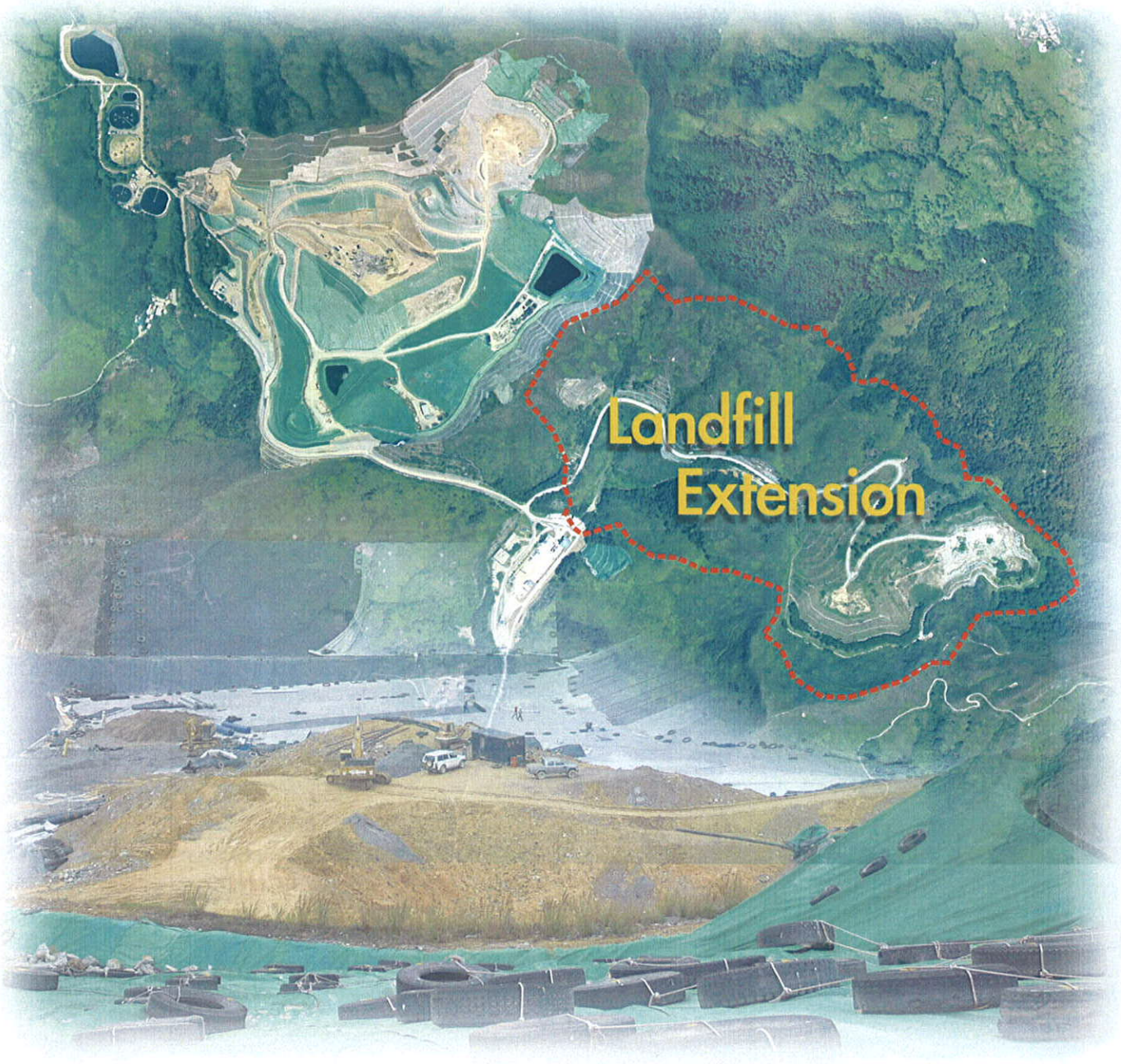
環境保護署
Environmental Protection Department

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 Impact Assessment Executive Summary



May 2007

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Contents

Drawings

Appendices

1 Introduction

1.1 Project Background

1.1.1 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.

1.1.2 At time of commissioning, the three landfills with a total capacity in the order of 140 Mm^3 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.

1.1.3 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.

1.1.4 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^3. 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. **Drawing No. 24315/01/005** depicts the general topography at/around the extension site, showing that it is generally in the form of a bowl bounded by Robin's Nest and Wo Keng Shan.

1.1.5 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 EIA Study Objective

1.2.1 The purpose of this EIA Study is to provide information on the nature and extent of environmental impacts arising from the construction, operation, restoration and aftercare stages of the NENT Landfill Extension, and to contribute to decisions on the overall acceptability of the Project, after the implementation of environmental mitigation measures.

1.2.2 The NENT Landfill Extension is a Designated Project under Schedule 2, G.1, of the EIAO : "A landfill for waste as defined in the Waste Disposal Ordinance (Cap. 354)". The EIA study, undertaken under the NENT Landfill Extension Feasibility Study, has therefore been carried out in strict accordance with the EIAO, including the requirements stipulated in EIA Study Brief No. ESB-114/2004 issued under the EIAO.

1.2.3 This Executive Summary serves to summarise the key points of the EIA Study.

1.3 General Description of Project

1.3.1 **Drawing No. 24315/01/001** shows the location of the Project site. 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.

1.4 Project Programme

1.4.1 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.

1.4.2 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 talling 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.

1.4.3 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.

1.4.4 Even though there will not be any overlapping in operation between the Landfill Extension and the Existing Landfill, the two contracts will still overlap in other terms.

1.4.5 Clearly the initial development (notably the initial site formation) for the NENT Landfill Extension will overlap and hence interface with the final operational period of the Existing NENT Landfill as well as part of its restoration & aftercare, whereas the early operation period of the NENT Landfill Extension plus continuation of its development works will overlap/interface with the remaining restoration of the existing landfill and the main part of its aftercare.

1.4.6 A tentative outline programme for implementation of the NENT Landfill Extension is shown in **Appendix A**. As pointed out in 1.4.1 above, the exact timing of the various activities may vary, depending on actual volume of waste to be delivered in the forthcoming years.

2 CONSIDERATION OF ALTERNATIVES

2.1 Alternative Extension Layout

In working out the most desirable layout for NENT Landfill Extension, a number of layout options were formulated, evaluated and then compared, based on various evaluation criteria and an evaluation framework agreed with relevant stakeholders in advance.

The key issues and constraints identified during the course of study were taken into account in formulation of landfill extension layout options. A total of 4 broad options (as well as related sub-options) were thoroughly evaluated and discussed at a Value Management Workshop, attended by relevant stakeholders. Key features of the various options are recapitulated below.

2.1.1 Broad Layout Option 1

Option 1

Option 1 adopts a similar rationale as the proposed conforming scheme in the EPD's preliminary study under "Agreement No. CE45/99, Extension of Existing Landfills and Identification of Potential Waste Disposal Sites, Final Strategic Environmental Assessment Report". It achieves a landfill capacity of 17Mm^3, and infringes a minor part of the Tong To Shan Archaeological Site (TTSAS). The area of built heritage affected will only be limited to the secondary features of boulder paths and boulder terraces. The main archaeological features will be untouched (see **Drawing No. 24315/01/101** for layout). The key parametric indicators of this option are outlined below in Table 2.1.

Table 2.1: Summary of Option 1

Waste receiving area	60 ha
Maximum fill level	+245 mPD
Site formation complexity	Cut volume 5.9 Mm^3, Fill volume 2.3 Mm^3
Landfill capacity	17.4 Mm^3

Option 1a

Option 1a is similar to Option 1 except with the slight extension to the southern boundary and the increase in fill level to meet the target landfill capacity of 19Mm^3. The design is achieved by raising the eastern part of the landfill extension by approximate 10m relative to the original design to reach a maximum level of +255mPD (see **Drawing No. 24315/01/102**). The maximum height of the adjacent Wo Keng Shan is about +297mPD. It is envisaged that the visual impact due to a 10m raise would be insignificant. The key parametric indicators of this option are outlined in Table 2.2.

Table 2.2: Summary of Option 1a

Waste receiving area	61 ha
Maximum fill level	+255 mPD
Site formation complexity	Cut volume 6.0 Mm^3, Fill volume 2.2 Mm^3
Landfill capacity	20.2 Mm^3

Option 1b

Option 1b is derived based on Options 1 and 1a, with the same encroachment to TTSAS, to further increase the landfill capacity. The design is achieved by the slight extension to the south boundary and the increase in fill level to +300mPD (see **Drawing No. 24315/01/103)**. This roughly matches with the maximum elevation of +297mPD of the adjacent Wo Keng Shan. The key parametric indicators of this option are outlined in Table 2.3.

Table 2.3: Summary of Option 1b

Waste receiving area	61 ha
Maximum fill level	+300 mPD
Site formation complexity	Cut volume 6.0 Mm^3, Fill volume 2.2 Mm^3
Landfill capacity	25.2 Mm^3

2.1.2 Broad Layout Option 2

Option 2

Option 2 avoids the encroachment on TTSAS and keeps the peak level the same as Option 1 (i.e. +245mPD). This will reduce the actual landfill capacity to 16.8Mm^3 (see **Drawing No. 24315/01/104**). The key parametric indicators of this option are outlined in Table 2.4.

