

**TECHNICAL NOTE: APPENDIX II
WENT AND NENT LANDFILL
ARCHAEOLOGICAL RELICS
(NOVEMBER 2002)**

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1.1 Introduction

- 1.1.1 In order to provide additional landfill capacity in the HKSAR for the disposal of solid waste it has been proposed, amongst other measures, that the existing WENT and NENT Landfills should be extended.
- 1.1.2 For the WENT site (located near Castle Peak in the West New Territories), two proposed extension areas (WENT A and WENT B) have been identified, both of which are located to the west of the current landfill site. The WENT B Extension site includes the full area of the Tsang Tsui Archaeological Site (TTAS) (see Drawing 305B).
- 1.1.3 For the NENT site (located near Robin's Nest in the North West New Territories), an extension to the south-east of the current landfill site has been proposed. The NENT Extension site overlaps the area at Tong To Shan and Ngong Tong, where a previous settlement has been discovered. The NENT Extension site coincides with a small part of the proposed Tong To Shan Archaeological Site and a larger area in Ngong Tong where graves have been identified (see Drawing 116D).
- 1.1.4 It is planned that construction of both the NENT and WENT Landfill Extensions would start in 2011.

1.2 Waste Management in Hong Kong

- 1.2.1 A study (CE45/99) has been carried out on behalf of the HKSAR Government to identify the necessary landfill capacity for waste disposal until 2050. This study identified that, assuming that waste-to-energy facilities and other measures to reduce waste are commissioned, the HKSAR needs to provide a total landfill capacity of about 515 M tonnes up to 2050.

- 1.2.2 A variety of options for providing this capacity were identified as follows:

Remaining capacity in SENT, NENT and WENT Landfills at the end of 2001	117 M tonnes
Landfill Extensions:	
• NENT B Landfill Extension	21 M tonnes
• WENT A Landfill Extension	6 M tonnes
• WENT B Landfill Extension	72 M tonnes
New Series Landfills:	
• New land based landfill site at Pillar Point Valley North	72 M tonnes
• New marine landfill site at South Cheung Chau	154 M tonnes
TOTAL	442 M tonnes
SHORTFALL	73 M tonnes

- 1.2.3 An exhaustive search of the HKSAR has been made and no other land based sites are available. The only way that the shortfall can be made up would be to develop another marine landfill site.
- 1.2.4 The existing landfills will be exhausted in the coming 10 to 15 years, with SENT by 2009, WENT and NENT by 2013 at the earliest.



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1.2.5 Due to the lead-in time required for consultation, design and, in the case of South Cheung Chau, the construction of the artificial island, the new landfills cannot be commissioned before 2020. There is thus a definite need to extend the capacity of the existing landfills to ensure the availability of landfill capacity until the new series landfills are available. Failure to secure adequate extension of capacity would result in the current capacity being used up before new capacity could be made available, and hence there would be a discontinuity to the essential waste disposal services for the whole community.

1.2.6 To ensure the waste disposal system can be operated in an environmentally acceptable standard, at least two landfills at different locations should be maintained at all time. As there is no extension scheme identified for the SENT Landfill, both the extensions to the WENT and NENT Landfills are indispensable.

1.2.7 Even with the introduction of waste minimisation techniques throughout the HKSAR, the community will continue to generate waste at a similar rate to the present rate. Using current waste generation assumptions, it is estimated that approximately 40 M tonnes will be produced in the 7 year-long discontinuity (between 2013 and 2020). During this period, the HKSAR Government would have to manage this waste in order to avoid illegal fly-tipping. If no capacity is available at suitably engineered waste disposal landfill sites, the Government would be forced to either utilise a less highly engineered site, which is untenable (even if a suitable site could be located), or to provide temporary storage for the waste until such a time as the new series landfill sites are able to start receiving waste. Temporary storage of waste has many inherent problems including:

- The need to identify a suitably large site,
- Environmental issues such as noise, odour, dust, visual impact, hygiene problems in the surrounding area etc. will have to be managed and mitigated,
- Some form of containment system would have to be constructed to retain the waste. This should ideally limit the volume of water entering the waste, and must allow leachate and/or gas to be collected and treated.
- The cost of temporary storage per tonne of waste will be significantly higher than landfilling, due to the volume of temporary works that would be required, the double handling of the waste as it is eventually transferred to the landfill site and the likely remediation that would be required at the temporary storage site once it is no longer required.

