

NOTE FOR PUBLIC WORKS SUBCOMMITTEE OF FINANCE COMMITTEE

Supplementary information on 45DR – Restoration of Pillar Point Valley Landfill

INTRODUCTION

In considering PWSC(2003-04)29 on **45DR** at the Public Works Subcommittee meeting on 11 June 2003, Members requested the Administration to provide supplementary information on the quantity of landfill gas generated at the closed landfills and details on the utilisation of landfill gas.

THE ADMINISTRATION'S RESPONSE

Landfill Gas Generation

2. Landfill gas (LFG) is a product of refuse decomposition. The quantity of LFG generated and its energy value depend highly on the amount and types of waste in place, the depth of the waste, the age of the landfill and the amount of moisture in the landfill. There is thus no single reliable and accurate method of predicting LFG generation rates. LFG comprises mainly methane and carbon dioxide with small quantities of other gases and corrosive contaminants. Very often, LFG generation reaches its maximum around the time when the landfill is closed. The methane content is usually around 50 – 60% by volume. Closed landfills will continue to produce LFG for many years, but the quantity and the methane content will gradually decrease.

3. At present, there are 13¹ closed landfills in Hong Kong. These landfills did not have LFG collection systems when they were built. The LFG

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¹ The 13 landfills are Shuen Wan, Gin Drinkers Bay, Jordan Valley, Tseung Kwan O Stage I and Stage II/III, Sai Tso Wan, Ma Yau Tong Central, Ma Yau Tong West, Ngau Chi Wan, Siu Lang Shui, Ngau Tam Mei, Ma Tso Lung and Pillar Point Valley.

released to the atmosphere has caused pollution and potential safety problems. Over the past six years, we have restored 12 of the 13 landfills, and LFG management systems have been installed at these landfills as part of the restoration programme. The locations of the 13 closed landfills are at Enclosure 1. The actual and forecast LFG production at these 13 closed landfills are at Enclosures 2 to 14.

Landfill Gas Utilisation Options

4. LFG may be used as an energy source due to its methane content. LFG can be utilised through (a) direct use as replacement fuel; (b) electricity generation; or (c) indirect use as enhanced fuel. It may be used directly on-site at the landfills or off-site as a fuel or converted to electricity. It must be noted that LFG with less than 35% methane content has no utilisation value. The following paragraphs discuss the utilisation options that have been examined.

On-site Utilisation

5. As stated above, LFG with less than 35% methane content has no utilisation value. Of the 12 restored landfills, only five (at Shuen Wan, Gin Drinkers Bay, Jordan Valley, Tseung Kwan O Stage I and Stage II/III) are generating LFG with methane content of above 35%. The other seven (at Sai Tso Wan, Ma Yau Tong Central, Ma Yau Tong West, Ngau Chi Wan, Siu Lang Shui, Ngau Tam Mei and Ma Tso Lung) are generating LFG with low methane content. Four of them have exceptionally low LFG production rates of less than 100 cubic metres per hour (m³/hr). Details of their LFG quantity and methane content are at Enclosures 2 to 13.

6. Of the five aforesaid landfills that generate LFG with higher methane content, three (Gin Drinkers Bay, Jordan Valley and Tseung Kwan O Stage II/III) have on-site leachate treatment plants, and LFG is used to provide thermal energy to treat leachate and generate electricity to operate the treatment plants. These treatment plants also treat leachate collected from eight² other landfills that do not have on-site similar treatment facilities. Tseung Kwan O Stage I Landfill uses LFG to generate electricity to meet on-site requirements.

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² The eight landfills are Tseung Kwan O Stage I, Sai Tso Wan, Ma Yau Tong Central, Ma Yau Tong West, Ngau Chi Wan, Siu Lang Shui, Ngau Tam Mei and Ma Tso Lung.

*Off-site Utilisation Options**(I) Direct use as Replacement Fuel*

7. Direct use of LFG is an attractive utilisation method because it can achieve the highest energy efficiency by using the heat energy generated from the burning of LFG direct. LFG can be burnt as a replacement fuel, typically for fuel oil, Towngas or coal, for use by industries close to the landfills. However it cannot be used directly by domestic users because it is not compatible with Towngas and petroleum gas.

8. Most of the closed landfills do not have industries with high energy demand in their vicinity. So far, we have identified only one major energy user that is situated near the Shuen Wan Landfill at Tai Po – the Hong Kong and China Gas Company Limited (HKCG). Since September 1999, the Landfill has been supplying cleansed LFG to HKCG's Towngas production plant at the Tai Po Industrial Estate through a 1.5 kilometres pipeline for use as replacement fuel for the production of Towngas. When the scheme was planned, the calculations were based on the then projected LFG generation rate, and it was considered that the scheme should be viable over 10 years. However, the actual LFG generation rate turned out to be half of the projected amount in the first year of the scheme, and the LFG amount has continued to decline. The current LFG generation rate for the Shuen Wan Landfill is about 650 m³/hr, against the predicted rate of 2 150 m³/hr.

(II) Electricity Generation

9. Electricity generation is a relatively inefficient method of utilising LFG as it only converts about one third of the energy available in the gas into electricity and it involves significant investment. At present, LFG-generated electricity is used to satisfy on-site energy requirements. If there is surplus capacity, and with the agreement of the China Light and Power Company Ltd, it may be supplied to the local grid. An example is that in 2002, the Southeast New Territories Landfill supplied about 1 million kilowatt hours of surplus electricity to the grid.

10. However, for closed landfills, because of the low and decreasing LFG levels, setting up electricity generating facilities would not be cost effective. For instance, at the Tseung Kwan O Stage I and Stage II/III Landfills, the total

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surplus LFG would decrease from 1 990 m³/hr in 2003 to none in 2007. The estimated total surplus LFG in the next five years would be about 37 million m³. The estimated cost to convert surplus LFG to electricity is about \$31 million, but the value of the electricity would worth some \$20 million only.

(III) Conversion to Natural Gas as Enhanced Fuel

11. Liquefied Natural Gas (LNG) or Compressed Natural Gas (CNG) has a methane content of over 97% by volume. They can be used to run vehicles and is an environmentally friendly fuel. However, there is currently no infrastructure in Hong Kong to provide LNG or CNG to retail customers. Although LFG can be upgraded for use as LNG or CNG, significant capital investment will be required to establish the necessary gas-processing facilities.

Overview of LFG Utilisation

12. The following table is an overview of LFG utilisation in the restored landfills –

Restored Landfill	Handling of LFG
Shuen Wan	100% piped to HKCG plant
Gin Drinkers Bay	92% used on-site, especially for leachate treatment plant
Tseung Kwan O Stage II/III	76% used on-site, especially for leachate treatment plant; insufficient LFG for on-site use by 2005
Jordan Valley	19% used on-site, especially for leachate treatment plant; energy required for the plant decreasing due to decreasing volume of leachate in recent years