Table 2.4: Summary of Option 2

Waste receiving area	55 ha
Maximum fill level	+245 mPD
Site formation complexity	Cut volume 4.7 Mm^3, Fill volume 2.0 Mm^3
Landfill capacity	16.8 Mm^3

Option 2a

Similar to Option 2, Option 2a also avoids the encroachment on TTSAS and again falls short of meeting the target capacity of 19Mm^3. The design deviates from Option 2 by raising the eastern part of the landfill extension by approximate 10m to reach a maximum level of +255mPD (see **Drawing No. 24315/01/105**). The key parametric indicators of this option are outlined in Table 2.5.

Table 2.5: Summary of Option 2a

Waste receiving area	55 ha
Maximum fill level	+255 mPD
Site formation complexity	Cut volume 4.7 Mm^3, Fill volume 2.0 Mm^3
Landfill capacity	18.4 Mm^3

2.1.3 Broad Layout Option 3

Archaeological survey conducted on the site has identified a number of large graves in the heart of the landfill extension. Option 3 is developed with extensive reinforced earth wall at the northern boundary to avoid the need for clearance of these existing large graves (**Drawing No. 24315/01/106**). The landfill capacity will however be reduced to only 11.1Mm^3. The key parametric indicators of this option are outlined in Table 2.6.

Table 2.6: Summary of Option 3

Waste receiving area	50 ha
Maximum fill level	+245 mPD
Site formation complexity	Cut volume 3.7 Mm^3, Fill volume 2.8 Mm^3
Landfill capacity	11.1 Mm^3

2.1.4 Broad Layout Option 4

Option 4 is developed with the northwestern and southeastern boundary extended to reach the ridgeline to maximize the landfill capacity. The northern boundary is also set back to minimize the impact to woodland (see **Drawing No. 24315/01/107**). The landfill capacity can achieve 21.4Mm^3 while encroachment on the Lin Ma Hang catchment can be totally avoided. The key parametric indicators of this option are outlined in Table 2.7.

Table 2.7: Summary of Option 4

Waste receiving area	63 ha
Maximum fill level	+255 mPD
Site formation complexity	Cut volume 6.2 Mm^3, Fill volume 2.2 Mm^3
Landfill capacity	21.4 Mm^3

2.2 Selection of Preferred Option

2.2.1 These options were evaluated / assessed in accordance with the following factors and main criteria:

- Waste management needs of 19Mm^3 capacity for the NENT Landfill Extension scheme;
- Engineering considerations including site formation complexity, constructability, drainage impact and maintenance;
- Environmental issues such as air quality, noise, water quality, waste management, landfill gas hazard, landscape and visual, cultural heritage, ecology, etc;
- Social issues such as afteruse flexibility, cost of disposal, land resumption and graves clearance.

2.2.2 Amongst the three options in Broad Layout Option 1, Option 1a is the most preferred. Similarly, Option 2a is the most preferred option under Broad Layout Option 2. Accordingly, Option 1a and Option 2a were therefore directly compared with Option 3 and Option 4 on different areas, so as to arrive at the most favourable layout for NENT Landfill Extension.

2.2.3 Waste Management Needs

Options 1a and 4 achieving the target waste capacity of 19Mm^3 are thus considered as preferred options.

2.2.4 Engineering Viability

Option 2a and 3 with relatively long reinforced earth wall that would impose difficulties in site formation phasing is less preferred among the options. Option 1a that would pose drainage impact on downstream of Lin Ma Hang Stream and Ping Yuen River is also not preferable though it has the shortest reinforced earth wall and associated drainage system for maintenance.

2.2.5 Environmental Protection

Options 2a, 3 and 4 are preferred options from environmental point of view as they do not have water quality impact on Lin Ma Hang Stream. Option 2a and 3 have samller scale of woodland loss. Other environmental considerations such as landscape, visual, air, noise and landfill gas are similar for the four options.

2.2.6 Social and Community Impacts

Option 1a encroaches into Tong To Shan Archaeological Site and it need substantial land resumption. Option 3 resulting in the highest unit disposal cost is considered not preferred though it affects the least number of graves. Options 1a and 4 with larger landfill area are preferred in terms of flexibility for afteruse.

2.2.7 Among the four options, Option 4 was evaluated as the most preferred option as it acquires high rank in most of the aspects. See Drawing No. 24315/01/107 for the layout of Option 4.

2.3 Alternative Construction Methods and Sequences of Works

2.3.1 Different construction methodology and sequences of works were studied, giving careful consideration on environmental impacts including noise, ecology, cultural heritage, etc.

2.3.2 It is recommended to adopt a balanced cut-and-fill site formation for constructing the landfill bowl within the existing valley. This will optimise the reuse of excavated materials, i.e. to minimise import or export of materials. The process involves temporarily stockpiling of excavated materials on site for use as daily cover during the operational stage and final capping during the restoration stage. This will reduce construction materials / waste to be delivered to public fill bank. In addition, daily cover and temporary cover will be provided to reduce potential impact on air and water qualities during the operational stage of the Project.

2.3.3 The NENT Landfill Extension will be developed in three phases to allow progressive use of the overall landfill area. Each phase will be constructed, operated and restored at a rate dependent on the delivery of waste. Simultaneous construction, operation and capping activities will therefore occur in different parts of the site.

2.3.4 Alternative construction methods such as blasting have also been evaluated but found to be not desirable from an engineering perspective. The balancing of cut-

and-fill limits the usable area of the landfill site and therefore the amount of stockpiled materials. Blasting will generate a significantly larger volume of excavated and stockpiled materials, and the usable area of the landfill site will be much reduced. There is also a safety concern if blasting is conducted in close proximity to the tipping area, as refuse collection vehicles and operators might be at risk if the buffer distance provided is not sufficient.

3 SUMMARY OF KEY FINDINGS IN EIA STUDY

3.1 Air Quality

3.1.1 Construction dust modelling results show that there would be no adverse construction dust impact on the Air Sensitive Receivers (ASRs) in the vicinity of the Project site. Good site practices throughout the construction period are recommended to further eliminate any dust problem.

3.1.2 Dispersion modelling results show that gaseous emissions from ammonia stripping plant, LFG power generator and flaring system of the NENT Landfill Extension would have no adverse impact on the ASRs throughout the operational period of the Project. The maximum allowable discharge limits from the above facilities should be specified in contract specifications to control air emissions. Regular emission monitoring of these facilities is recommended to ensure their proper functioning.

3.1.3 Odour assessment results show that there would be no adverse impact on the ASRs during the operational period of the Project, except the derelict and vacant Tong To Shan Tsuen. Residual impact at Tong To Shan Tsuen is considered to be very scarce and transient in nature and can be mitigated with good site practices (including application of thicker daily cover / alternative daily cover, progressive restoration for inactive tipping face), as well as periodic odour patrol should be carried out during active tipping period. In case the weather condition is poor (stable and calm weather), tipping should be arranged at an upwind location as far as practicable, and/or thicker daily cover / alternative daily cover should be applied subject to EM&A programme.

3.1.4 The scale of construction activities during the restoration and aftercare stages of the Project will be small when compared with the construction phase. Construction dust is therefore not anticipated to be an issue. The impact of stack gas emissions from treatment facilities will be much reduced during these stages given the gradual reduction in leachate and LFG generation rates over time. Odour in restored landfill will not be a concern. Air quality will not be worse than during the operational phase and hence no adverse impact is anticipated.

3.1.5 Requirements for regular monitoring of dust concentration, gas emission and odour are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.2 Noise

3.2.1 The assessment has been conducted based on daytime noise criteria specified in the TM-EIAO. It is predicted that the construction noise impacts associated with the construction activities on the Project site would not exceed the criteria. No adverse construction noise impact is anticipated.

3.2.2 Road traffic noise at Wo Keng Shan Road has been assessed to be insignificant. Noise assessment results indicate that road traffic noise levels will comply with the noise criterion. Residual road traffic noise impact is therefore not anticipated.

3.2.3 Assessment results also indicate that under the "unmitigated" scenario, the operational noise impact will comply with the noise criteria during the early stage of tipping when the topography screening effect is adequate. For the later stage of tipping when the topography is insufficient to screen the noise impact, assessment results indicate that the predicted noise levels at 2 sensitive receivers will exceed the noise criterion. With the adoption of quiet plants, operational fixed noise impacts will be controlled to within the noise criterion.

3.2.4 Requirements for regular monitoring of noise monitoring are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.3 Water Quality

3.3.1 With proper implementation of construction site runoff control measures, adverse water quality impact during construction phase is not anticipated. No overflow or discharge of raw leachate, treated leachate and contaminated surface runoff from the tipping face to Ping Yuen River and its tributaries will be allowed under any circumstances.

3.3.2 The rate of leachate seepage is potentially 0.06 litres per hectare per day, which is considered to be insignificant. If there were accidental leakage of leachate, the Contingency Plan on Accidental Leakage of Leachate (including active pumping of leakage from leachate and groundwater collection layer to the on-site leachate treatment plant) would be implemented, and thus the impact on the groundwater quality would be insignificant.

3.3.3 Assessment results on groundwater flow impact show that the groundwater level beneath the site may potentially fall by 1.5m over the operational lifetime of the landfill extension. Ground water levels at Wo Keng Shan could fall by 0.5m to 1m over the operational lifetime of the landfill extension whereas a drop of 0.6m can be expected at Ping Yeung over the same period. However, it should be noted the groundwater table downstream will be recharged by adjacent catchments and therefore the potential impact predicted above would be conservative. A number of measures to mitigate the potential loss of groundwater yields have also been proposed in the EIA Report (including provision of water supply for irrigation to affected downstream villages). The draw down of groundwater level will not induce insurmountable water quality impact.

