundina graminifolia</i> .	To minimise loss of plant species of conservation interest	DBO Contractor	Within and near construction site	Before commencement of construction phase	N/A
S10	E18	10-year ecological monitoring of compensatory woodland planting during the restoration and after-care phases	To mitigate loss of woodland habitats	DBO Contractor	Entire construction site	Restoration and Aftercare phase	N/A

APPENDIX D

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**A Sample List of VOC  
Monitoring Parameters**

Subject to further agreement between the DBO contractor and EPD, the following VOC parameters shall be considered for surface gas emission monitoring:

- 1\_1\_1-Trichloroethane
- 1\_2-Dichloroethane
- Butanethiol
- Carbon Tetrachloride
- Dimethyl Sulfide
- Ethanol
- Ethyl Propionate
- Methanethiol
- Xylenes
- n-Butyl Benzenes
- Nonane
- Undecane
- Terpenes
- Trichloroethylene
- 1\_2-Dibromoethane
- Benzene
- Butyl acetate
- Chloroform
- Dipropyl Ether
- Ethyl Benzene
- Limonene
- Methanol
- Methyl Propionate
- n-Decanes
- n-Octane
- Propyl Propionate
- Tetrachloroethylene
- Vinyl Chloride
- 1\_2-Dichlorobenzene
- Butan-2-ol
- Carbon Disulphide
- Dichlorodifluoromethane
- Ethanethiol
- Ethyl Butyrate
- Methane
- Methyl Butyrate
- Methylene Chloride
- n-Heptane
- Propyl Benzene
- Butanethiol
- Toluene




Other parameters such as temperature, wind speed and direction should also be collected during VOC sampling. In case there is any abnormality, special monitoring should be conducted. The monitoring result shall also be reviewed and verified by IC and IEC.

DRAWINGS





**LEGEND**

-  EXISTING LANDFILL
-  LANDFILL EXTENSION
-  LANDFILL EXTENSION WASTE BOUNDARY

Rev	Description	By	Date

Consultant  
**ARUP** 奧雅納工程顧問  
 Ove Arup & Partners Hong Kong Limited

Project title  
 Agreement No. CE 20/2004 (EP)  
 North-East New Territories (NENT)  
 Landfill Extension  
 Feasibility Study

Drawing title  
**LOCATION PLAN**

Drawing no.	24315/01/001	Rev.	-
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Checked	PM	Approved	YWW
Scale	1 : 20000 ON A3	Status	PRELIMINARY