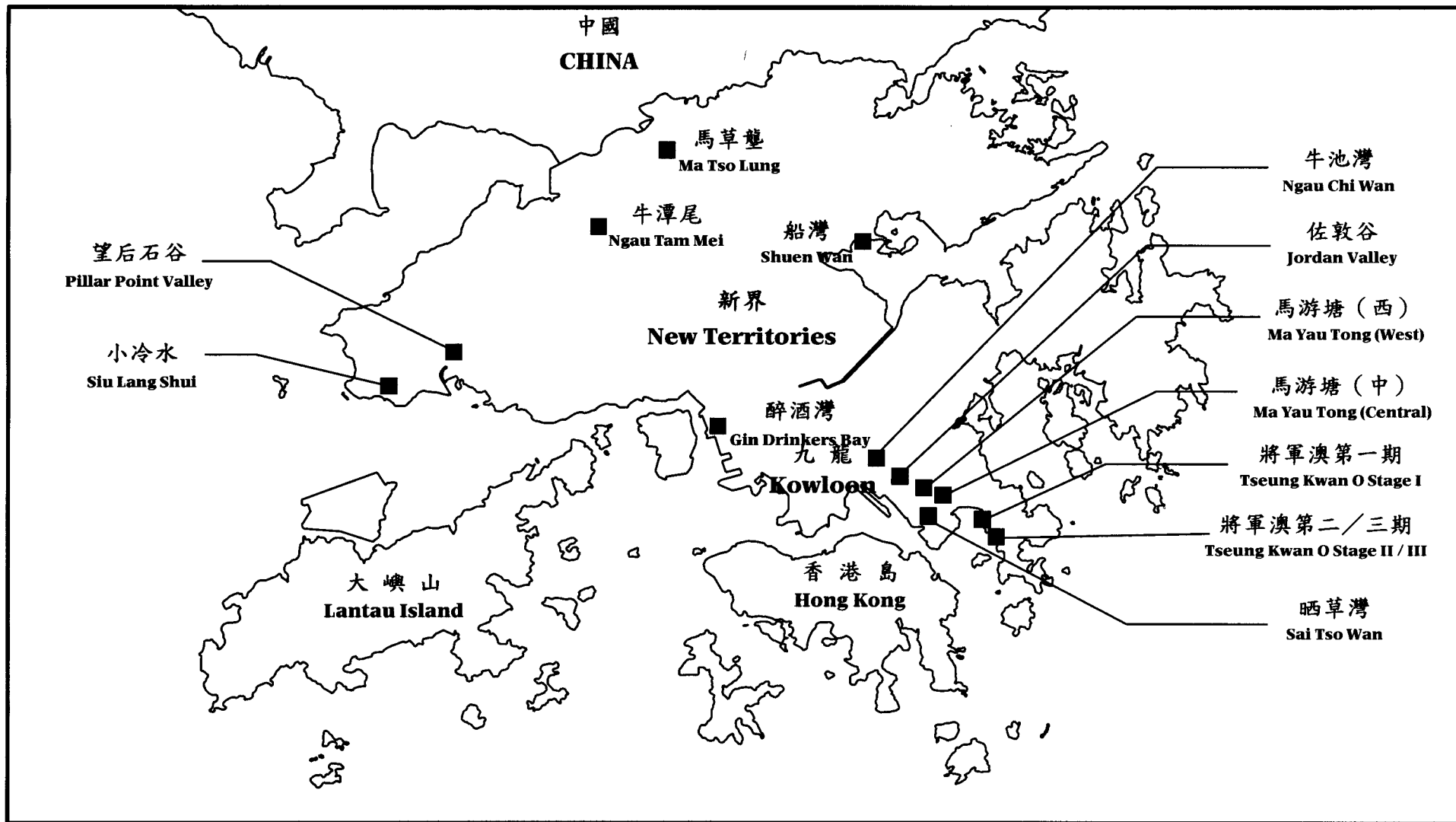
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Restored Landfill	Handling of LFG
Tseung Kwan O Stage I	3.4% used on-site; no leachate treatment plant on this site because leachate is treated in the nearby Tseung Kwan O Stage II/III Landfill; LFG may be piped to Tseung Kwan O Stage II/III Landfill by 2005 when the latter has insufficient LFG to operate the plant
Sai Tso Wan, Ma Yau Tong Central	Little LFG; to ensure safety of the site and nearby areas, all the LFG is flared on-site
Ngau Chi Wan, Siu Lang Shui, Ngau Tam Mei, Ma Tso Lung, Ma Yau Tong West	Extremely little LFG with low methane content; flaring not needed; managed release into the atmosphere to prevent horizontal migration

13. Overall speaking, about 5 200 m³/hr of usable LFG are generated at the closed landfills. Under the current arrangements, about 3 100 m³/hr, or about 60 % of the usable gas, are used either on-site or off-site. Separately, there are 770 m³/hr of LFG with low methane content and cannot be used.

