

**Discussion Paper of
Islands District Council
Paper No. IDC 23/2011**

Development of the Integrated Waste Management Facilities

Purpose

This paper provides an update on the development of Integrated Waste Management Facilities (IWMF) in Hong Kong.

Background

2. Waste management is an everyday issue for cities around the world. Of the 13,300 tonnes of wastes disposed of at our landfills every day, 9,000 tonnes are unrecovered municipal solid waste (MSW), 900 tonnes are sludge generated from the Harbour Area Treatment Scheme or other sewage treatment processes, and about 3,200 tonnes are construction waste. The recovery rate of our MSW stands at 49%¹. Currently, the unrecovered MSW are disposed of in their entirety at the three strategic landfills in Hong Kong, namely the South East New Territories (SENT) Landfill, the North East New Territories (NENT) Landfill and the West New Territories (WENT) Landfill.

3. For a densely-populated and small city like Hong Kong, the current practice of relying on landfills as the sole means of disposing wastes is not sustainable. We need to identify an alternative approach to properly manage the wastes generated by our city. The urgency of the task is reinforced by the fact that the three strategic landfills are expected to be filled up one-by-one in 2014, 2016 and 2018.

4. The Government has earlier confirmed the adoption of incineration as the core technology in the development of IWMF in Hong Kong. The facilities will help significantly reduce the volume of wastes. The process of incineration will also generate electricity, thus turning wastes into resource while, at the same time, reducing local greenhouse gas emissions. It will form an integral part of Hong Kong's sustainable waste management policy and contribute to the proper treatment of the tens of thousands tonnes of wastes generated by our city. In order to identify a suitable location for IWMF, a detailed site selection study was conducted in 2007-08 to examine the potential sites for developing the facility against a range of criteria including environmental, ecological, planning, transport, technology/ engineering, economic and social considerations. The study initially covered all suitable government sites throughout the territory and involved several rounds of selection before the Tsang Tsui Ash Lagoons (TTAL) site in Tuen Mun and the artificial island near Shek Kwu Chau (SKC) were identified for further consideration. The location of the two sites is shown in **Figure 1** below. In November 2008, we launched a detailed Engineering Investigation and Environmental Impact Assessment Studies (EI & EIA Studies) for the two potential sites for the first IWMF. The EIA Study was completed in January 2011 while the EI Study is near completion. In accordance with the requirements under the Environmental

¹The recycling rate for Singapore is 43% 、UK 35% 、USA33% 、France33% 、Tokyo23% 、Germany63%

Impact Assessment Ordinance, the EIA report is available for the public to comment starting from 17 February 2011.

Waste Management Strategy

5. In 2005, the Government promulgated a “Policy Framework for the Management of Municipal Solid Waste (2005-2014)” (the Policy Framework), setting out the measures of waste avoidance and minimization; promoting reuse, recovery and recycling; as well as reducing the volume of wastes as the main strategies for waste management. Under the Policy Framework, the Government will pursue, in parallel with efforts to reduce waste at source, the development of IWMF with incineration as the core technology.

6. On 4 January, 2011, the Government announced an implementation plan for waste management strategies following a review of the “Policy Framework”. The review aims to bring into action a comprehensive waste management solution for our city in the long run. The implementation plan sets "reduce, recycle and proper waste management" as the objective, with three core strategies including : (i) to strengthen efforts in promoting waste reduction at source and recycling; (ii) to introduce modern facilities for waste treatment; and (iii) to extend the existing landfills in a timely manner. The three strategies each plays an indispensable role in our waste management solution. To start with, reduction at source will relieve the pressure on waste disposal. We must further strengthen our effort in this area through raising public awareness. While it is important to provide more facilities and hardware to facilitate recycling, we also need to ensure enough support is given to our partners to underpin district programmes. Waste reduction and recovery would continue to be our priority, but the experience of other places shows that waste recovery alone cannot provide a total solution to the waste problem. Take Germany as an example. With its recycling rate at 63%, there still remains a considerable amount of wastes that have to be treated. . This explains the need to introduce modern waste treatment facilities to Hong Kong. As a proven technology, such facilities will help significantly reduce the volume of waste by up to 90%, while recovering energy for electricity generation during the process of incineration. The last, yet also indispensable, element of our waste management strategy is the timely extension of landfills. We need to ensure that sufficient landfill space is made available to cope with wastes that are not treated by IWMF due to capacity constraints and house the residual ash from incineration.