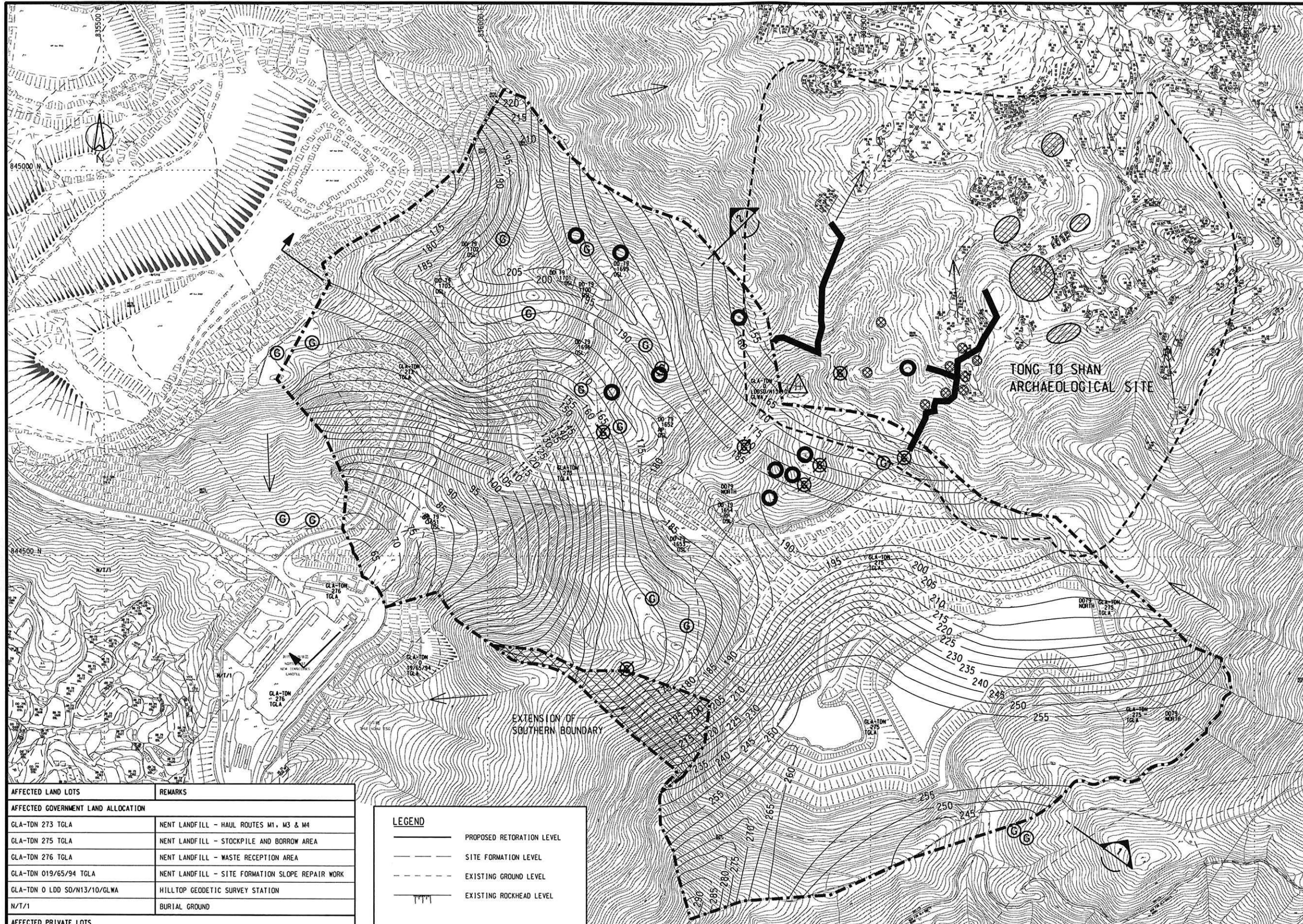
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**LEGEND**

- PROPOSED LANDFILL EXTENSION WASTE BOUNDARY
- - - TONG TO SHAN ARCHAEOLOGICAL SITE
- LOTS BOUNDARY
- BOULDER PATHS
- ⊗ STONE TERRACES
- ⊘ AREA WITH BUILDING REMAIN IDENTIFIED (2000 HKIA SURVEY)
- ⊙ EXISTING GRAVES
- ⊗ EXISTING GRAVES (ABANDONED)
- ⊙ NGONG TONG HISTORIC GRAVES
- △ HILTOP SURVEY STATION
- SURFACE WATER FLOW

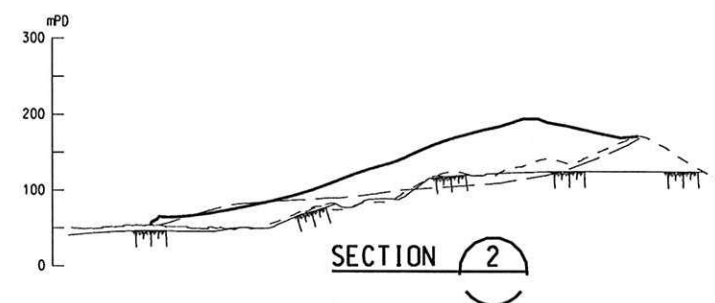
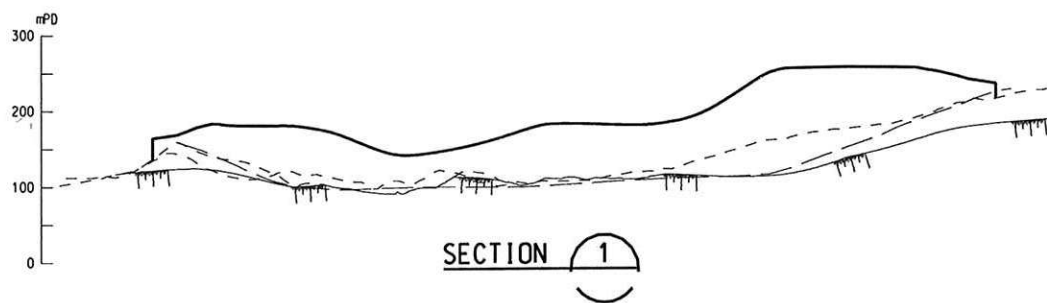
**OPTION 4**