Environment, Transport and Works Bureau
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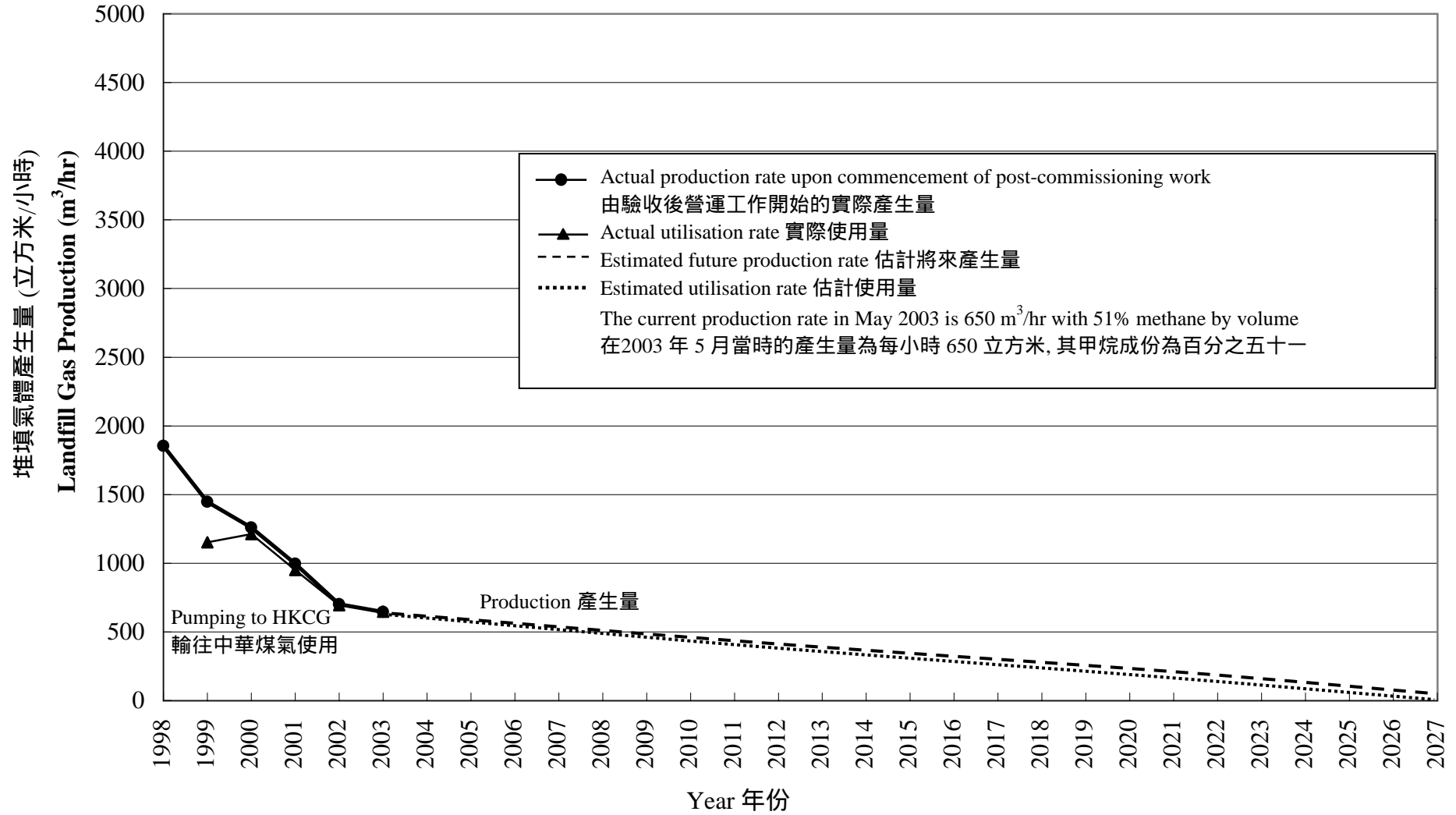
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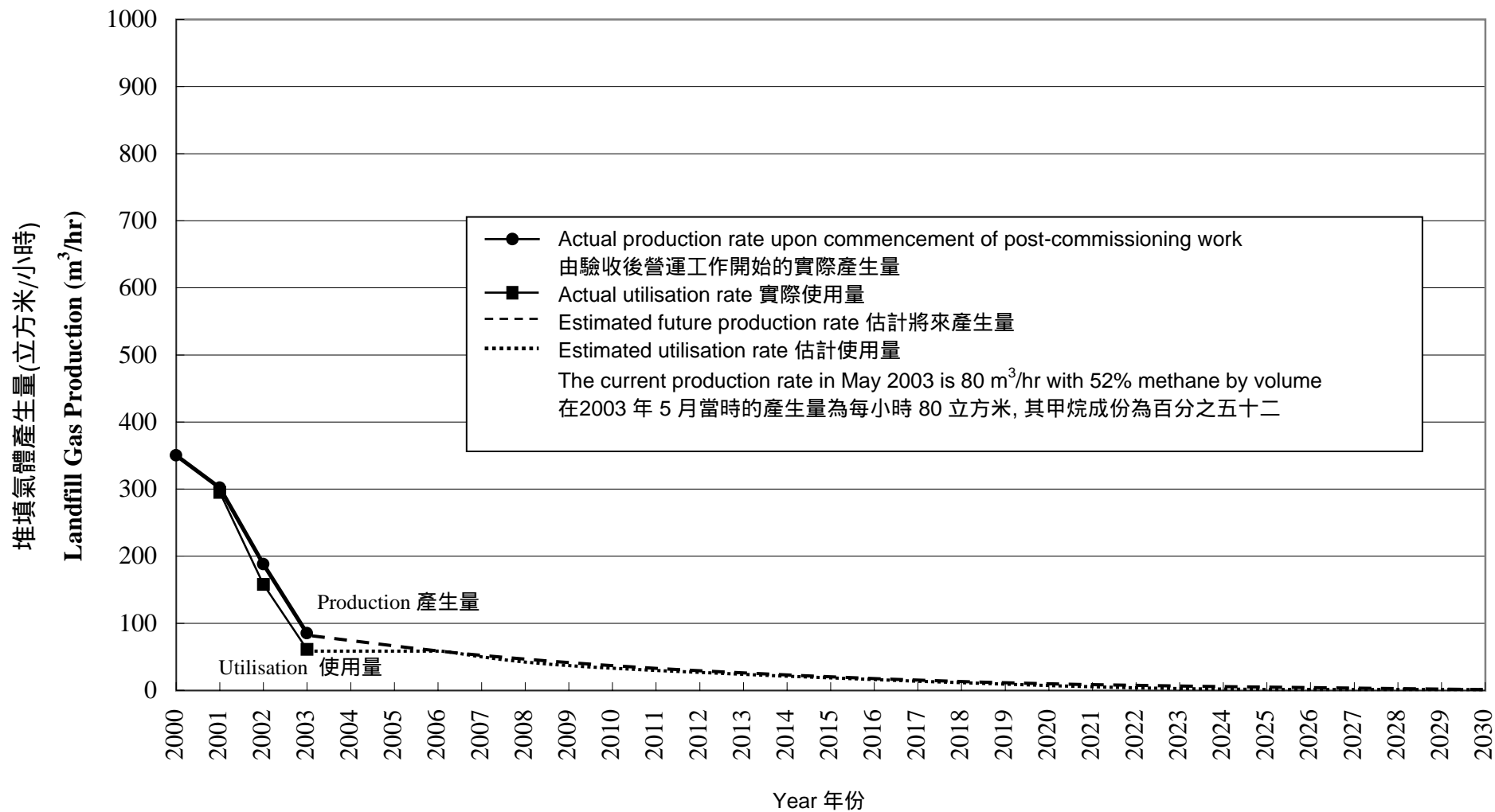
Location of closed landfills
已關閉的堆填區位置圖

船灣堆填區的堆填氣體產生量

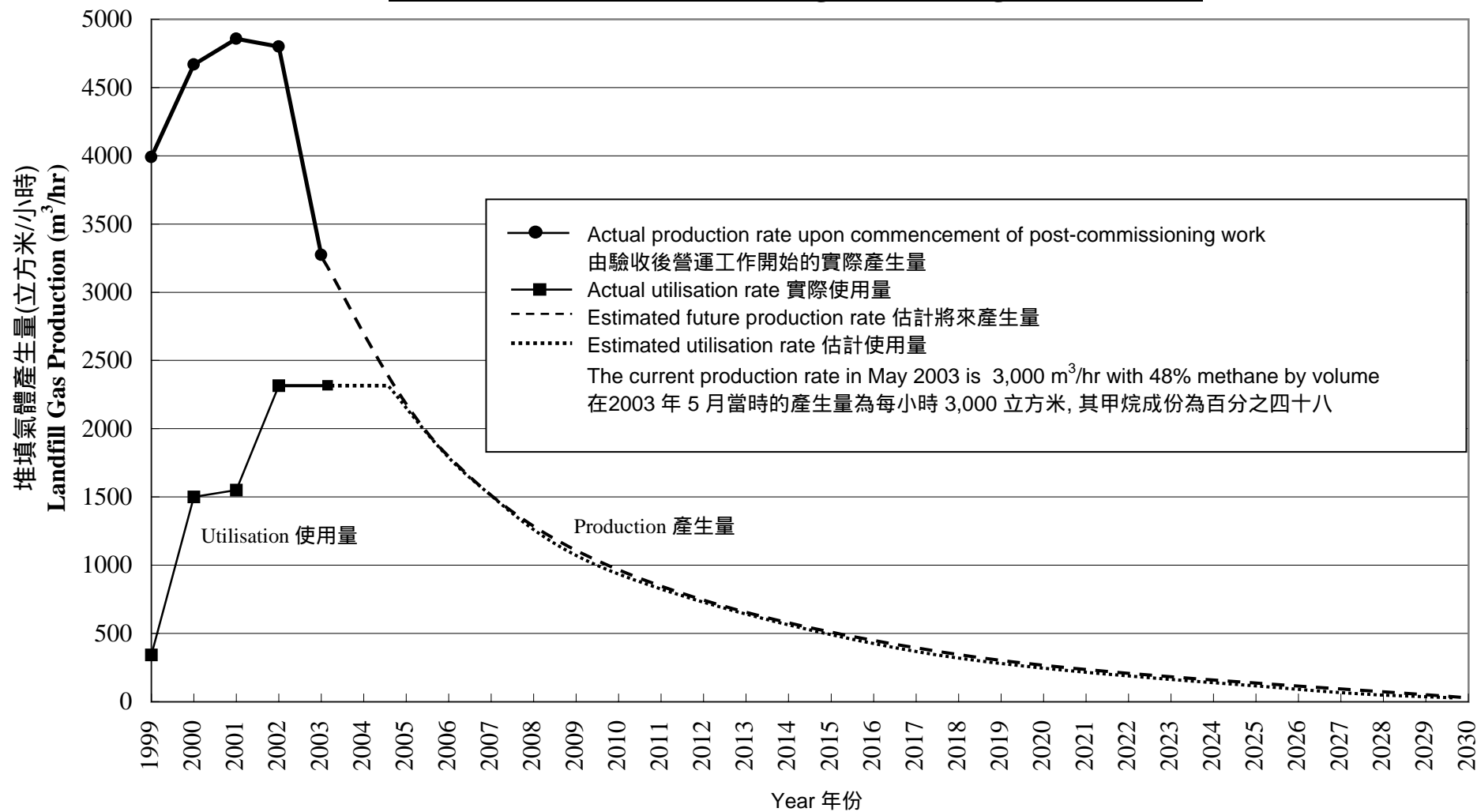
Landfill Gas Production in Shuen Wan Landfill