7. A series of action plans are thrashed out in line with the above strategies. They are devised to strengthen community-level waste reduction efforts, as we bring in modern treatment facilities and extend our landfills to help resolve our waste problem. The specific measures are as follows:

- (a) Raise the MSW recovery target to 55% by 2015 through stepping up publicity and promotional efforts on waste reduction and recycling;
- (b) Promote waste recovery at district levels, such as bartering and food waste recycling programmes etc.;
- (c) Speed up legislative proposals for new and extended programmes under the Product Responsibility Scheme (PRS) to encourage waste reduction at source;
- (d) Consult the public on possible options to introduce MSW charging as a direct

economic disincentive to reduce waste at source;

(e) Introduce advanced waste treatment facilities (including an IWMF with a daily capacity of 3,000 tonnes and two organic waste treatment facilities with a combined capacity of 500 tonnes per day) to help reduce the volume of wastes and turn waste into energy. We plan to seek approval from the Finance Committee of the Legislative Council (LegCo) in early 2012; and

(f) Implement the landfill extension plans in a timely manner to ensure the proper handling of solid wastes.

Evaluation of technologies

8. In order to identify the right technology for the IWMF, the government invited companies from Hong Kong and overseas to submit expression of interest for the provision of waste management technology in 2002. A total of 59 submissions were received. Subsequently an Advisory Group (AG) on waste management facilities was formed with members from professional bodies, environmental groups and the academia. Its task was to assess the proposals and recommend the waste treatment technology suitable for the IWMF in Hong Kong, drawing from a range of technologies such as incineration, gasification and co-combustion. The AG concluded that in light of the heterogeneous nature of the MSW in Hong Kong, the IWMF should adopt a multi-technology approach with incineration as the core waste treatment technology.

9. Modern incineration technology brings together an effective process control mechanism and an air cleansing system to minimize the emission of pollutants. The process of incineration is designed so that wastes would undergo treatment in a high-temperature environment, with adequate flue gas combustion residence time and in highly turbulent conditions. This would result in the optimal combustion of wastes, ensuring the complete destruction of organic pollutants (e.g. dioxin) and eliminating any factor for the generation of new pollutants in the process. Fitted with state-of-the-art flue gas cleaning and pollution control facilities (e.g. fibre filter, scrubber and powdered activated carbon injection system), the technology can effectively control pollutant emissions and meet the most stringent international emission standards. At the end of the incineration process, the residues and fly ash collected will be solidified by mixing with cement before they are disposed of at the landfills. We have conducted briefings for Islands District Council on the details of modern incineration technology and its safety standards, as well as the progress of the comprehensive site search in March, 2008 (please refer to the Paper to the Islands District Council No. IDC 48/2008).

10. Overseas experiences have reaffirmed the environmental performance of modern incineration facilities. They are designed and operated to the most stringent international emission standards, suitable for operation in urban settings with no adverse health impact on residents. This is confirmed by a study conducted in England in 2004, which found no evidence of the presence of modern incinerators impacting human health². Recent studies

² DEFRA. 2004. Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes. Enviro Consulting Ltd., University of Birmingham, Risk and Policy Analysts Ltd., Open University and Maggie Thurgood, Department of Environment Food and Rural Affairs, HMSO, London, UK.

carried out in Portugal and Spain also found no noticeable increase in the dioxin level in the bodies of residents who live close to incinerators. The emission standards to be adopted for the proposed IWWMF will be as stringent as those adopted in technologically advanced countries. We will also set up a highly transparent monitoring system, with real-time emission data made available to the public.

11. As recommended by the Advisory Committee on the Environment (ACE), Hong Kong will introduce IWWMF in phases. In deciding the scale of the Phase 1 IWWMF, we have considered the factor of economies of scale and made references to the experiences of other densely-populated cities with demographic and geographic similarities as Hong Kong. It is concluded that the first IWWMF should have a daily handling capacity of about 3,000 tonnes. The facility will also incorporate a small scale sorting and recycling plant to recover the recyclable materials from the MSW taken in by the plant.

12. On the basis of the AG's recommendations, we further reviewed the various detailed thermal treatment technologies, including the moving grate technology, fluidized-bed, rotary kiln incineration, as well as the eco-co-combustion system, gasification, plasma gasification and pyrolysis, in the EI study in 2009. The review identified moving grate incineration technology as the mainstream treatment technology for waste management facilities worldwide, adopted on the merits of its environmental performance, technological soundness, reliability, operation, adaptability in waste treatment and cost effectiveness. The conclusion is consistent with the views given by the AG previously. The ACE was consulted and gave its support in December 2009.

