For information

Legislative Council Panel on Environmental Affairs

Water Quality Management:
A Strategic Framework for Sewage Treatment

Introduction

In June 1999, Members considered two papers relating to submissions to the Public Works Sub-Committee seeking funds for sewage treatment systems in Cheung Chau and Sham Tseng. In the course of discussion, and the subsequent discussion at PWSC, it became clear that many Members would appreciate an overview of the planning for sewage treatment in Hong Kong so as to be in a position to consider requests for funding for specific items in context. This paper attempts to provide that overview.

Planning Criteria

2. The criteria that drive the planning of sewage treatment facilities are the Water Quality Objectives (WQOs) established under the Water Pollution Control Ordinance. These are set so as to meet various environmental and conservation goals, the most important of which are the protection of public health and the maintenance of normal, natural aquatic ecosystems. Examples are:

(i) the WQO for gazetted bathing beaches, which is that the water should not contain, on average, more than 180 *E. coli* bacteria in every 100 millilitres; at this level swimmers are unlikely to contract even minor illness as a result of swimming in the water; this objective is thus a public-health-related objective;

(ii) the WQO for ammonia in marine waters; ammonia is found at quite high levels in sewage and is toxic to fish, so the

WQO specifies that in our marine waters the unionized ammonia level must on average not exceed 0.021 milligrammes in every litre of seawater; this level is unlikely to have any adverse impact on marine life;

(iii) the WQO for total inorganic nitrogen; this is a measure of the amount of nutrients in the water; a high level of nutrients will tend to promote the excessive growth of algae which may disrupt the functioning of ecosystems and, in certain circumstances, produce offensive algal blooms; these problems occur particularly in places where pollution is not well dispersed, so the WQO varies from location to location depending on the physical characteristics of the area.

3. Some WQOs cannot be expressed in quantitative numerical terms so qualitative ones are used instead. For example one WQO is that solids discharged should not be allowed to accumulate such that they have an adverse effect on marine life. Similarly toxic substances may not be discharged such that they produce immediate toxic effects or accumulate in food chains. In addition to these statutory objectives, as a result of a review in early 1998, the Administration has also adopted a qualitative objective for planning purposes of minimizing potential risk to marine mammals that may arise from the presence of sewage-derived micro-organisms in their environment.

Spatial Variation in Criteria

4. The numerical values of the WQOs may vary from place to place depending on the conservation goals (or beneficial uses) in each location, and on the *assimilative capacity* of the area in question. This latter can be thought of as the amount of waste that a body of water can safely absorb without leading to an infringement of the WQOs. It depends on the natural dispersive characteristics of the area in question. Essentially, an area of deep fast-flowing water where pollutants are rapidly diluted and dispersed will have a high assimilative capacity, whereas semi-enclosed areas, such as shallow bays, will have a low assimilative capacity. In Hong Kong, places such as Tolo Harbour and Deep Bay have a low assimilative capacity, whereas Victoria Harbour has quite a high assimilative capacity.

Sewage Treatment Strategy

5. Until the mid-80s, the basic concept of utilizing the assimilative capacity of the environment to receive and break down waste was applied to sewerage planning, but without any numerical criteria. In consequence it was assumed, for example, that large quantities of sewage receiving only rudimentary treatment could be safely discharged into the dynamic, highly dispersive environment of Victoria Harbour. But equally it was recognized that discharges into more confined waters such as rivers or semi-enclosed bays, required a much higher level of treatment. Generally speaking such discharges received biological (or "secondary") treatment to breakdown the wastes and remove some nutrients before discharge. Thus, in the mid-80s, a framework had evolved as illustrated in Figure 1, where biological treatment was provided to sewage generated in many New Towns and discharged into areas of low assimilative capacity while rudimentary ("preliminary") treatment was provided to sewage generated in the older urban areas.

6. It became clear in the early 80s that this latter position was not environmentally sustainable. Numerical objectives, such as those described in paragraph 2 above were established, and tools developed to allow assessments to be made of the quantitative relationships between the quality and quantity of sewage discharged, the locations of the discharges, and the impact on the receiving environment. This work and the subsequent construction of sewage treatment capacity has led to the position we have at present, which is represented in Figure 2. It has also provided the framework for the likely eventual configuration to be attained in the next 10 to 15 years, as shown in Figure 3. Essentially, the main features of this current strategic framework are:

(i) sewage has been or will be diverted out of all areas of low assimilative capacity; in this context, the diversion of treated sewage out of the Tolo Harbour catchment to Victoria Harbour represented the first step; future steps will focus on the need to transfer treated flows from the Yuen Long area away from Deep Bay to discharge in Urmston Road; and later on the need to transfer also the treated effluent from the Shek Wu Hui works which currently discharges into Deep Bay via the Indus River;