3.3.4 The amount of leachate generated from the NENT Landfill Extension has been estimated. The average peak leachate generated from both landfills is estimated to be 1,200m^3/day, which is within the treatment capacity of the existing leachate treatment plant. The maximum peak leachate generated from both landfills during a severe storm event is estimated to be 1,500 m^3/day, and new temporary storage lagoons will be constructed to store the additional leachate (under severe storm event during the peak operation life) for further treatment. It is therefore concluded that no adverse impact on the downstream sewerage network is expected.

3.3.5 Sewage will be generated by workforce on site throughout the construction, operation, restoration and aftercare stages. Adverse impact is not anticipated as both portable toilets and permanent toilets at the site office will be provided to collect all sewage generated.

3.3.6 Given that the NENT Landfill Extension will only be in operation after the closure of the existing NENT Landfill, no cumulative water quality impact due to the construction / operation of the two landfills will occur. Nonetheless, cumulative impact will occur when restoration in existing landfill and operation in the landfill extension take place concurrently. As the two landfills fall into different drainage catchments (NENT Landfill Extension falls within Ping Yuen River Catchment while the existing NENT Landfill falls within Kong Yiu River Catchment), with the proper implementation of leachate management system as proposed in the EIA Report, no adverse cumulative impact is anticipated.

3.3.7 Requirements for regular monitoring of groundwater, surface water and leachate are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.4 Waste Management

3.4.1 The waste management assessment has reviewed the potential impacts from various types of wastes generated from the construction, operation, restoration and aftercare stages of the NENT Landfill Extension. Through the analysis of the Project activities, the quantity, quality and timing of waste arising have been identified, including excavated materials from site preparation, chemical waste arising from maintenance of plant and equipment, general waste from daily activities, and sludge from leachate treatment plant. By adopting a material

balance approach (e.g. balance cut-and-fill in site formation design, and with the appropriate mitigation measures in place, no adverse environmental impact is anticipated.

3.4.2 Waste control and monitoring are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.5 Landfill Gas

3.5.1 The results of this qualitative risk assessment for LFG hazards associated with the construction, operation, restoration and aftercare stages indicate that the overall risks to the receivers within the NENT Landfill Extension would be categorised as 'High' and that to the receivers outside the NENT Landfill Extension would be 'Medium'. Systems for continuous surface gas monitoring and active gas extraction will be in place for the NENT Landfill Extension. The sensitive receivers falling within the newly proposed 250m consultation zone shall 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 would be anticipated.

3.5.2 Requirements for regular monitoring of landfill gas monitoring are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.6 Landscape and Visual

3.6.1 The NENT Landfill Extension consists mainly the Stockpile and Borrow Area and haul roads of the existing NENT Landfill. Furthermore, the existing NENT Landfill is located immediately adjoining to the northwest of the landfill extension. The existing landscape resources and characters of the landfill extension are therefore deteriorated by both the existing NENT Landfill and its Stockpile and Borrow Area.

3.6.2 In terms of residual landscape impact, it is concluded that with implementation of mitigation measures, the NENT Landfill Extension will have slight impact to the upland landscape at the northwest facing slope of Wo Keng Shan and moderate impact to rural settlement Landscape of Tong To Shan Tsuen & Ngong Tong. Furthermore, it is assessed that there will be slight to moderate residual impact to the woodland and slight residual impact to shrubland and grassland within the Project site. The lost of 1.5 ha of existing woodland and 5.8 ha of shrubland will be compensated by 26.83 ha of woodland mix progressively planted in phases with about 148,100 nos. of tree seedlings / whips. In addition, 19 ha of shrubland mix planting and 17.55 ha of grassland will be created in the restoration phase of the NENT Landfill Extension.

3.6.3 The existing NENT Landfill site, its Stockpile and Borrow Area and the proposed NENT Landfill Extension will affect the same sets of visual sensitive receivers in view of their proximity to each other. It is noted that the landscape character of the NENT Landfill Extension will be similar to that of the existing landfill and its associated Stockpile and Borrow Area. In terms of residual visual impact, the extension site will have slight impact to the majority of the identified visual sensitive receivers. Moderate to significant impact is expected to hikers at the top of Robin's Nest, whereas moderate impact is expected to visual sensitive receivers at Lin Ma Hang and to potential future users at the existing NENT Landfill during its aftercare period.

3.6.4 The proposed landfill extension will be restored and vegetated to match with its surrounding landform and vegetation patterns in the restoration and aftercare stages. In summary, the overall landscape and visual impact of the Project is acceptable with mitigation measures implemented.

3.6.5 Requirements for landscape and visual monitoring are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.7 Cultural Heritage

3.7.1 The construction activities associated with the site formation for the NENT Landfill Extension will not impact on any areas containing archaeological potential. Archaeological resources identified as part of the Tong To Shan Archaeological Site in previous investigations are located outside of the extension boundary and will not be impacted by the construction works.

3.7.2 13 historical graves and two sections of boulder paths will be directly impacted by the construction activities of the proposed extension. Mitigation in the form of detailed preservation by record will be conducted prior to the commencement of the construction phase. The impacts on the Cultural Landscape Features associated with the Tong To Shan Archaeological Site will be minimal as the agricultural terraces and associated features, including the main sections of the boulder paths are all beyond the extension boundary.

3.7.3 With the implementation of mitigation measures, there will be no impacts to cultural heritage resources during construction, operation, restoration and aftercare stages of the NENT Landfill Extension.

3.7.4 Requirements of survey and preservation are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.8 Ecology

3.8.1 The NENT Landfill Extension consists of the existing Stockpile and Borrow Area and haul road of NENT Landfill. It covers 0.12 ha of abandoned agriculture land, 47.64 ha of grassland with low shrub, 4.01 ha of natural woodland, 4.76 ha of plantation, 6.89 ha of urbanised/disturbed land, and 2,530m of stream/channel habitats and its associated flora and fauna. In fact, the selected layout (Option 4) is one of the options that enable the NENT Landfill Extension to avoid Lin Ma Hang Stream and its catchment completely. The existing grassland and woodland are largely disturbed by the construction activities in the existing Stockpile and Borrow Area. The overall ecological impacts are ranked as moderate and would be mitigated by compensatory planting and good site practice.

3.8.2 Potential ecological impacts caused by LFG and leachate are considered minor. With adoption of the proposed leachate and landfill gas collection facilities and contingency plans, no residual impacts are anticipated.

3.8.3 Upon completion of operation, the landfill site would be restored by planting of woodland, shrubland and grassland species, and the surface flow of Ping Yuen River would be restored. No adverse ecological impact to the surrounding terrestrial and aquatic habitats and their associated flora and fauna is anticipated.

3.8.4 Requirements for ecological monitoring are detailed in the Environmental Monitoring and Audit (EM&A) programme.

3.9 Environmental Monitoring and Audit (EM&A)

3.9.1 Environmental monitoring and audit (EM&A) requirements have been specified in an EM&A Manual. The EM&A Manual contains full details of proposed baseline and compliance monitoring programme, as well as performance specifications, audit requirements and monitoring procedures.

4 Overall Conclusion

An EIA Report has been prepared to satisfy the requirements as specified in the EIA Study Brief No ESB-114/2004 and the TM-EIAO. All the latest design information has been incorporated into the EIA process. The aspects that have been considered in this EIA Report include:

- Layout option evaluation;
- Description of construction, operational and aftercare activities;
- Air quality impact;
- Noise impact;
- Water quality impact;
- Waste management implications;
- Landfill gas hazards;
- Landscape and visual impact;
- Impact on cultural heritage;
- Ecological impact;
- EM&A requirements.

Overall, the EIA Report has predicted that the Project would be environmentally acceptable with the implementation of the proposed mitigation measures for construction and operation phases. An environmental monitoring and audit programme has been recommended to ensure the effectiveness of recommended mitigation measures.