1.3 Preservation of Archaeological Relics

1.3.1 The preferred method of preservation of archaeological relics is to preserve them insitu, i.e. to avoid them altogether. This would be done by amending the proposed development scheme so as to exclude the area of the relics from the development area. The costs and benefits of preservation insitu must be weighed against all other material considerations including the relative importance and significance of the relics themselves.



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1.3.2 A further technique for preservation that is sometimes used is preservation insitu by burying the archaeological relics under earthworks or the foundations of structures so that they are preserved undamaged for posterity. In this case care must be taken to ensure that the earthworks (designed to protect the archaeological remains) do not cause damage to the relics, either during construction or due to the load imposed upon them.

1.3.3 Where it is not possible to preserve relics insitu, an acceptable alternative may be to preserve them by relocation, i.e. to arrange for a rescue excavation of the area prior to commencement of construction. During the excavation the archaeological evidence is recorded and the results of the excavation published.

1.4 Assessment of Preferred Preservation Option

1.4.1 For each landfill a number of alternative options were assessed for practicability, feasibility and effectiveness.

1.5 WENT Landfill

Background on Tsang Tsui Archaeological Site (TTAS)

1.5.1 The TTAS was initially identified by the Antiquities and Monuments Office (AMO) of the Leisure and Cultural Services Department in October 2000, during the preliminary feasibility study for a Sludge Treatment facility. Relics dating from the late Neolithic Period (c.2500-1500 B.C) were found at the site.

1.5.2 The TTAS is a recorded item by AMO and is thus protected by the Antiquities and Monuments Ordinance, Cap. 53.

1.5.3 The proposed WENT B Extension to the existing WENT Landfill overlaps the boundary of the TTAS, and thus, to ascertain the archaeological potential of the proposed extension a preliminary archaeological survey, comprising the excavation of 8 test pits together with drilling of 44 auger holes, was carried out between August and September 2001.

1.5.4 The investigation concluded that the construction of the former BBC station, the WENT Landfill and the CLP ash lagoons has left the area very disturbed and that, with the exception of the existing TTAS it was very unlikely that archaeological remains would be found in this area. The Preliminary Archaeological Report on the Proposed Extensions of WENT Landfill at Nim Wan Site, Tuen Mun concluded that no further archaeological survey would be required.

1.5.5 The report on the archaeological investigation proposed that the extension of WENT Landfill should be allowed to go ahead, but that the existing TTAS should not be disturbed and that prior consent from AMO would be necessary for any proposed development within the boundary of the TTAS.

Options

Preservation Insitu by avoiding Archaeological Site

1.5.6 The first option considered was to preserve the TTAS by amending the landfill extension boundary to avoid the area where the relics are located.



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- 1.5.7 The TTAS is located near the centre of the WENT B Extension area, in the area where it is likely that the greatest depth of waste would be placed.
- 1.5.8 Amending the boundary of the landfill extension so as to avoid the TTAS is likely to reduce the capacity of the extension by 41 M tonnes (between half and two-thirds of the proposed volume). As mentioned in Section 1.2 it is predicted that even with the construction of two new landfill sites, and the extension of the existing landfills, there would be a shortfall of approximately 73 M tonnes in the landfill capacity available in Hong Kong until 2050. Loss of capacity of the WENT B Extension would result in the shortfall in capacity increasing to 114 M tonnes.
- 1.5.9 In addition to the loss of capacity, the unit cost of providing waste disposal capacity (currently assessed to be approximately \$50/tonne) is likely to increase as it would not be possible to realise the same economies of scale.
- 1.5.10 Based on current waste generation rates in Hong Kong, it is likely that if the full capacity of the WENT Extensions cannot be provided, there would be a “gap” in the provision of landfill capacity in the Tuen Mun area. This area will be serving nearly two-thirds of the total waste generated in the HKSAR by that time. The waste which would have been disposed of at the WENT site will have to be diverted to the extended NENT site, but this in turn would cause the NENT site to become filled more quickly, and it’s capacity would be exhausted before the new landfills can be made operational. The implications of this are discussed in Sections 1.2.5 to 1.2.7 with the capacity of all the existing and extension sites becoming exhausted before any new site is available.
- 1.5.11 The costs of construction for the WENT B Extension and an island landfill are \$50 per tonne and \$200 per tonne respectively. The additional cost to the Government in compensating the capacity lost at the WENT B site by building another island landfill has been estimated at \$6 billion (i.e. 41 M tonnes x (\$200-\$50)). Besides, the building of another island landfill would shift the environmental impacts of a land-based landfill to a marine-based one with more severe implications.