(ii) all major sewage discharges will be disinfected so as to remove 99.9% of sewage bacteria;

(iii) medium quantity flows discharging into areas of moderate assimilative capacity, such as inner Mirs Bay and Port Shelter have been or will be subject to biological treatment; disinfection and nutrient removal have been or will be provided where this is necessary to ensure the relevant WQOs are met;

(iv) chemically enhanced primary treatment (plus disinfection, to satisfy the requirement in (ii) above) will be provided for large flows into areas of relatively high dispersive capacity; this covers the plan for the subsequent stages of the sewerage system that will handle flows from around Victoria Harbour, as well as other large and medium volume discharges into areas of high current flow such as those that exist in northwestern waters and near the Ma Wan Channel; Sham Tseng sewage treatment works falls into this category;

(v) the treatment level for other small discharges into areas of good dispersive capacity where no conservation goals are under threat will be decided on a case-by-case basis; the Cheung Chau sewage treatment works and the replacement outfall fall into this category.

7. This approach ensures that the environmental objectives are met while minimizing the need to sterilize large areas of land with treatment works which have a considerable "bad neighbour" potential. Equally it ensures that the treatment capacity is planned in a cost-effective manner whereby expenditure of large sums of money to bring about marginal improvements in pollutant removal rates, with no associated environmental gain, is avoided.

Conclusion

8. Determination of the level of treatment to be applied to municipal sewage varies according to the assimilative capacity of the area where the

wastewater will be discharged, and the objective criteria to be met. Where numerical criteria have been difficult to establish the Administration has adopted a suitably conservative approach, as exemplified by the decision to disinfect major discharges to remove 99.9% of bacteria so as to minimize a potential threat to marine mammals. This has led to an overall strategic framework of goals for sewage treatment, summarized in Figure 3, which will provide the context for future specific sewage treatment projects and ensure cost-effective attainment of environmental goals.

Planning, Environment and Lands Bureau
Environmental Protection Department
Drainage Services Department
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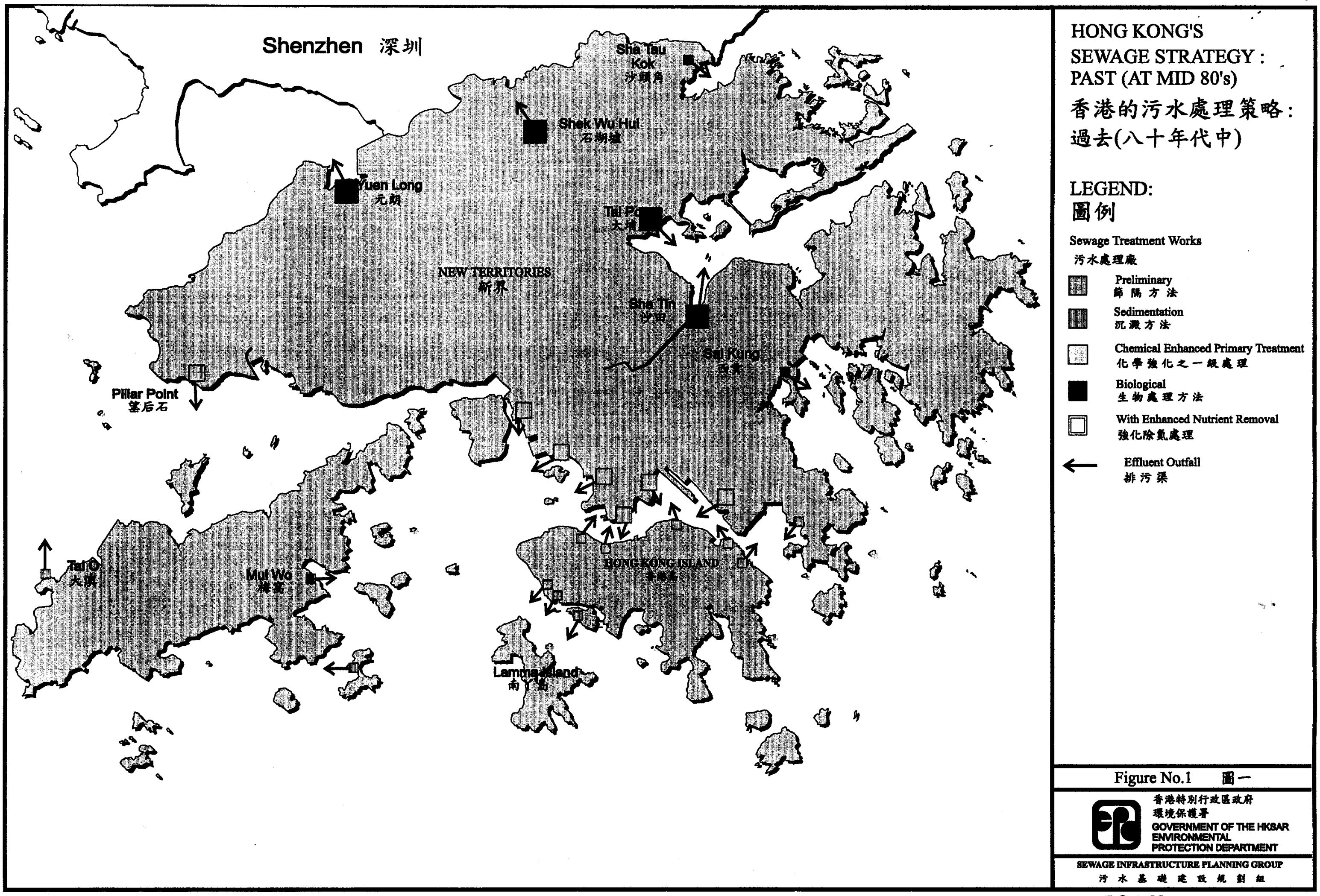