DRAWINGS

Rev	Description	By	Date

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

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Feasibility Study

Drawing title
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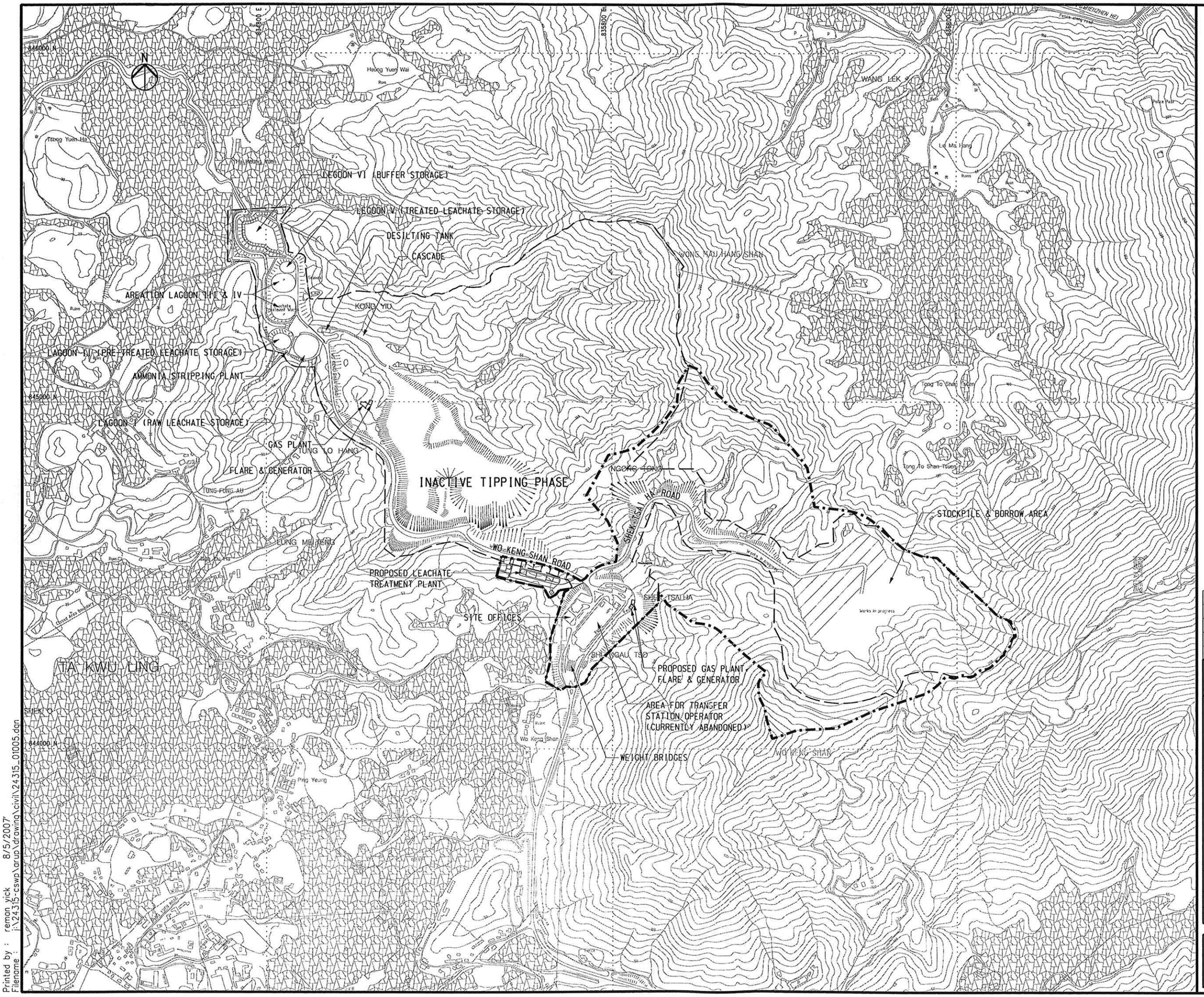

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EXISTING NENT LANDFILL AND PROPOSED LANDFILL EXTENSION

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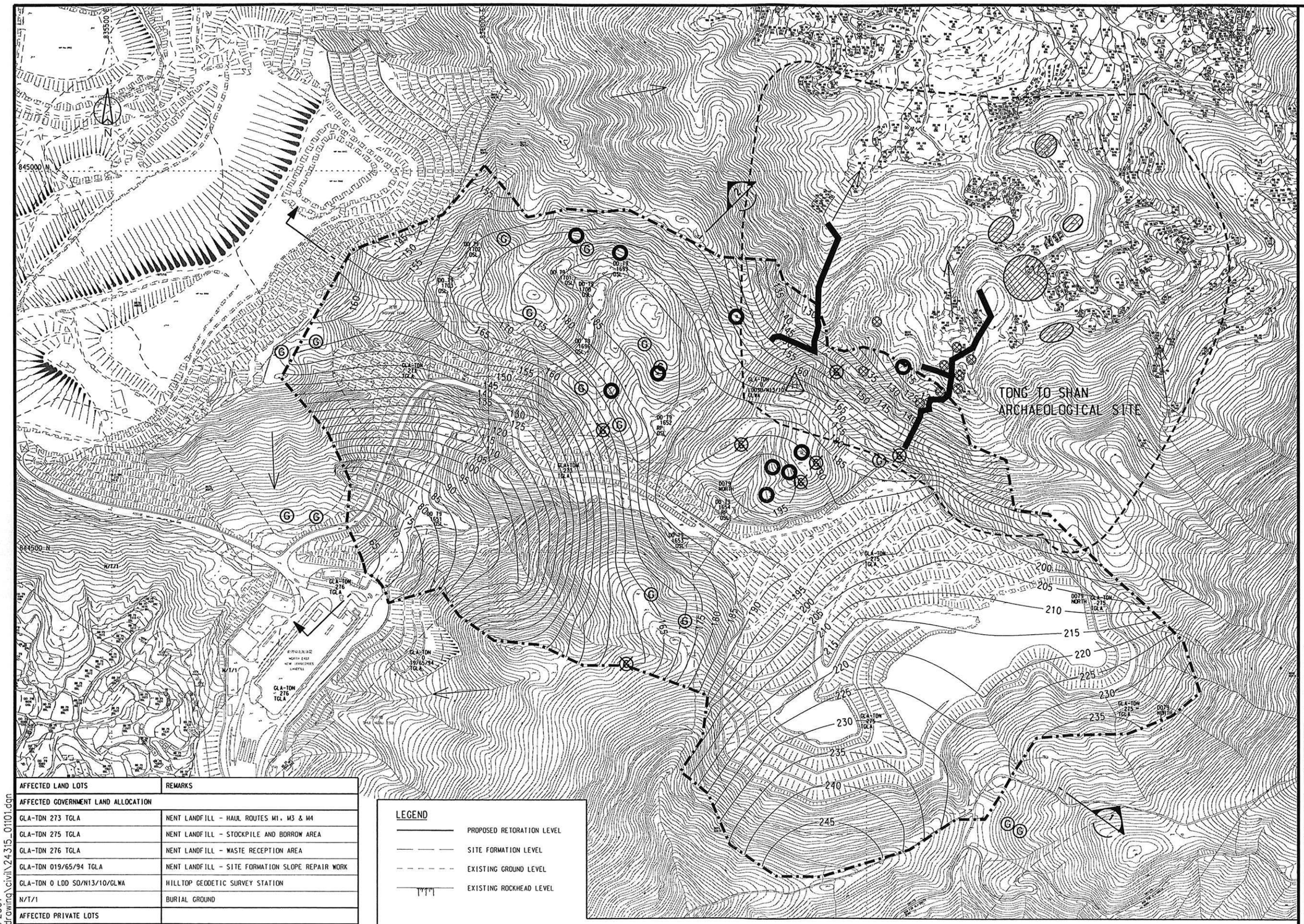


LEGEND

- 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

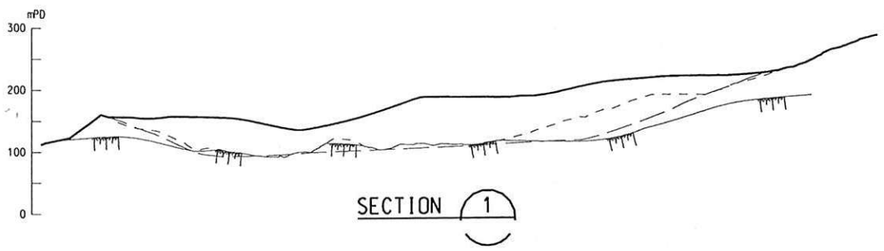
OPTION 1

- SITE AREA 60ha;
- MAX. LEVEL +245mPD;
- CUT VOLUME = 5.9Mm^3;
- FILL VOLUME = 2.3Mm^3;
- TOTAL LANDFILL VOLUME = 21.0Mm^3;
- TOTAL WASTE CAPACITY = 17.4Mm^3;
- TOTAL 21 GRAVES AFFECTED INCLUDING 10 OLD GRAVES.

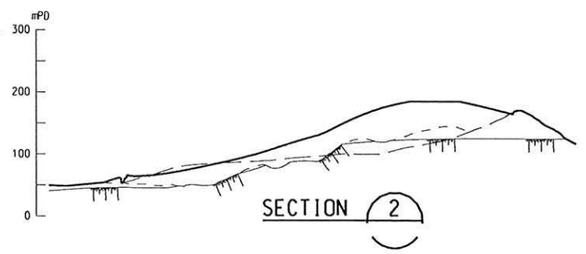
AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
GLA-TDN 273 TGLA	NENT LANDFILL - HAUL ROUTES M1, M3 & M4
GLA-TDN 275 TGLA	NENT LANDFILL - STOCKPILE AND BORROW AREA
GLA-TDN 276 TGLA	NENT LANDFILL - WASTE RECEPTION AREA
GLA-TDN 019/65/94 TGLA	NENT LANDFILL - SITE FORMATION SLOPE REPAIR WORK
GLA-TDN 0 LDD SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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