Preservation Insitu by Burial

- 1.5.12 The second option considered was to preserve the TTAS insitu, but buried under the landfill. This preservation method is based on the assumption that it would be possible to exhume the relics in the future, if this is desired.
- 1.5.13 However, as the relics are located within one metre below the ground level, they would be easily damaged during the clearance operation and subsequent site formation to provide a stable foundation for the landfill liner. Also, after burial, the eventual loading imposed by up to 100 metres depth of waste could lead to the relics being damaged insitu.
- 1.5.14 Besides, any future exhumation of the relics would be difficult, costly and undesirable, as it could compromise the integrity of the landfill liner, and the excavation through large depths of waste would have significant safety, environmental and health concerns.

Preservation by Removal

- 1.5.15 The third option considered was to remove the relics using rescue excavation techniques before the construction of the landfill.



- 1.5.16 This would involve archaeological recording of the site prior to commencement of the landfill construction. A programme, which would normally include fieldwork, would be set up to collect specified data within given time and cost restraints. The scope of this programme would be agreed with AMO. The end result of the programme would be publications that reflect the significance of the data collected, and the creation of an archive deposited in an appropriate place to allow continuing curation and legitimate access to the artefacts.
- 1.5.17 This preservation method has the advantages that it would allow the development of the WENT B Extension to continue and at the same time the archaeological relics and findings from the programme could be displayed at a suitable location within the HKSAR as an educational facility that would benefit the community.

Summary

- 1.5.18 All options were considered to identify the most practical and feasible means.
- 1.5.19 The following options were considered:

(a) *Preservation Insitu by avoiding Archaeological Site:*

Because of capacity loss to the landfill and the additional costs of allocating the landfill capacity elsewhere, this option is not considered feasible.

(b) *Preservation Insitu by Burial*

Because of:

- the potential damage to the relics during clearance and site formation, and subsequently by the loading of waste;
 - the unlikelihood that the landfill would be “mined” in the future;
 - the difficulty of excavating through a depth of waste, which could be as much as 100 m; and
 - the associated health/safety issues and environmental risks;
- this option is not considered feasible.

(c) *Preservation by Removal*

From a conservation point of view, this is the least attractive of the options because it involves the removal of the relics and the loss of the site for future investigations. Nevertheless as a last resort, recognising the impracticability and non-feasibility of the other options, this is the most practical and feasible option.

It is envisaged that the relics would be put on display at either an existing museum or a dedicated facility/visitors’ centre developed as part of the landfill scheme. Putting the excavated relics on display would enable the public to better appreciate Hong Kong’s varied historical background than if these relics remained buried in the ground.

Alternatively rather than a site specific display of relics in a visitors’ centre, a regional museum facility could be developed to enable the rich and varied archaeological findings along the shoreline of the North West New Territories (TTAS



being one of many archaeological sites along this part of the SAR's coast) to be put on display and include relics from the numerous archaeological sites along the eastern shoreline of Deep Bay and around Lung Kwu Tan.

1.6 NENT Landfill

Background

- 1.6.1 A preliminary archaeological survey and assessment of the proposed NENT Landfill site was carried out in August and September 2001. In this survey a "settlement district" dated from the first half of the 17th century to the early 20th century was discovered in the northern part of the area and centred at Tong To Shan. The features identified include 91 stone structural features, mainly distributed in the vicinity of Tong To Shan and 40 graves in the Ngong Tong area to the west of the northern part of the survey area.
- 1.6.2 The stone structural features comprise buildings (remains of houses and a cistern), slope protection walls and trackways.
- 1.6.3 The report on the archaeological survey concluded that the Tong To Shan Settlement has great cultural, historical and archaeological significance as it has been well preserved and reflects many aspects of human life in Hong Kong during a period of over 300 years. It was recommended that the site should be protected as much as possible, and that the Tong To Shan area, which was considered to be more important than the Ngong Tong area, should be singled out as the "Tong To Shan Archaeological Site" (TTSAS) and excluded from the area of the proposed NENT Landfill Extension. The report indicated that part of the Ngong Tong area could be used for the proposed landfill project, but that some of the graves, with important historical and cultural significance should be preserved and that other graves should be removed prior to construction.