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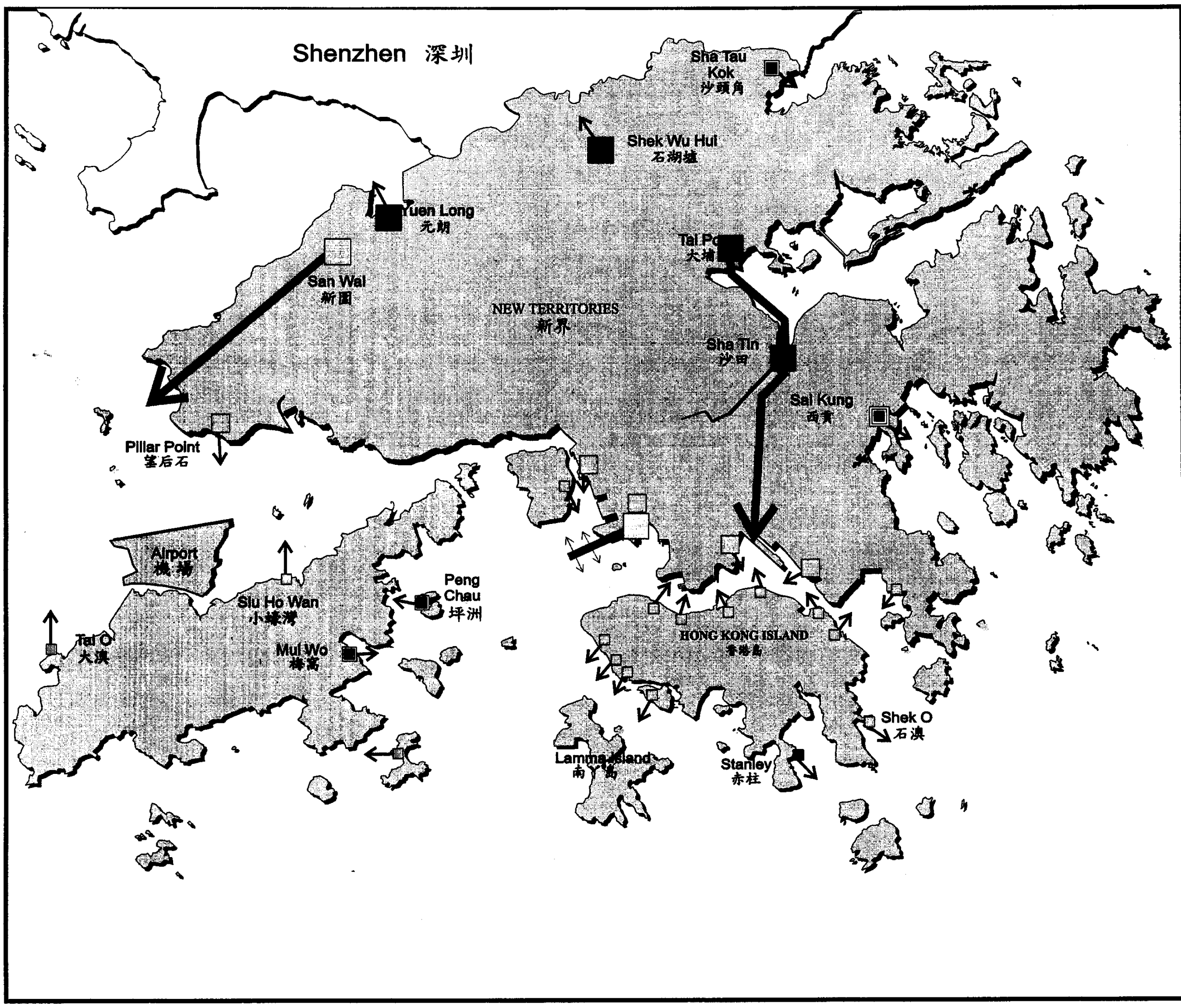