Environmental Impact Assessment Study

13. The EIA study on IWWMF commenced in 2008 to assess the cumulative impact on areas arising from the Project and other developments, covering noise, air, water, waste, ecology, landscape and cultural heritage and was conducted in accordance with the Environmental Impact Assessment Ordinance and the Technical Memorandum on EIA Process. The EIA has proposed appropriate mitigation measures to ensure that the impact on the environment can be alleviated to an acceptable level, and will recommend environmental monitoring and audit programmes to ensure the effectiveness of various mitigation measures. The EIA study was conducted based on the development of an IWWMF with a treatment capacity of 3,000 tonnes per day at the two potential sites, i.e. TTAL site in Tuen Mun and the artificial island near SKC.

14. Three scenarios are examined based on the two potential sites in the EIA study:

- (a) developing an IWWMF with a capacity of 3,000 tonnes per day at the TTAL site;
- (b) developing an IWWMF with a capacity of 3,000 tonnes per day at the artificial island at SKC; and
- (c) developing an IWWMF with a capacity of 3,000 tonnes per day at each of the two potential sites (co-existing scenario).

Annex

15. The summary of the EIA study is at **Annex**. The EIA report indicates that the construction of modern incineration facilities at the above two sites and under all three scenarios is environmentally acceptable, provided that advanced technologies are adopted

and appropriate mitigation measures are implemented. The main points of the EIA report are as follows:

(a) the EIA report indicates that emission from the incineration plant will fully comply with the European Union (EU) emission standards for MSW incinerators, the most stringent standards available. Advanced air pollution control systems, including selective catalytic reduction (SCR) for nitrogen oxides (NO_x) removal, activated carbon for dioxins removal and continuous emission monitoring system, will be installed in the IWMF to ensure emission from the IWMF stack would be within the most stringent standards. As such, the Project will not incur any unacceptable risks;

(b) with the implementation of recommended mitigation measures and adoption of best construction practices, no unacceptable residual impact on water quality is expected during the construction phase. An on-site wastewater treatment plant will be provided in the operation phase. All wastewater generated during operation will be treated at the treatment plant;

(c) no archaeological site was identified within the study area. Therefore, it will not cause any adverse archaeological impact;

(d) regarding the visual impact induced by reclamation and construction of facilities, various mitigation measures were proposed, which included an aesthetic design, to enhance the aesthetic quality of the Project. According to the experiences in Japan and Europe, modern waste to energy facilities can become local attractive icons;

(e) both proposed sites do not fall within the statutory or proposed ecology conservation zones. The area for reclamation has been minimized. In addition, the island site has taken an artificial island construction approach to preserve the original coastline. Works design and construction technologies with least pollution impact will be adopted. With the implementation of various recommended mitigation measures, potential impact of the Project on marine ecology and fisheries is considered to be acceptable; and

(f) on the storage and treatment of waste and ashes, leakage of any fugitive release into the outdoors atmosphere is not expected. The fly ash and air pollution control residues will be solidified by mixing with cement inside the incineration plant. With the implementation of the recommendations of the health risk control measures, potential health impacts resulting from the transport, storage and disposal of waste and ashes will all meet the environmental standards.

16. In addition, the IWMF will include an environmental education center to demonstrate the most advanced waste-to-energy technologies for environmental education purpose. Like the Sludge Treatment Facilities currently under construction, the IWMF will incorporate recreational and leisure facilities. As to the specific types of community facilities to be included, the Government will fully consult the District Councils concerned during the design and planning stage.

17. The public are welcome to provide their views on the EIA report between 17

February and 18 March under the Environmental Impact Assessment Ordinance. The full EIA report is now available at internet website (www.eia.hk). In the meantime, we will discuss the EIA report and the site selection with stakeholders including the District Councils concerned, with a view to developing the first IWMP in Hong Kong.

Project profile and operation

18. The site selection study completed in 2007-2008 identified TTAL and the adjacent water area of SKC as the sites for the development of the IWMP. The TTAL site is located in northwest New Territories, adjacent to the WENT Landfill and the Black Point Power Station. The other site is an artificial island to be formed by reclamation at the southwestern coast of SKC. At present, SKC is granted to the Society for the Aid and Rehabilitation of Drug Addicts (SARDA) for use as a rehabilitation centre, which now houses approximately 300 rehabilitants and staff. There is no other existing or planned residential, commercial or industrial development on the island. The IWMP will be built on a piece of reclaimed land measuring about 11.8 hectares (ha) with berth area and storage area for waste containers. Due to occasionally rough sea condition in the vicinity of the artificial island near SKC, the Project will include constructing a breakwater of about 4.1 ha to ensure that loading/ unloading activities can be safely carried out in the berth, and that the safety of facilities can be guaranteed. The area enclosed by the breakwater (including the area of the breakwater) will be about 31 ha (**Figure 2**). To conserve the natural coastline of SKC, the reclamation area will not be connected to SKC. Instead, the coast of SKC and the reclamation area will be separated by a water channel.