Options

Preservation In situ by avoiding Archaeological Site

- 1.6.4 The first option considered was to preserve the TTSAS by amending the landfill extension boundary to avoid the area where the relics are located.
- 1.6.5 The TTSAS is located in and adjacent to the central northern part of the NENT Extension area.
- 1.6.6 In order to minimise the impact on the TTSAS, the initial NENT B Extension has been amended by revising the extension boundary so as to minimise the overlap between the NENT B Extension area and the TTSAS¹. The loss of waste filling capacity resulting from this amendment was about 0.4 M tonnes. There is also some cost implication in building steep slopes by reinforced earth techniques than traditional methods. However, this mitigation ensures that the majority of the features at the TTSAS are left in situ, except that some of the graves in the Ngong Tong area and parts of two of the stone paths and one slope protection wall would need to be removed/buried. If the NENT B Extension cannot

¹ The initial scheme for NENT B is shown on Drawing 98347/129; with the slopes of the earth embankment on the northern side of the landfill would extend significantly into TTSAS. Drawing 98347/129B illustrates a revised scheme with steepened slopes on the north side of the earth embankment achieved using reinforced earth techniques to avoid much of TTSAS.



be implemented, the waste that would be disposed of at this site (approximately one-third of the total waste generated in Hong Kong by that time) would have to be diverted to the extended WENT site. This would cause the WENT site to become filled more quickly, and it's capacity would be exhausted before the new landfills can be made operational. The implications of this are discussed in Sections 1.2.5 to 1.2.7.

- 1.6.7 Further amending the boundary of this site so as to avoid the TTSAS entirely is likely to reduce the capacity of the extension by some 5 M tonnes (approximately one quarter of the capacity of the site). The costs of construction for the NENT B Extension and an island landfill are \$110 per tonne and \$200 per tonne respectively. The additional cost to the Government in compensating the capacity lost at the NENT B site by building another island landfill has been estimated at \$450 million (i.e. 5 M tonnes x (\$200-\$110)). Besides, the building of another island landfill would shift the environmental impacts of a land-based landfill to a marine-based site with more severe implications.

Preservation Insitu by Burial

- 1.6.8 The second option considered was to preserve the TTSAS insitu, but buried under the landfill. This preservation method is based on the assumption that it would be possible to exhume the relics in the future, if this is desired.
- 1.6.9 However, as the relics are situated at the ground level, they would be damaged during the clearance operation and subsequent site formation to provide a stable foundation for the landfill liner.
- 1.6.10 Besides, any future exhumation of the relics would be difficult, costly and undesirable, as it could compromise the stability of the embankment and integrity of the landfill liner, and the excavation through large depths of soil/waste would have significant safety, environmental and health concerns.

Preservation Insitu by using a Cavern Structure

- 1.6.11 The third option considered was to preserve the stone paths and stone walls in caverns built into the earth embankment on the north side of the landfill. These caverns would provide access to the stone paths and walls for archaeological investigation and inspection.
- 1.6.12 The caverns are envisaged as being something similar to a road subway with concrete side walls and a roof soffit. Lighting would be provided, and the height and width of the cavern would be such that small excavation machinery could enter, with an "excavation corridor" on either side of the stone path, enabling archaeological investigations to continue inside the cavern. However, the caverns would be vulnerable to landfill gas accumulation, with the possibility of gas migrating from the waste in the landfill. Appropriate venting and monitoring would be needed before anyone could enter a cavern.

Preservation by Detailed Recording

- 1.6.13 The fourth option considered was to prepare a detailed record of the stone paths and walls before they were destroyed/covered up by the construction of the landfill extension.
- 1.6.14 This would involve archaeological recording of the parts of the TTSAS that conflict with the NENT B Extension site prior to commencement of construction. A programme, which would normally include fieldwork, would be set up to collect specified data within given

time and cost restraints. The stone paths and walls would be recorded by photographic, cartographic and video means before being destroyed/covered up by the landfill development. The scope of this programme would be agreed with AMO. The end result of the programme would be publications that reflect the significance of the data collected, and the creation of an archive deposited in an appropriate place to allow continuing curation and legitimate access to the relics.

1.6.15 This preservation method has the advantages that it would allow the development of the full capacity of the NENT B Extension, whilst at the same time preserving the majority of the TTSAS insitu. The archaeological remains that had to be moved for the NENT B Extension to go ahead could be rescued and displayed at a suitable location within the HKSAR as an educational facility that would benefit the community.

1.6.16 As part of the relocation of those remains that fall within the NENT B footprint, the remaining TTSAS area could be improved so that the public could inspect those remains that are preserved insitu. This together with the visitors' centre could enhance the value of the TTSAS as an educational resource.

Summary

1.6.17 All options were considered to identify the most practical and feasible means.

1.6.18 The following options were considered:

(a) *Preservation Insitu by avoiding Archaeological Site*

Because of capacity loss to the landfill and the additional costs of allocating this landfill capacity elsewhere, this option is not feasible.