- SITE AREA 63ha;
- MAX. LEVEL +255mPD;
- CUT VOLUME = 6.2Mm<sup>3</sup>;
- FILL VOLUME = 2.2Mm<sup>3</sup>;
- TOTAL LANDFILL VOLUME = 25.2Mm<sup>3</sup>;
- TOTAL WASTE CAPACITY = 21.4Mm<sup>3</sup>;
- TOTAL 20 GRAVES AFFECTED INCLUDING 9 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
<b>AFFECTED GOVERNMENT LAND ALLOCATION</b>	
GLA-TDN 273 TGLA	NENT LANDFILL - HAUL ROUTES M1, M3 & M4
GLA-TDN 275 TGLA	NENT LANDFILL - STOCKPILE AND BORROW AREA
GLA-TDN 276 TGLA	NENT LANDFILL - WASTE RECEPTION AREA
GLA-TDN 019/65/94 TGLA	NENT LANDFILL - SITE FORMATION SLOPE REPAIR WORK
GLA-TDN 0 LDD SD/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
<b>AFFECTED PRIVATE LOTS</b>	
DD79 1651 OSL	TO BE RESUMED
DD79 1652 RP OSL	TO BE RESUMED
DD79 1653 OSL	TO BE RESUMED
DD79 1654 RP OSL	TO BE RESUMED
DD79 1696 OSL	TO BE RESUMED
DD79 1699 OSL	TO BE RESUMED
DD79 1700 OSL	TO BE RESUMED
DD79 1701 OSL	TO BE RESUMED
DD79 1702 OSL	TO BE RESUMED
DD79 1703 OSL	TO BE RESUMED

**LEGEND**

- PROPOSED RETORATION LEVEL
- - - SITE FORMATION LEVEL
- EXISTING GROUND LEVEL
- EXISTING ROCKHEAD LEVEL



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 Agreement No. CE 20/2004 (EP)  
 North-East New Territories (NENT)  
 Landfill Extension  
 Feasibility Study