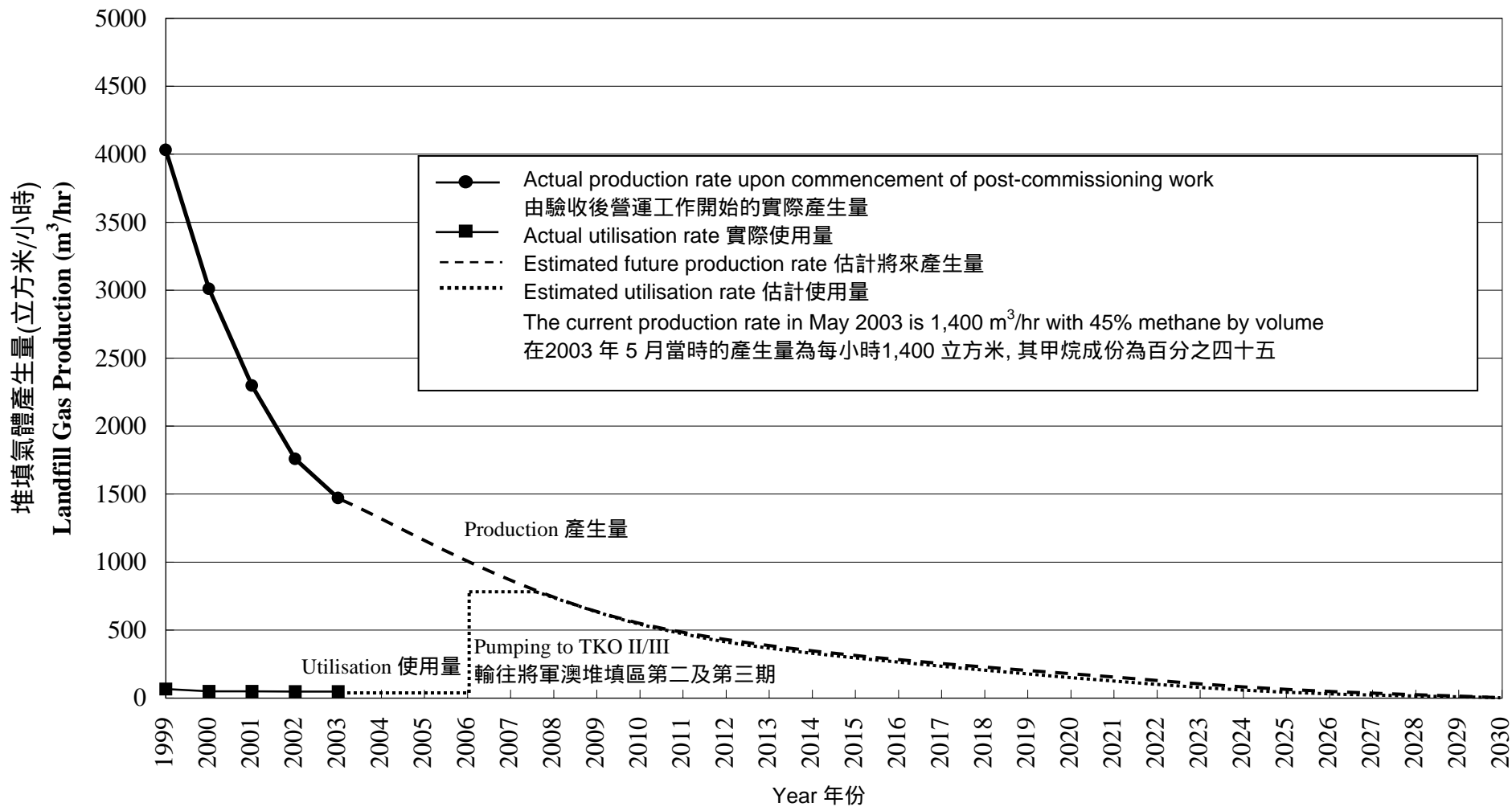
醉酒灣堆填區的堆填氣體產生量
Landfill Gas Production in Gin Drinkers Bay Landfill



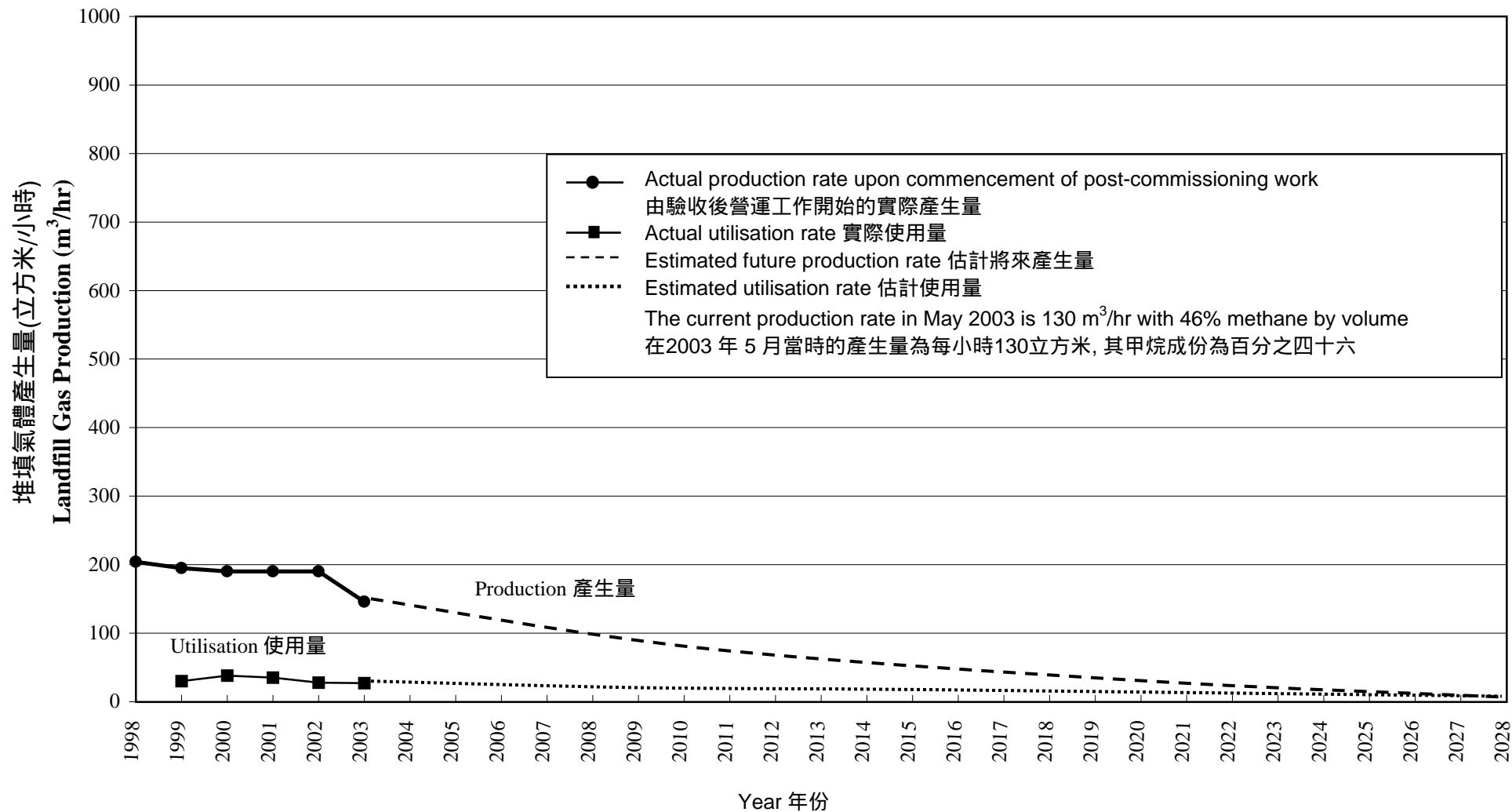
將軍澳堆填區第二及第三期的堆填氣體產生量 Landfill Gas Production in Tseung Kwan O Stage II/III Landfill