SECTION 1



SECTION 2

Rev	Description	By	Date

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

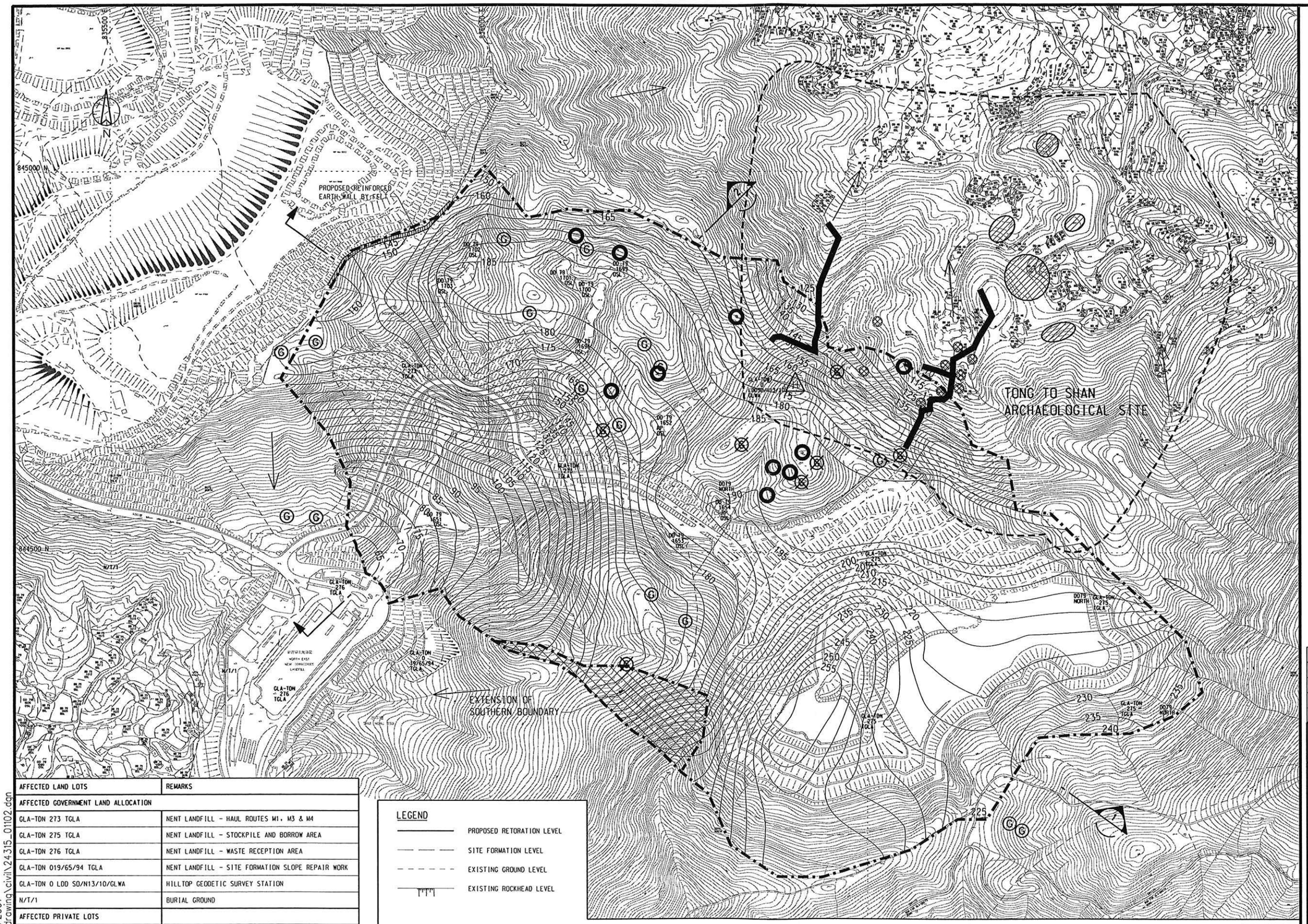
Project title
Agreement No. CE 20/2004 (EP)
North-East New Territories (NENT)
Landfill Extension
Feasibility Study

Drawing title
LANDFILL EXTENSION
LAYOUT OPTION 1

Drawing no.			Rev.
24315/01/101			-
Drawn	Date	Checked	Approved
RY	04/06	PW	YWY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

Printed by : reman yick 8/5/2007
Filename : i:\24315-cswp\arup\drawing\civil\24315_01101.dgn



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

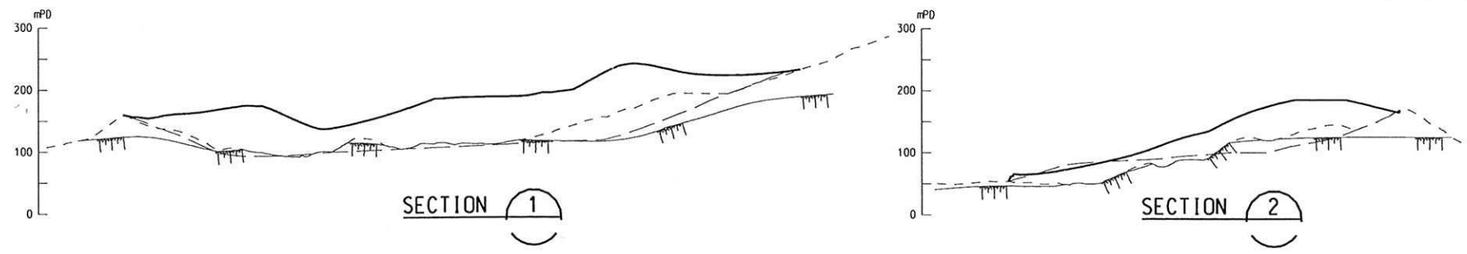
OPTION 1a

- SITE AREA 61ha;
- MAX. LEVEL +255mPD;
- CUT VOLUME = 6.0Mm^3;
- FILL VOLUME = 2.2Mm^3;
- TOTAL LANDFILL VOLUME = 24.0Mm^3;
- TOTAL WASTE CAPACITY = 20.2Mm^3;
- TOTAL 21 GRAVES AFFECTED INCLUDING 10 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
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 LOD SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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



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
LANDFILL EXTENSION
LAYOUT OPTION 1a

Drawing no.			Rev.
24315/01/102			-
Drawn	Date	Checked	Approved
RY	04/06	PM	YWY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

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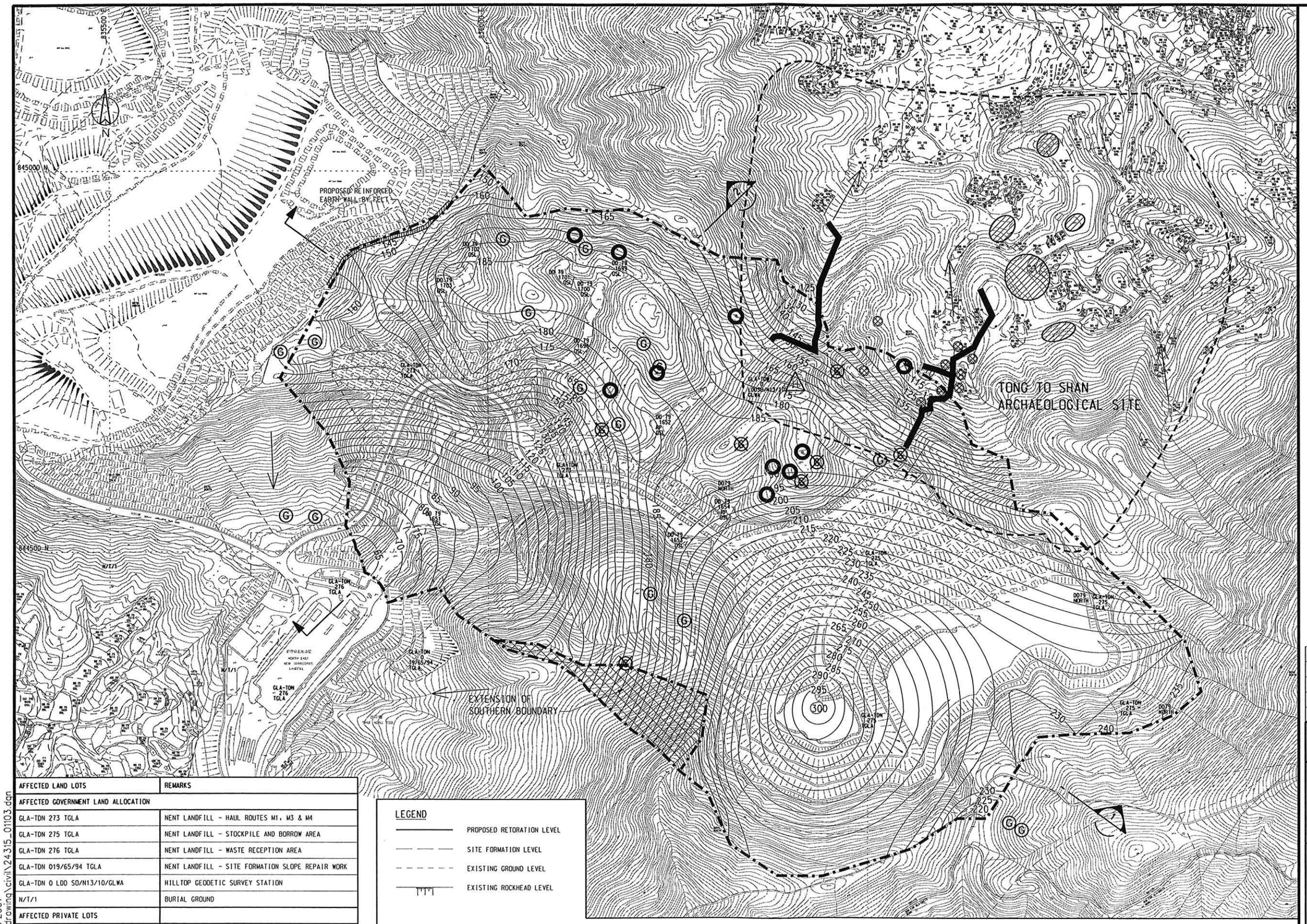