Drawing title  
**LANDFILL EXTENSION  
 LAYOUT OPTION 4**

Drawing no.  
**24315/01/107**

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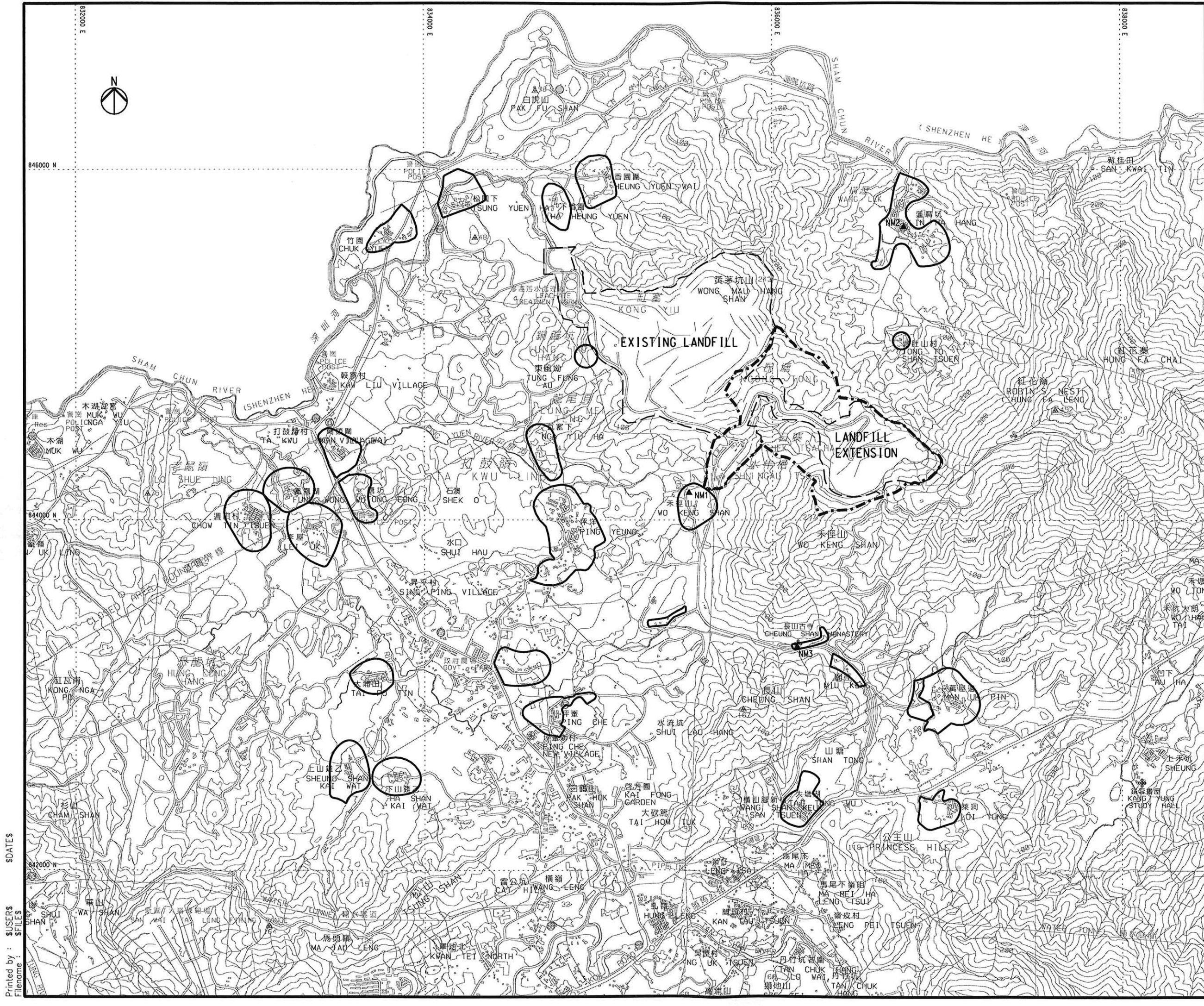
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**LEGEND**

-  EXISTING LANDFILL
-  LANDFILL EXTENSION
-  VILLAGE BOUNDARIES
-  ▲ NMI NOISE MONITORING LOCATION

Rev	Description	By	Date

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Project title  
 Agreement No. CE 20/2004 (EP)  
 North-East New Territories (NENT)  
 Landfill Extension  
 Feasibility Study