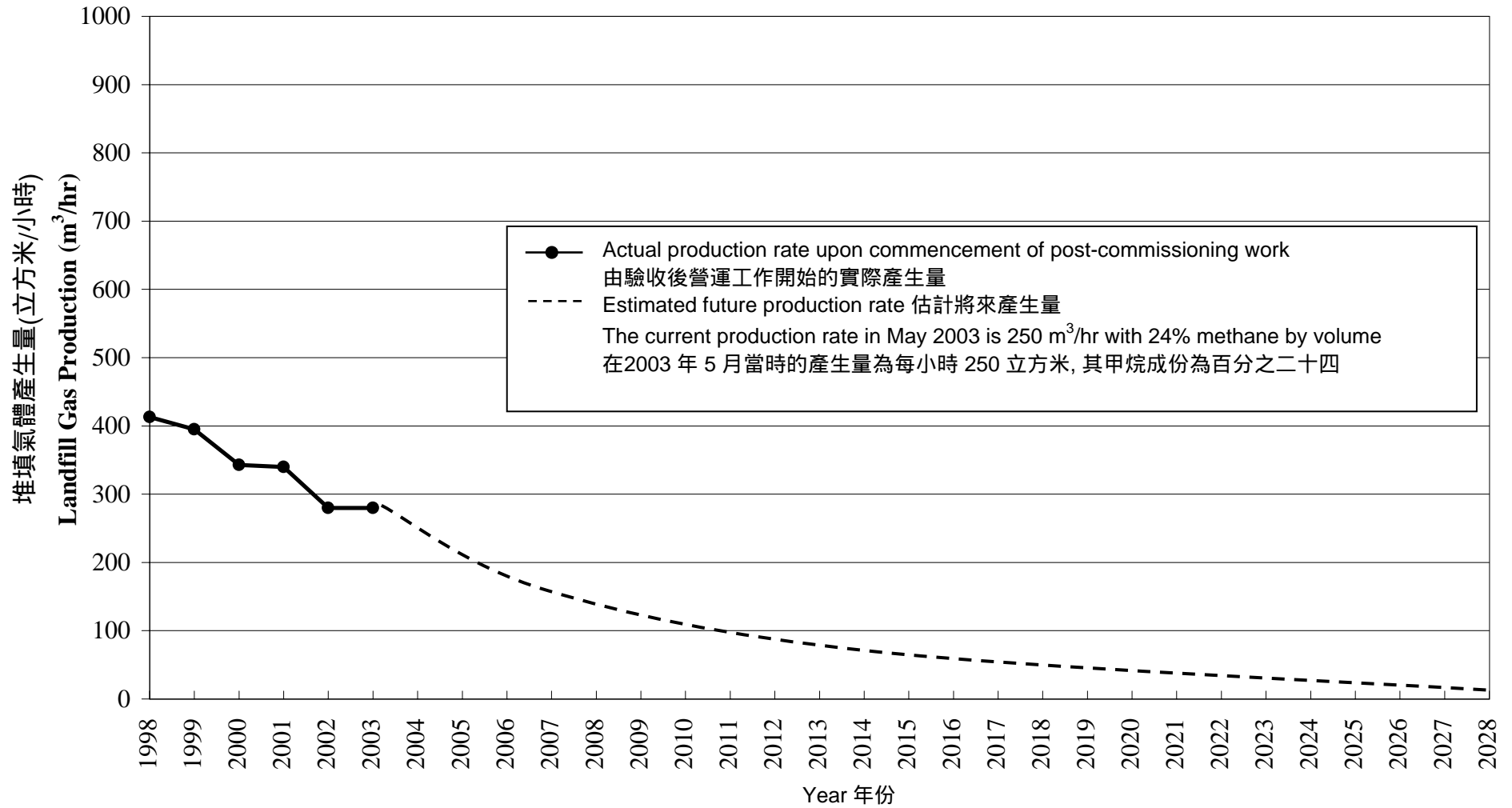
將軍澳堆填區第一期的堆填氣體產生量
Landfill Gas Production in Tseung Kwan O Stage I Landfill