The possibility of allocating the 5 M tonne capacity to other sites has been carefully considered. No further opportunity to transfer this capacity to land based sites can be identified, including the opportunities of increasing the size of the WENT Landfill Extensions.

In this context the following requirements of HKSAR's landfill strategy for the period up to 2020 were key considerations:

- (i) At least two landfills at different locations should be operating at any one time to ensure an acceptable waste disposal service to the HKSAR's householders, industrialists, commercial operators, contractors etc who are all producing waste, and rely on the Government to provide a seamless service for waste disposal.
- (ii) At least one of the two landfills should be a land based site so that in the case of severe weather conditions, at times of monsoons and typhoons there would be an alternative destination for waste if the marine vessels used to serve an island landfill are unable to operate.
- (iii) The major landfill extensions at WENT B and NENT B would be indispensable to ensure the continuous provision of a waste disposal service for the HKSAR during the period after the existing landfills are filled to capacity (2014) and

the first of the new landfills (including the island landfill) is available to take waste (2020). It is also necessary to ensure a smooth transition between the existing landfills and their extensions and the new series landfills, and therefore the landfill extensions should continue in operation to at least 2021.

(b) *Preservation In situ by Detailed Recording by Burial*

From a conservation point of view this is the least attractive of the options because it involves burying some of the stone paths and walls and the loss of part of the site for future investigations.

For those relics that are buried, it is likely that they would be lost because of:

- the potential damage to the relics during clearance and site formation;
- the unlikelihood that the landfill would be “mined” in the future;
- the difficulty of excavating through the large depth of waste as well as the earth embankment on the north side of the landfill;
- the possibility that the excavation could prejudice the stability of the earth embankment;
- and the associated health/safety issues and environmental risks.

Nevertheless as a last resort, recognising the impracticability and non-feasibility of the other options, this would be the most practical and feasible option.

For future reference, the stone paths and walls would be recorded by photographic, cartographic and video means before being buried by the landfill development. The end result of the programme would be publications that reflect the significance of the data collected, and the creation of an archive deposited in an appropriate place to allow continuing curation and legitimate access to the relics.

As a further mitigation measure, some of the relics could be excavated and put on display at a dedicated facility/visitors’ centre developed as part of the landfill scheme. Putting the excavated relics on display would enable the public to better appreciate Hong Kong’s varied historical background than if these relics remained buried in the ground.

(c) *Preservation In situ by using a Cavern Structure*

By including a cavern structure into the earth embankment on the north side of the landfill, access to the stone paths and walls could be provided for continued archaeological investigation and inspection. However, the existing features and landscape setting of the stone paths would be lost due to the embankment construction. There would also be health and safety concerns about the risk of landfill gas migration into the caverns that could potentially cause an explosion if gas is present in its most critical composition. Nevertheless with careful monitoring, venting and other arrangements for the cavern, the stone paths could be accessed for archaeological and tourism purposes.

This would be a median option: feasible but not cost-effective nor practical.



In view of the uncertainties in cost-effectiveness, practicality and feasibility of this preservation option, it is recommended that these areas be further investigated under the Feasibility Study and EIA Stage of this Project.

1.7 Summary

- 1.7.1 The development of the WENT B Extension is critical to ensuring continued waste disposal capacity in the HKSAR until such a time that the new sites at Pillar Point Valley North and South Cheung Chau can be brought into operation. This, together with the cost of the capacity loss caused by preservation of the TTAS insitu (\$6 billion) make this preservation option untenable. It is recommended that archaeological recording and a rescue excavation be carried out at this site, the relics removed to an appropriate location and the findings published. The relics could be displayed in a suitable facility to enable them to be used as an educational resource for the HKSAR. Detailed programme and rescue operations can be worked out in the Feasibility Study and EIA Stage.
- 1.7.2 The NENT B Extension boundary has already been mitigated so as to ensure that most of the relics at the TTSAS can be preserved insitu. Avoidance of the TTSAS entirely would result in a further cost to the Government of \$450 million to build another island landfill in compensating for the capacity loss. In addition, the building of another island landfill would shift the environmental impacts of a land-based landfill to a marine-based one with more severe implications. The total removal of the archaeological relics in the overlapping area to allow the NENT B Extension to go ahead is considered the most feasible and practical option. The excavated/rescued relics could be displayed in a suitable facility to enable them to be used as an educational resource for the HKSAR. The building of cavern structures under the earth embankment to protect the stone paths could be an alternative, but it involves many uncertainties in cost-effectiveness, practicality and feasibility that need to be further investigated under the Feasibility Study and EIA Stage.