Drawing title  
**NOISE MONITORING LOCATION**

Drawing no.	24315/13/251	Rev.	-
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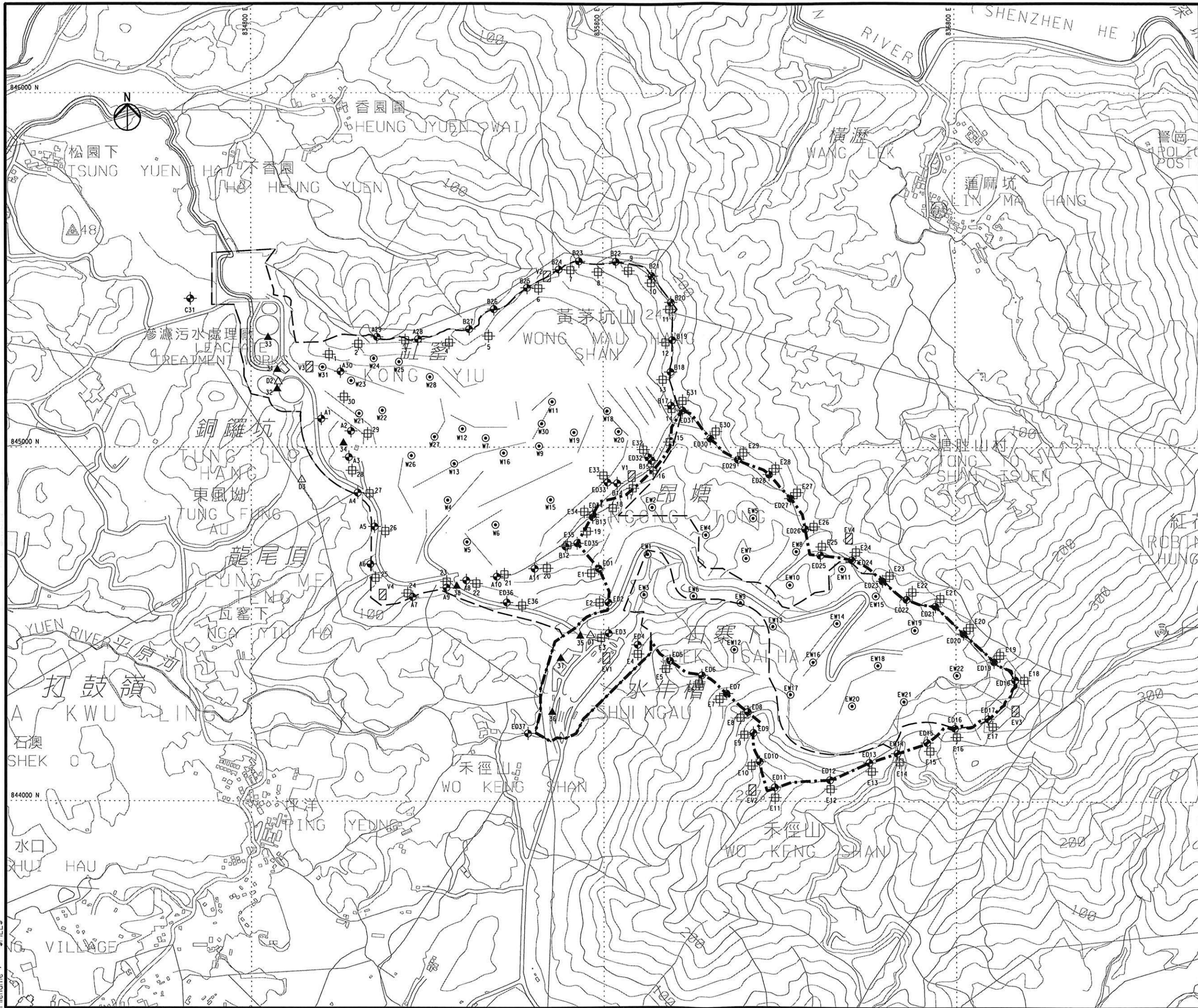
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- LEGEND**
- EXISTING LANDFILL
  - LANDFILL EXTENSION
  - FIXED LOCATIONS FOR BOREHOLES FOR GROUNDWATER MONITORING  
EXISTING A1-C31  
PROPOSED ED1-ED37
  - FIXED LOCATIONS FOR SURFACE GAS  
EXISTING MONITORING 1-30  
PROPOSED E1-E36
  - FIXED OFF-SITE LOCATION FOR VOCs  
EXISTING V1-V4  
PROPOSED EV1-EV4
  - FIXED LOCATIONS FOR CAVITIES, MANHOLES  
EXISTING 31-38
  - FIXED LOCATIONS FOR GAS WELLS  
EXISTING W1-W30  
PROPOSED EW1-EW22
  - FIXED LOCATIONS FOR DUST MONITORING  
EXISTING D1-D3

Rev	Description	By	Date

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Project title  
 Agreement No. CE 20/2004 (EP)  
 North-East New Territories (NENT)  
 Landfill Extension  
 Feasibility Study