LEGEND

- 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
- H HILTOP SURVEY STATION
- SURFACE WATER FLOW

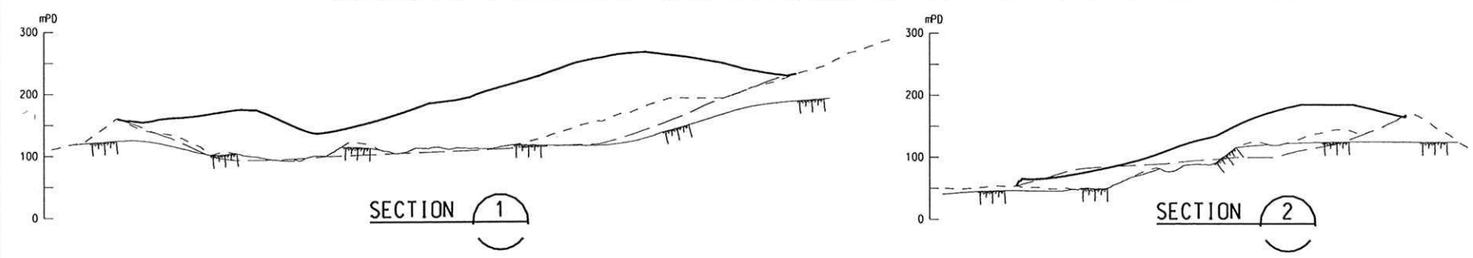
OPTION 1b

- SITE AREA 61ha;
- MAX. LEVEL +300mPD;
- CUT VOLUME = 6.0Mm^3;
- FILL VOLUME = 2.2Mm^3;
- TOTAL LANDFILL VOLUME = 29.0Mm^3;
- TOTAL WASTE CAPACITY = 25.2Mm^3;
- TOTAL 21 GRAVES AFFECTED INCLUDING 10 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
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 O LDD SD/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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



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
LANDFILL EXTENSION
LAYOUT OPTION 1b

Drawing no.			Rev.
24315/01/103			-
Drawn	Date	Checked	Approved
RY	04/06	PM	YMY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

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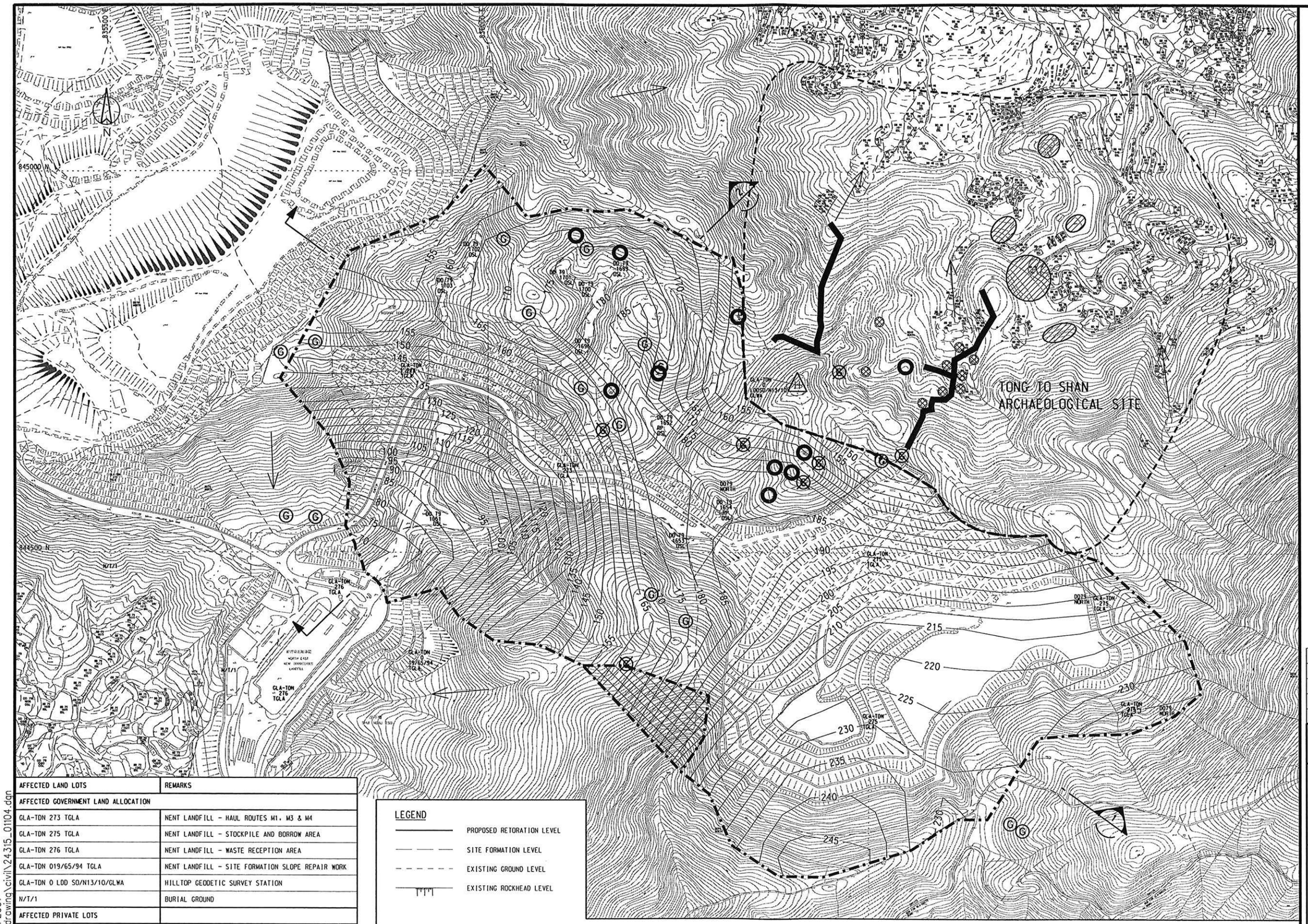

LEGEND

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

OPTION 2

- SITE AREA 54ha;
- TOTALLY AVOID TTSSD;
- MAX. LEVEL +245mPD;
- CUT VOLUME = 4.6Mm^3;
- FILL VOLUME = 2.0Mm^3;
- TOTAL LANDFILL VOLUME = 19.4Mm^3;
- TOTAL WASTE CAPACITY = 16.8Mm^3;
- TOTAL 20 GRAVES AFFECTED INCLUDING 9 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
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 O LDD SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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

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
LANDFILL EXTENSION
LAYOUT OPTION 2

Drawing no.			Rev.
24315/01/104			-
Drawn	Date	Checked	Approved
RY	04/06	PM	YWY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

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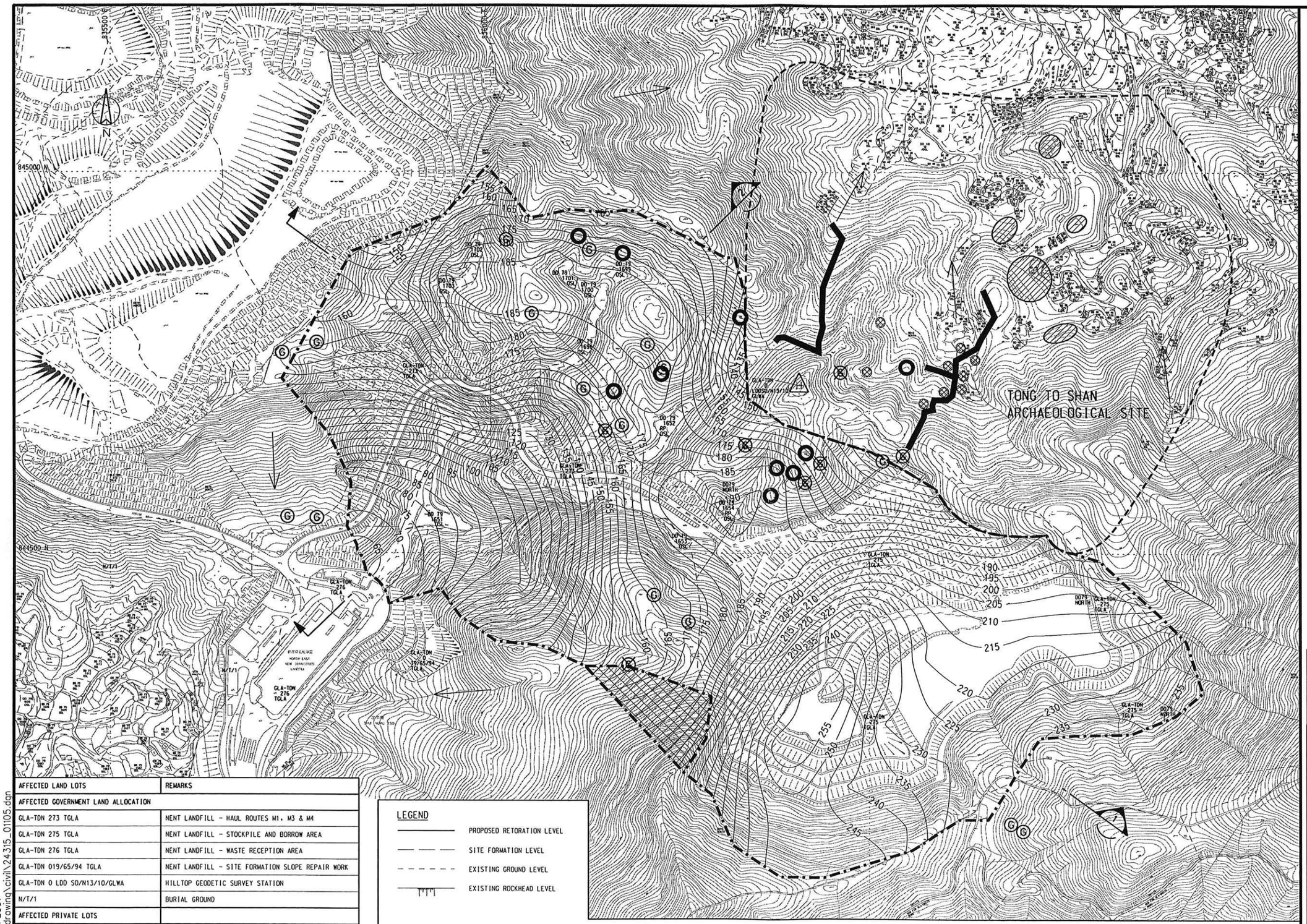