佐敦谷堆填區的堆填氣體產生量 Landfill Gas Production in Jordan Valley Landfill

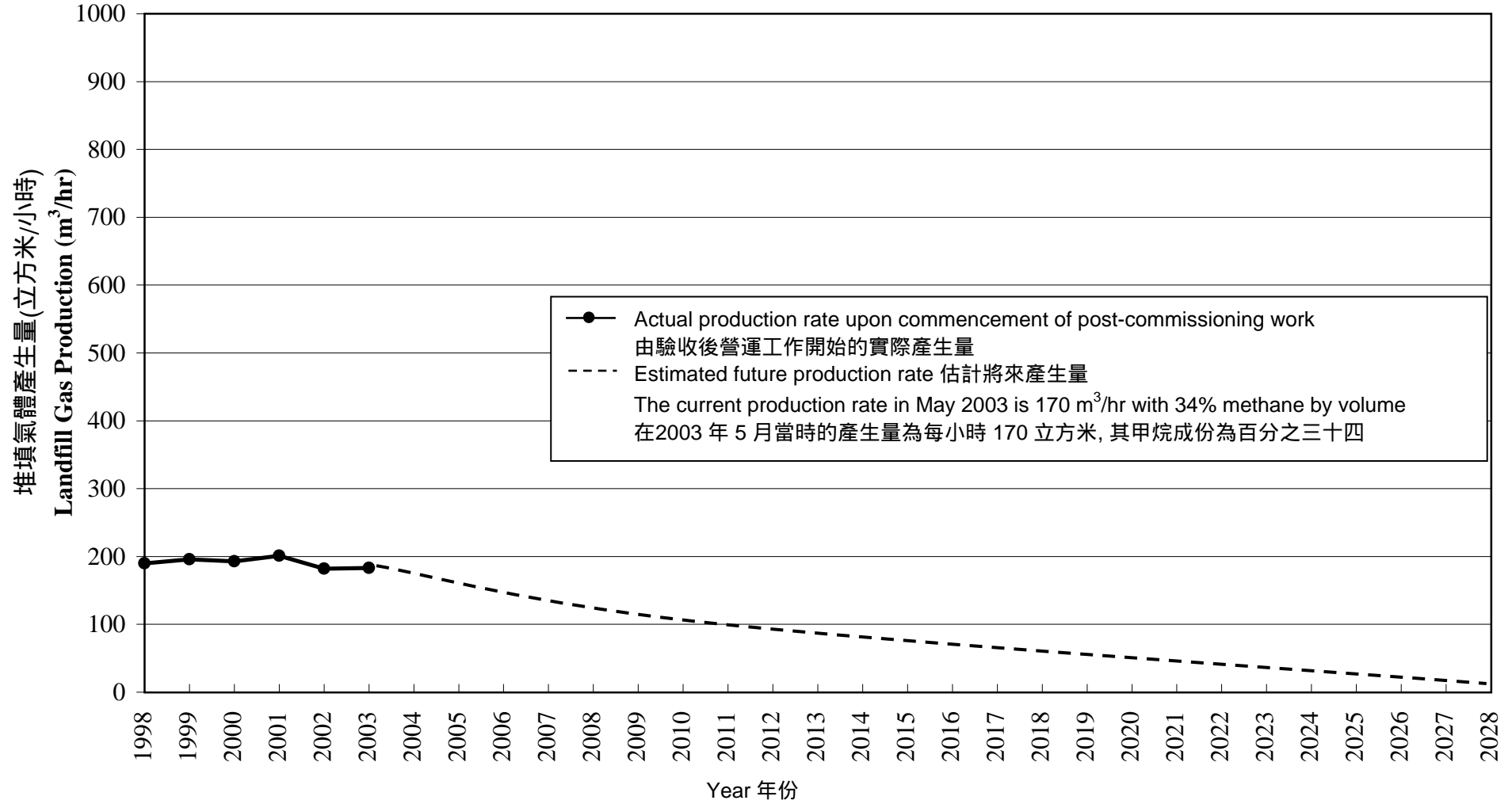


晒草灣堆填區的堆填氣體產生量 Landfill Gas Production in Sai Tso Wan Landfill



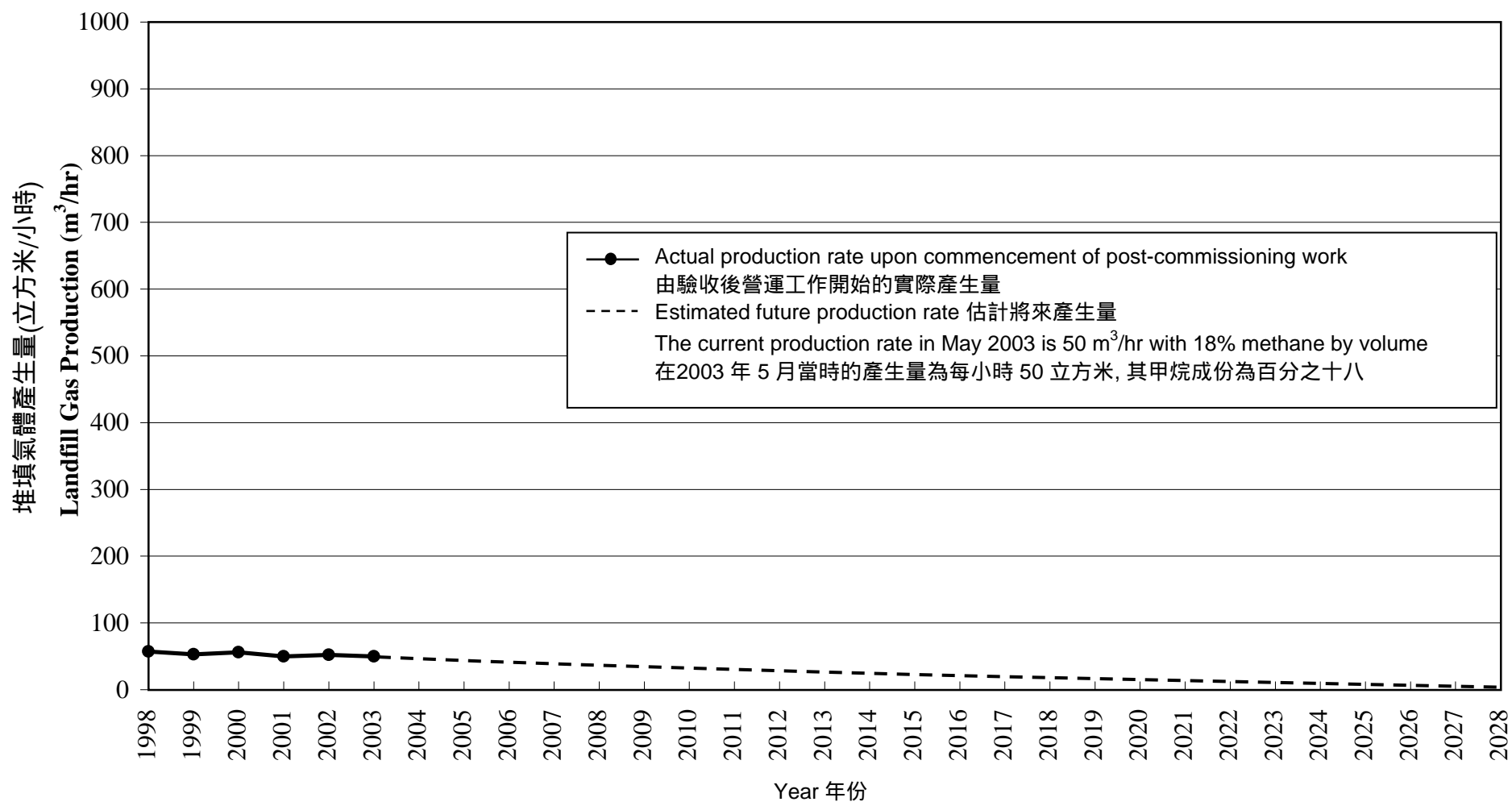
馬游塘中堆填區的堆填氣體產生量
Landfill Gas Production in Ma Yau Tong Central Landfill