HONG KONG'S SEWAGE STRATEGY : PRESENT

香港的污水處理策略：現時

LEGEND:
圖例

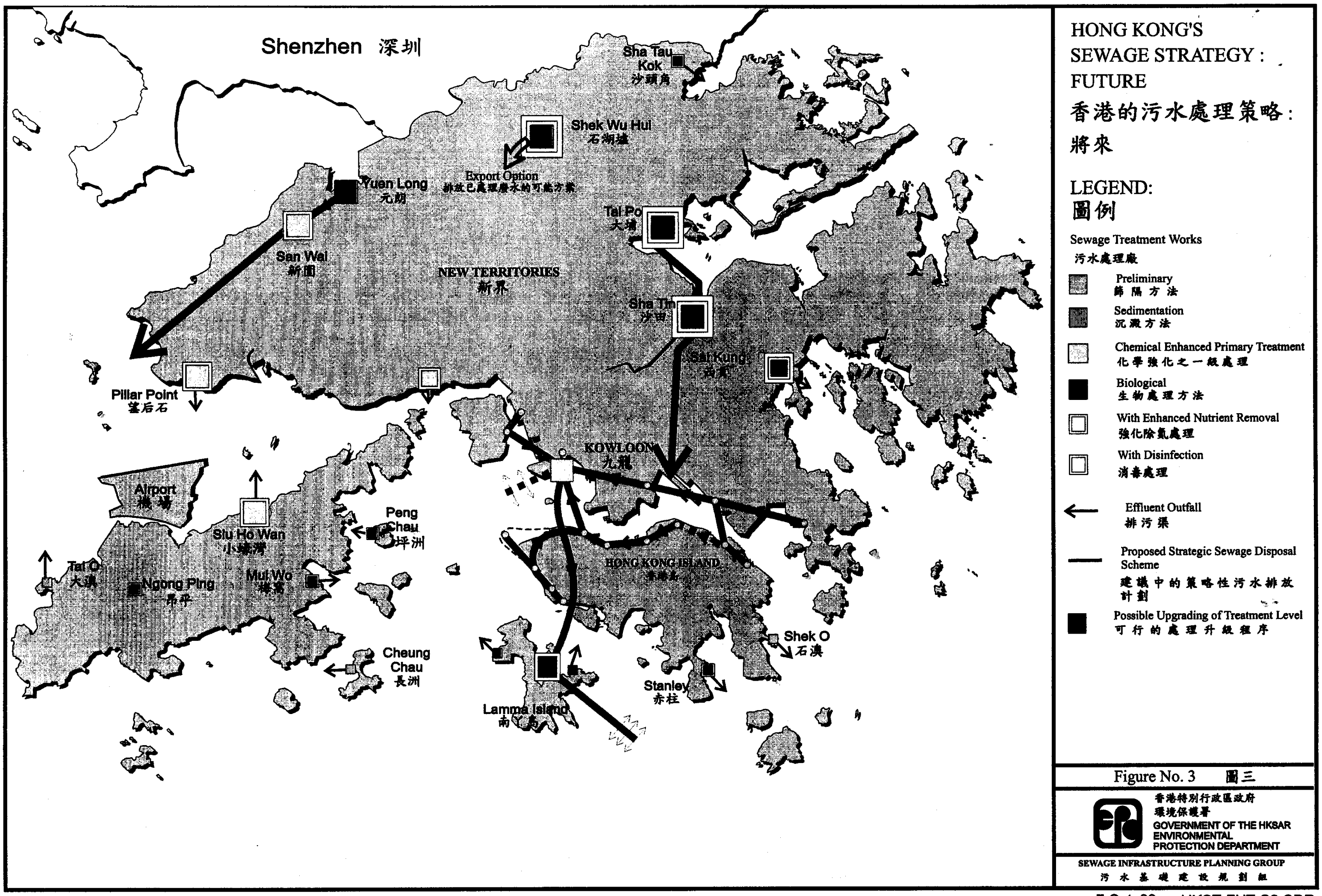
Sewage Treatment Works
污水處理廠

- Preliminary 篩隔方法
- Sedimentation 沉澱方法
- Chemical Enhanced Primary Treatment 化學強化之一級處理
- Biological 生物處理方法
- With Enhanced Nutrient Removal 強化除氮處理
- With Disinfection 消毒處理
- ← Effluent Outfall 排污渠

Figure No.2 圖二

香港特別行政區政府
環境保護署
GOVERNMENT OF THE HKSAR
ENVIRONMENTAL PROTECTION DEPARTMENT

SEWAGE INFRASTRUCTURE PLANNING GROUP
污水基礎建設規劃組



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