LEGEND

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

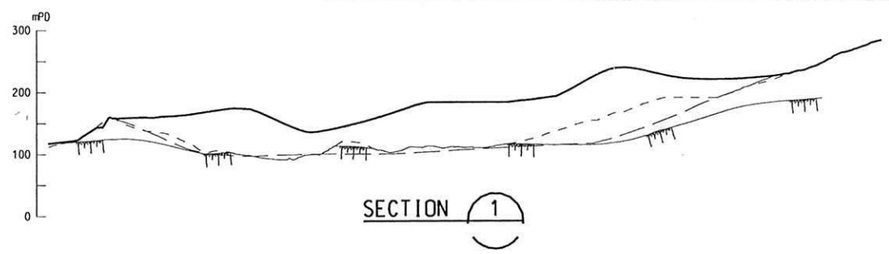
OPTION 2a

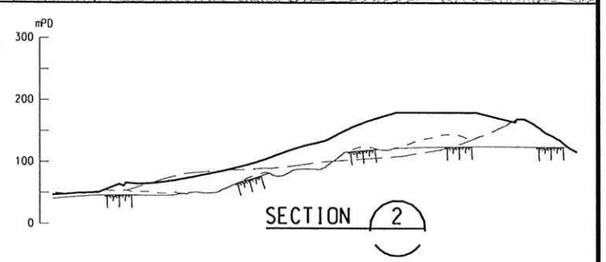
- SITE AREA 54ha;
- TOTALLY AVOID TTSSD;
- MAX. LEVEL +255mPD;
- CUT VOLUME = 4.6Mm^3;
- FILL VOLUME = 2.0Mm^3;
- TOTAL LANDFILL VOLUME = 21.0Mm^3;
- TOTAL WASTE CAPACITY = 18.4Mm^3;
- TOTAL 20 GRAVES AFFECTED INCLUDING 9 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
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 SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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





Rev	Description	By	Date

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

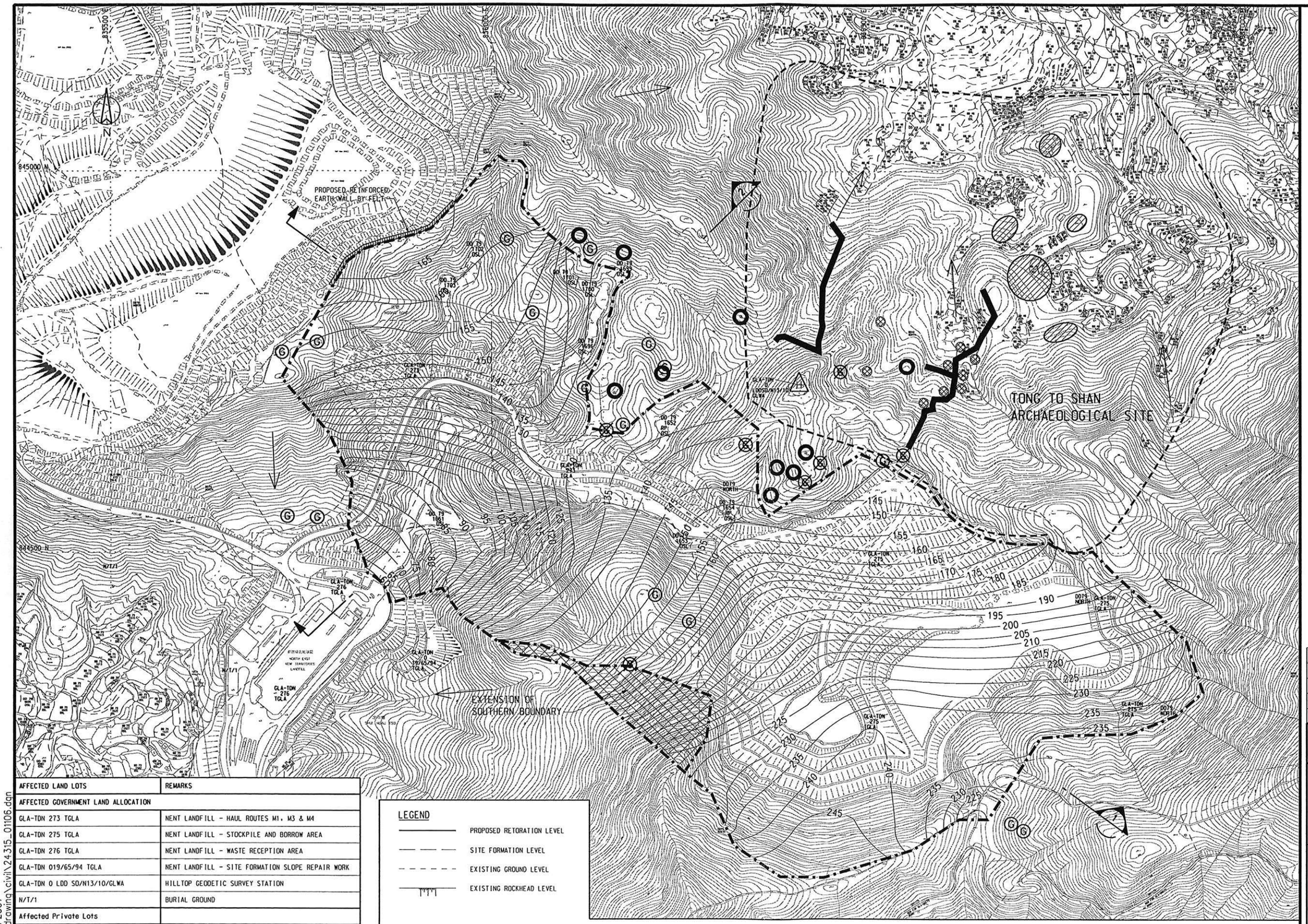
Project title
Agreement No. CE 20/2004 (EP)
North-East New Territories (NENT)
Landfill Extension
Feasibility Study

Drawing title
LANDFILL EXTENSION
LAYOUT OPTION 2a

Drawing no.			Rev.
24315/01/105			-
Drawn: RY	Date: 04/06	Checked: PM	Approved: YWY
Scale: 1 : 2500 ON A1		Status: PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

Printed by : remon yick 8/5/2007
Filename : i:\24315-cswb\arup\drawing\civil\24315_01105.dgn



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

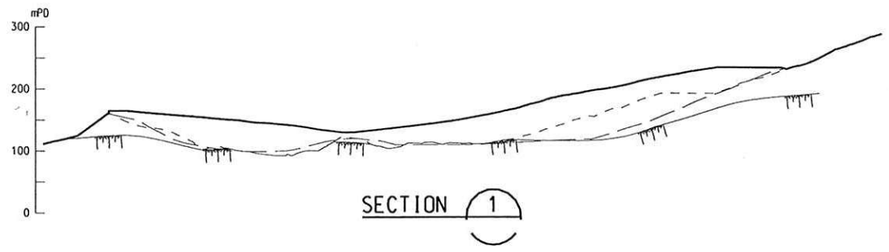
OPTION 3

- SITE AREA 50ha;
- MAX. LEVEL +245mPD;
- CUT VOLUME = 3.7Mm^3;
- FILL VOLUME = 2.8Mm^3;
- TOTAL LANDFILL VOLUME = 12.0Mm^3;
- TOTAL WASTE CAPACITY = 11.1Mm^3;
- TOTALLY AVOID TTSSD;
- ONLY 9 GRAVES AFFECTED AND TOTALLY AVOID OLD GRAVES.

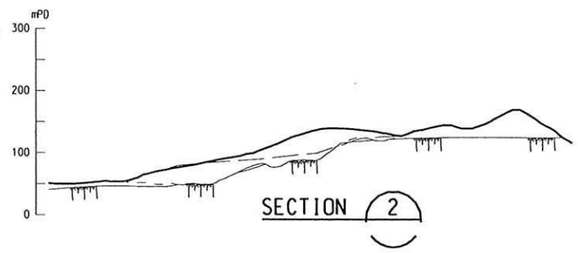
AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
GLA-TDN 273 TGLA	NENT LANDFILL - HAUL ROUTES M1, M3 & M4
GLA-TDN 275 TGLA	NENT LANDFILL - STOCKPILE AND BORROW AREA
GLA-TDN 276 TGLA	NENT LANDFILL - WASTE RECEPTION AREA
GLA-TDN 019/65/94 TGLA	NENT LANDFILL - SITE FORMATION SLOPE REPAIR WORK
GLA-TDN 0 LDD SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
Affected Private Lots	
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