附件 8
Enclosure 8



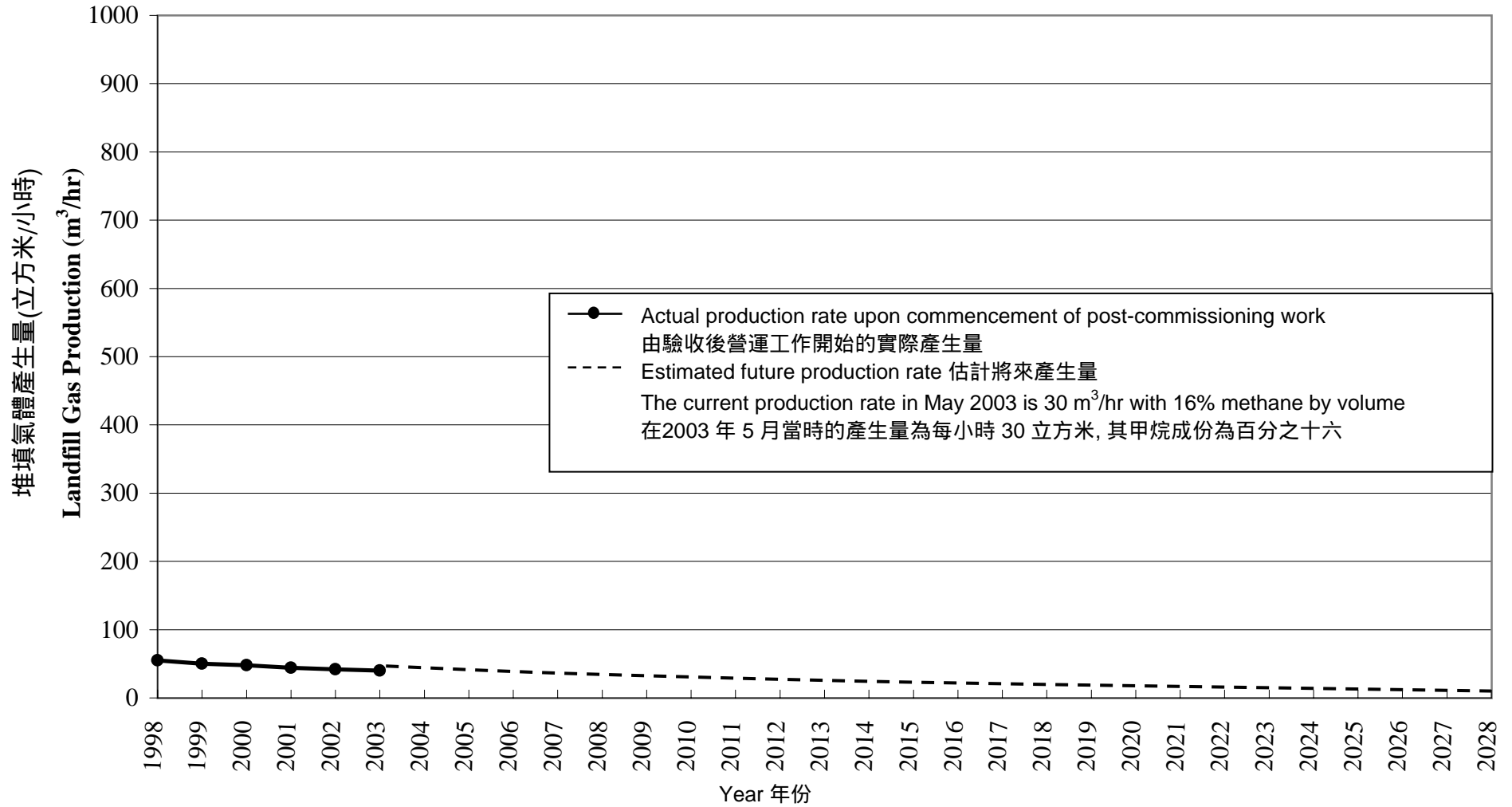
馬游塘西堆填區的堆填氣體產生量
Landfill Gas Production in Ma Yau Tong West Landfill