Drawing title  
**EXISTING LANDFILL AND  
 LANDFILL EXTENSION  
 MONITORING PLAN**

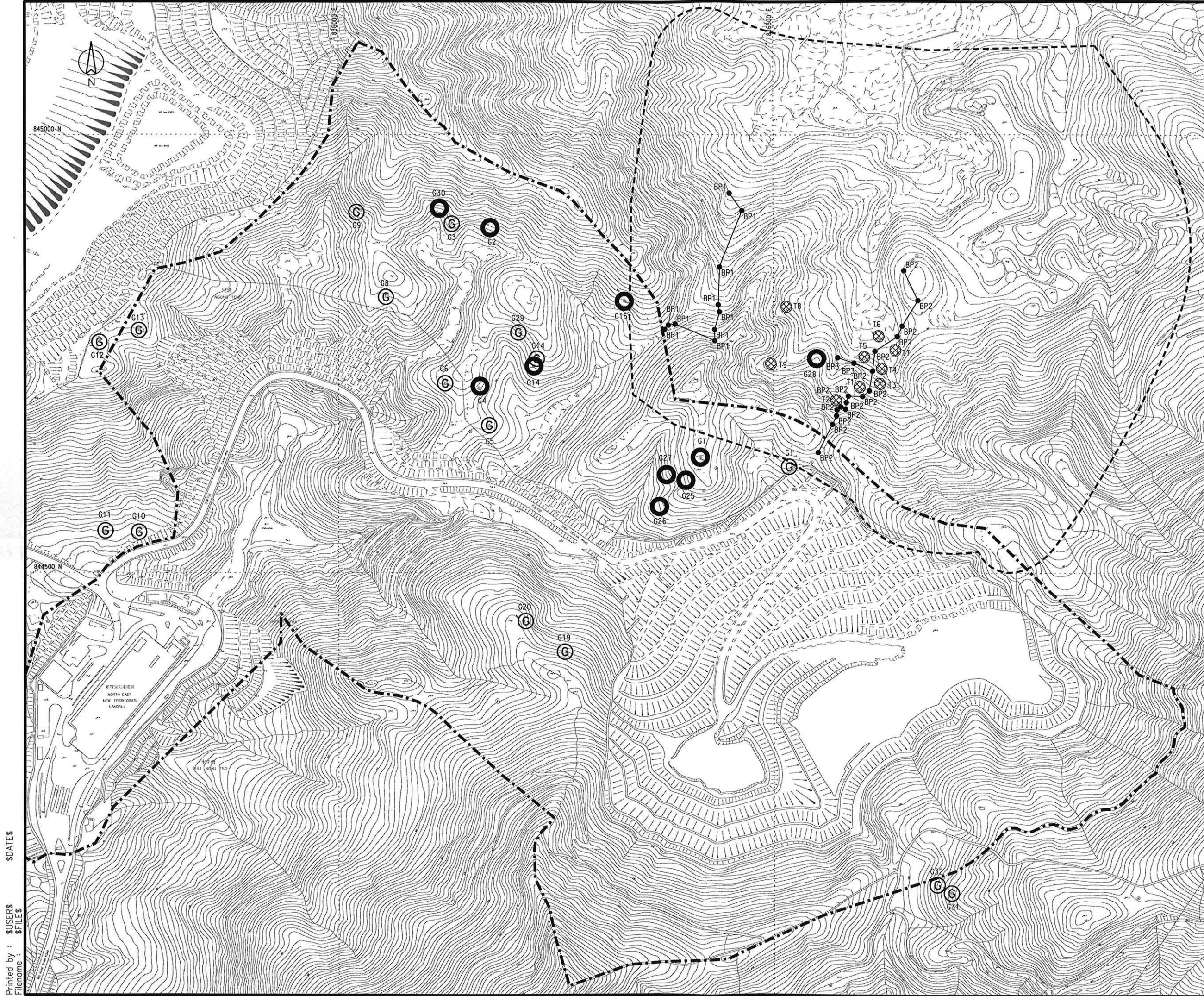
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- LEGEND**
- PROPOSED LANDFILL EXTENSION
  - TONG TO SHAN SETTLEMENT DISTRICT
  - EXISTING GRAVES
  - NGONG TONG HISTORIC GRAVES
  - BOULDER PATH
  - BOULDER TERRACES

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Drawing title  
**ARCHAEOLOGICAL FINDINGS**