SECTION 1



SECTION 2

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

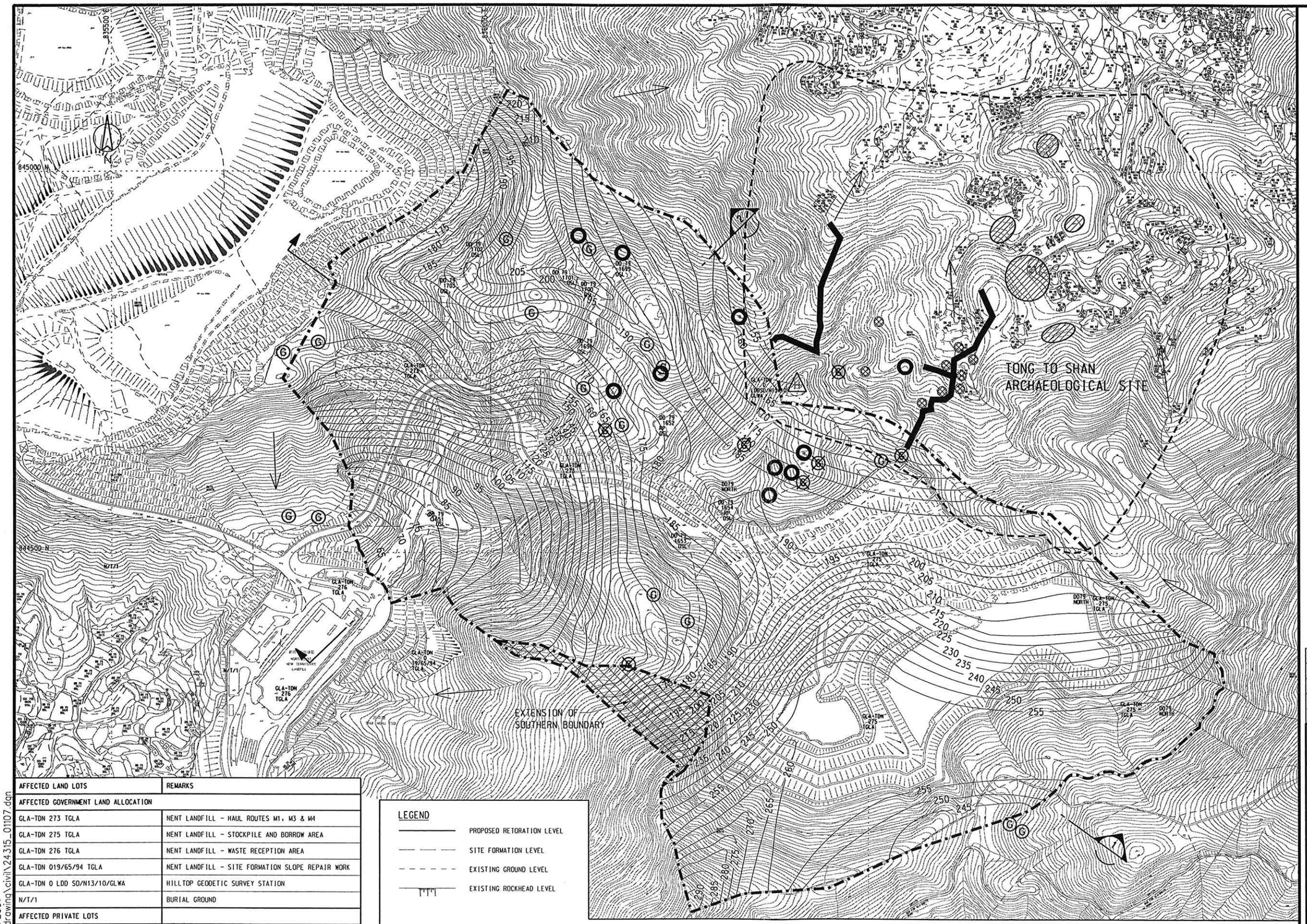
Drawing title

LANDFILL EXTENSION
LAYOUT OPTION 3

Drawing no.			Rev.
24315/01/106			-
Drawn	Date	Checked	Approved
RY	04/06	PM	YWY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

Printed by : reman yick
Filename : i:\24315-cswp\arup\drawing\civil\24315_01106.dgn
8/5/2007



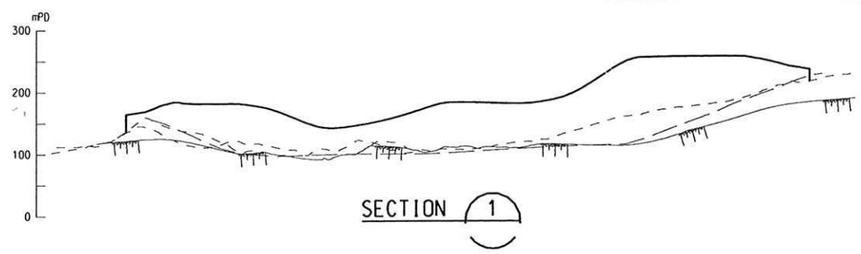
OPTION 4

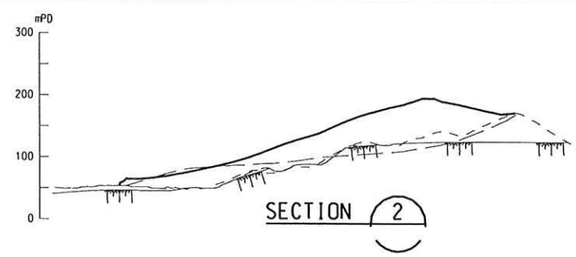
- SITE AREA 63ha;
- MAX. LEVEL +255mPD;
- CUT VOLUME = 6.2Mm^3;
- FILL VOLUME = 2.2Mm^3;
- TOTAL LANDFILL VOLUME = 25.2Mm^3;
- TOTAL WASTE CAPACITY = 21.4Mm^3;
- TOTAL 20 GRAVES AFFECTED INCLUDING 9 OLD GRAVES.

AFFECTED LAND LOTS	REMARKS
AFFECTED GOVERNMENT LAND ALLOCATION	
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 SO/N13/10/GLWA	HILLTOP GEODETIC SURVEY STATION
N/T/1	BURIAL GROUND
AFFECTED PRIVATE LOTS	
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





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
LANDFILL EXTENSION
LAYOUT OPTION 4

Drawing no.			Rev.
24315/01/107			-
Drawn	Date	Checked	Approved
RY	04/06	PM	YWY
Scale		Status	
1 : 2500 ON A1		PRELIMINARY	

環境保護署
廢物設施營運處
Environmental Protection Department
Waste Facilities Business Unit

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Filename : j:\24315-cswp\arup\drawing\civil\24315_01107.dgn

APPENDIX A

Tentative Outline Programme

ARUP

Ove Arup & Partners Hong Kong Ltd.

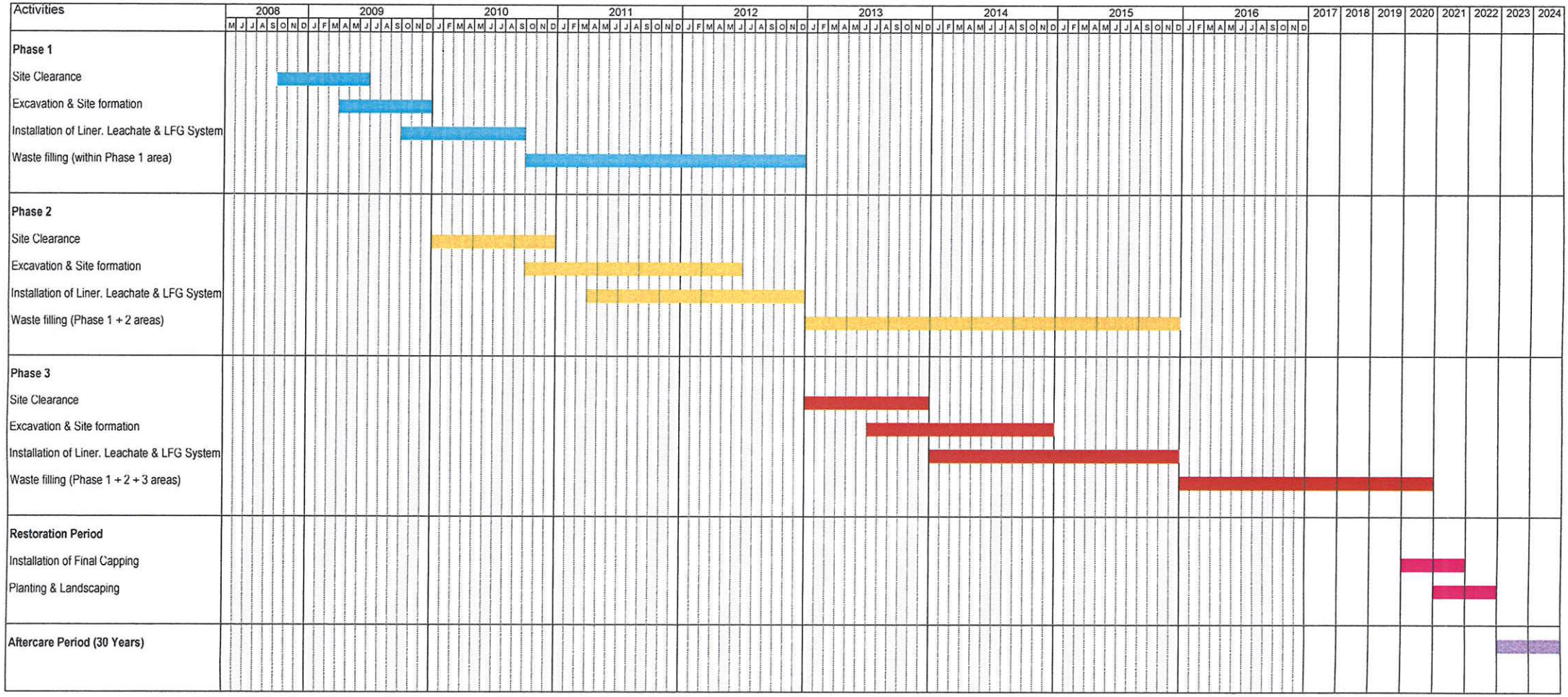
Agreement CE 20/2004(EP) North East New Territories Landfill Extension Feasibility Study

NENT LANDFILL EXTENSION TENTATIVE OUTLINE PROGRAMME

EXISTING NENT LANDFILL :

- Operation + Partial Capping
- Capping + Restoration
- Aftercare

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.