附件 9
 Enclosure 9

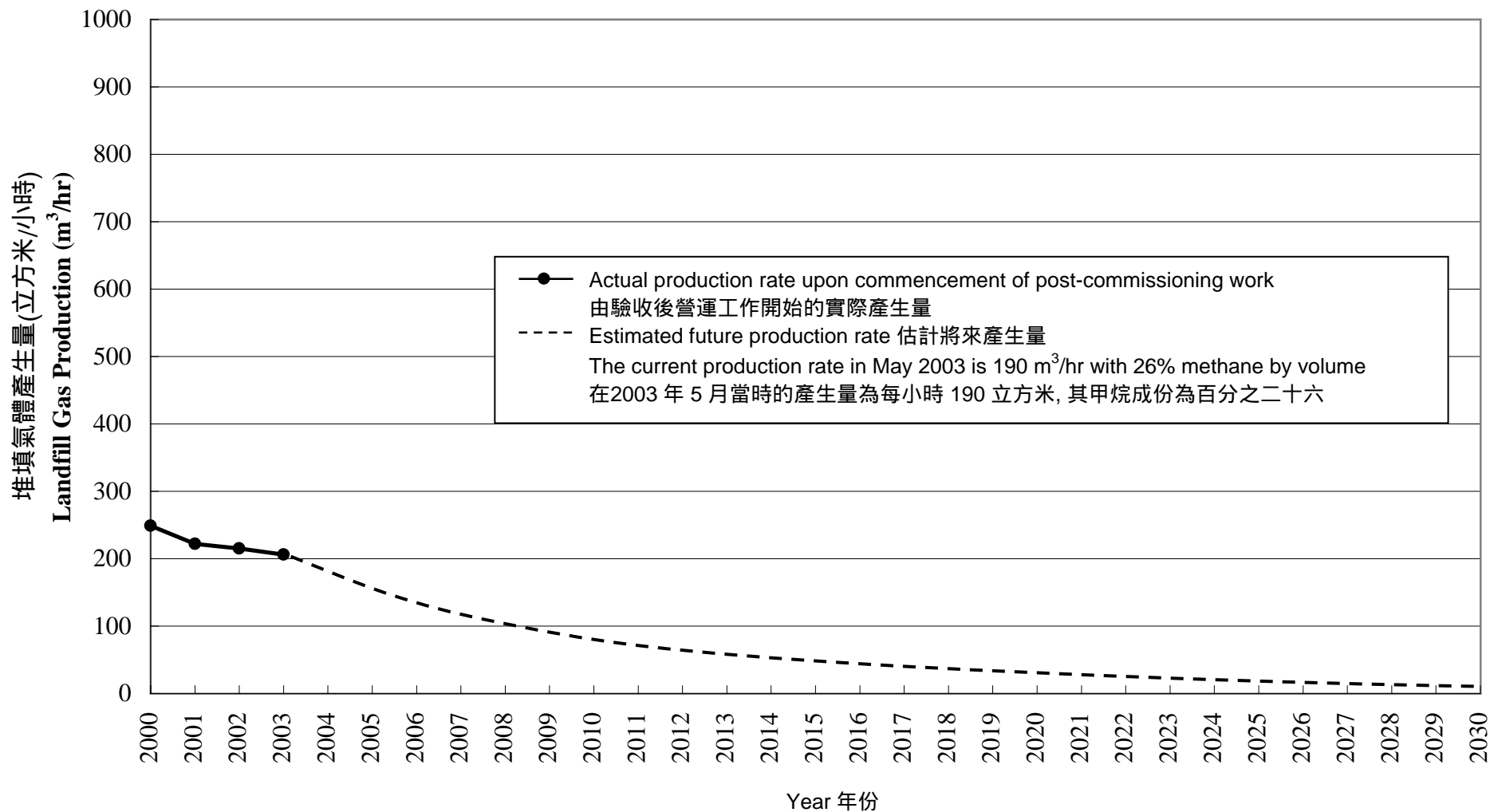


牛池灣堆填區的堆填氣體產生量
Landfill Gas Production in Ngau Chi Wan Landfill

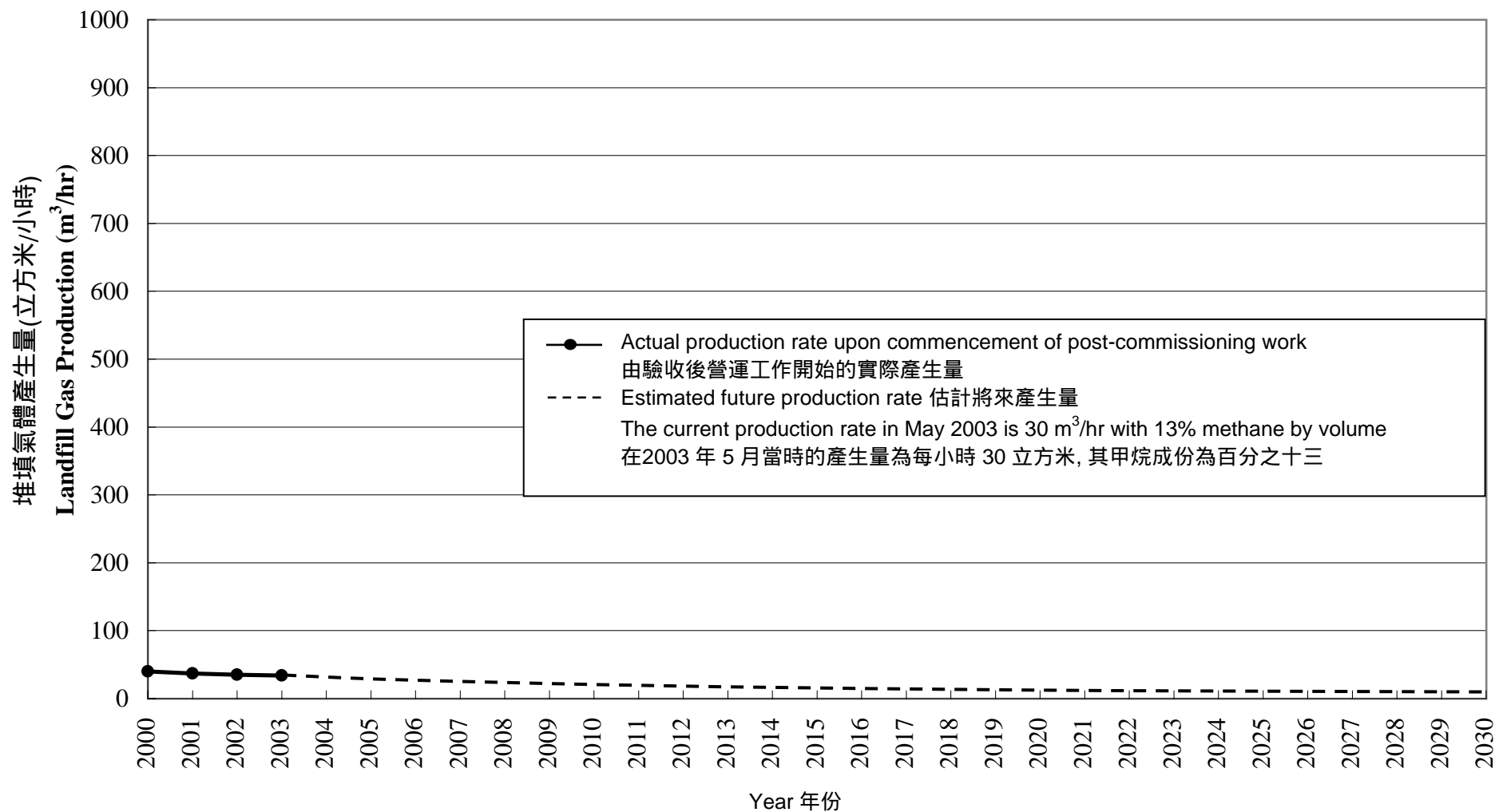
附件 10
Enclosure 10



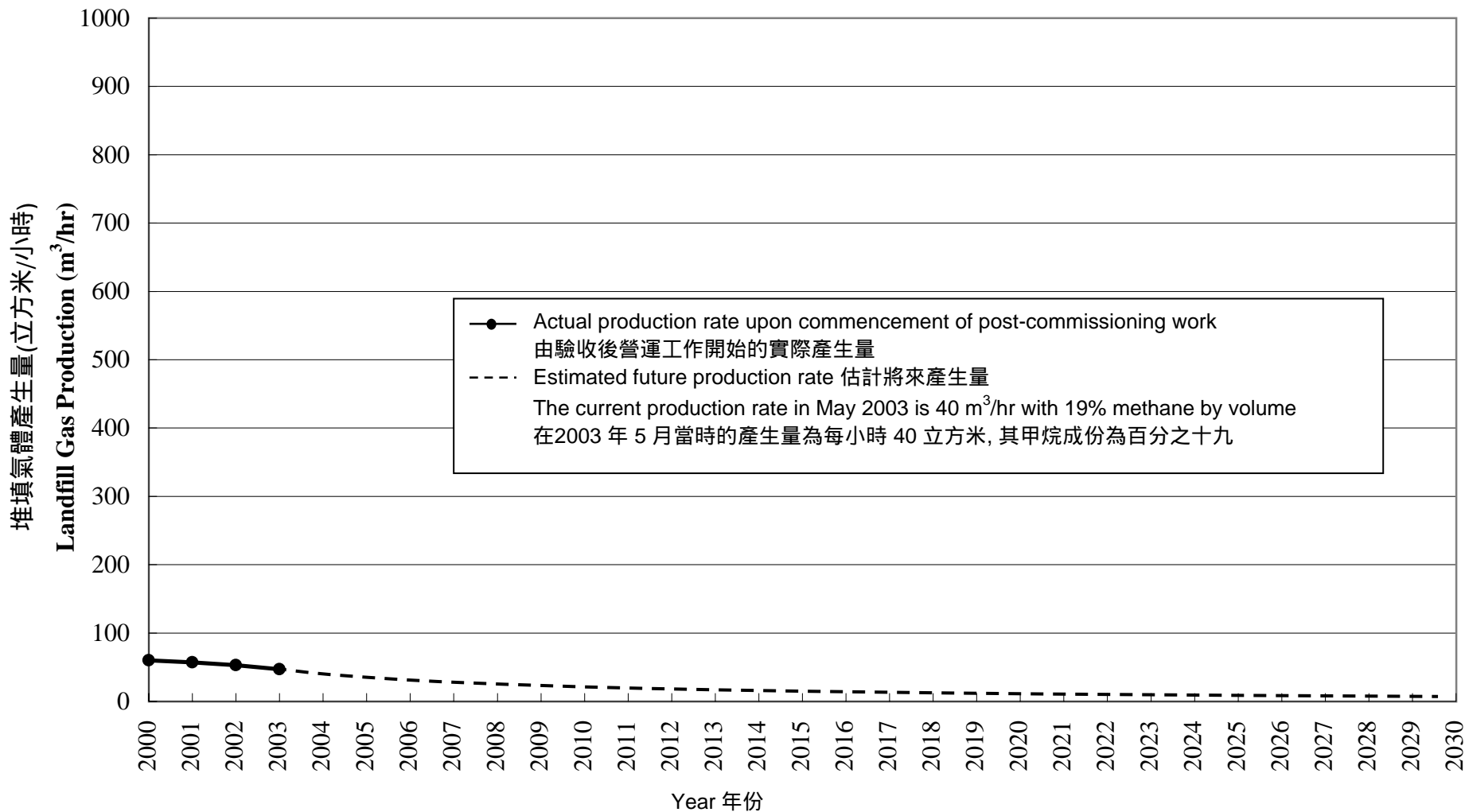
小冷水堆填區的堆填氣體產生量 Landfill Gas Production in Siu Lang Shui Landfill



牛潭尾堆填區的堆填氣體產生量 Landfill Gas Production in Ngau Tam Mei Landfill



馬草壟堆填區的堆填氣體產生量 Landfill Gas Production in Ma Tso Lung Landfill



望后石堆填區的堆填氣體產生量
Landfill Gas Production in Pillar Point Valley Landfill