Drawing no. <b>24315/13/606</b>		Rev. -	
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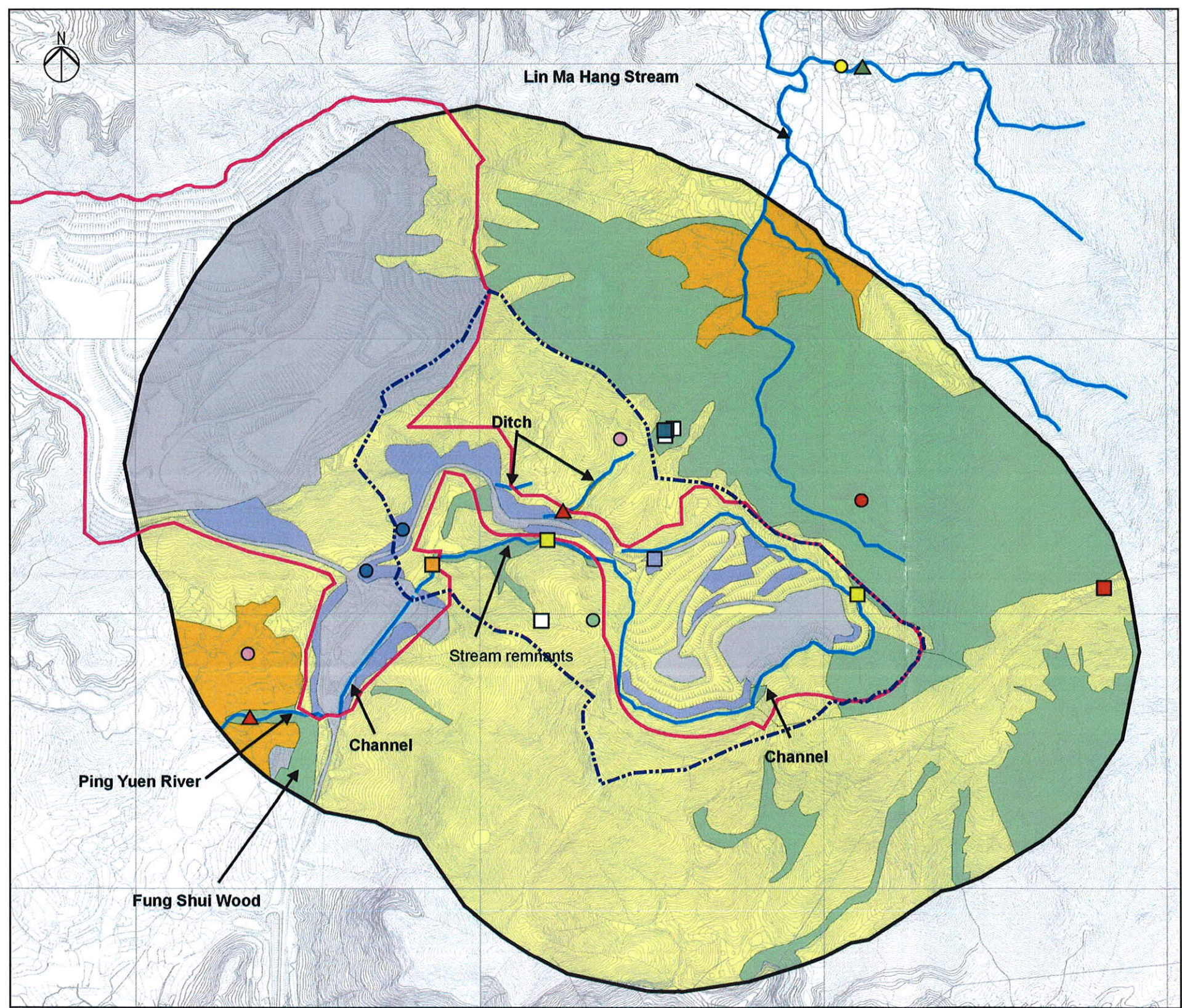
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**LEGEND**

- Proposed Landfill Extension Waste Boundary
- Existing Landfill
- 500 m boundary
- Stream/Channel/Ditch
- Native Woodland
- Abandoned Agriculture
- Grassland with low shrub
- Plantation Woodland
- Urbanised/Disturbed
- Endospermum chinense
- Rhododendron simsii
- Spathoglottis pubescens
- Arundina graminifolia
- Aquilaria sinensis
- Pavetta hongkongensis
- Collared Scops Owl
- Emerald Dove
- Greater Coucal
- Chinese Bullfrog
- Yellow Coster
- Rasbora steineri & Cryptopotamon anacoluthon
- Somanniathelphusa zanklon

Rev	Description	By	Date

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Project title  
 Agreement No. CE 20/2004 (EP)  
 North-East New Territories (NENT)  
 Landfill Extension  
 Feasibility Study

Drawing title  
**HABITAT MAP LOCATION OF SPECIES OF CONSERVATION INTEREST OVERLAID WITH OPTION 4**

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