19. The infrastructure of the IWMP will comprise an advanced incineration plant, a mechanical sorting and recycling plant, and ancillary and supporting facilities (**Figure 3**). Major facilities include: an incineration plant (including 6 moving grate incineration units, a waste heat recovery and power generation system, a flue gas treatment system, a stack, an ash storage and handling system and an odour control system, etc.), a mechanical treatment plant (including mechanical shredding and sorting facilities and an odour control system, etc.) and ancillary and supporting facilities (including an administration building/ visitors and environmental education centre, a desalination plant, a wastewater treatment plant, an electricity supply and export system). An on-site desalination plant will be provided for supplying fresh water to the IWMP. An on-site wastewater treatment plant will also be provided and the treated effluent will be reused in the incineration plant or the mechanical treatment plant or for washing and landscape irrigation within the IWMP. No effluent will be discharged into the nearby water body. Electricity generated during the incineration process will be used for daily operation of the facilities within the IWMP. Surplus energy will be exported via the newly laid cables to the electricity substation for connection into the electricity grids.

20. The IWMP will be operated on a 24-hour basis daily throughout the year, with the reception of MSW to be limited from 8 am to 8 pm. MSW loaded in containers will be delivered daily by marine vessels to a pier of the artificial island from the existing refuse transfer stations, including the Island East Transfer Station, Island West Transfer Station and West Kowloon Transfer Station. At the reception hall of the incineration plant, MSW from the containers will be discharged to a waste bunker. The MSW will then be fed into incineration furnaces for combustion. The heat energy released will be recovered to generate electricity through waste heat boilers and steam turbine generators. Flue gas generated from the incineration furnaces will be treated before discharging to the atmosphere.

Bottom ash, fly ash and air pollution control residues produced from the incineration process will be collected, fly ash and air pollution control residues will be stabilized by cement solidification pretreatment inside the plant and then disposed of at the WENT Landfill or its extension if they have met the disposal requirements. MSW delivered to the mechanical plant will be discharged to a waste bunker before further processing.

21. During the construction and operation phases of the IWMF, employment and economic opportunities will be created. Regarding the artificial island near SKC, it will generate demand for economic activities for SKC and the neighboring islands, such as Cheung Chau. The ferry services set up between the IWMF and Cheung Chau during the construction and operation periods, together with the education centers and recreational and leisure facilities within the IWMF site will serve residents in Cheung Chau and other outlying islands.

Overseas study visit for advanced waste facilities

22. In September 2009, a delegation comprising representatives from the EPD and 26 members of the Tuen Mun and Islands District Councils conducted a study visit to Tokyo and Osaka to inspect the use of advanced incineration technologies for waste and sludge treatment in Japan. The delegation visited three MSW incineration facilities, two sludge incineration facilities, and related community recreational facilities etc. The delegates had first-hand experience of the advanced operation of Japanese waste incineration facilities and the standard of operation of such facilities to meet or even exceed the highest environmental protection and safety standards. Apart from providing waste treatment services, some of the facilities are iconic architecture in their community and serve as a leisure and recreation cum environmental education center at the same time.

Site selection preference for the first modern IWMF

23. In the Policy Framework promulgated in 2005, the Government pointed out that Hong Kong must adopt advanced technologies to treat unavoidable waste in a cost-effective and sustainable manner. The planned modern waste treatment facilities will employ the state-of-the-art technology, and adopt the highest standard of management practice and environmental protection measures, their impacts on the surrounding environment will be minimized.

24. The EIA for the IWMF has now been completed. Taking into account the EIA report results, other factors relating to site selection and Hong Kong's overall waste management strategy as a whole, the Government has identified the artificial island near SKC as the preferred site for developing the first modern IWMF, subject to final approval of the EIA report. The main consideration factors are: –

- (a) Central location and distance of MSW transportation. The artificial island near SKC is closer to the refuse transfer stations on Hong Kong Island and Kowloon than TTAL. We estimate that the aggregate refuse vessel transfer trip length from the transfer stations to an IWMF at the artificial island near SKC would be reduced by one fourth to one third. The operation of the IWMF at the artificial island near SKC would be more environmental and cost effective. It would also reduce marine traffic near Ma Wan. . Residues generated by the incineration process will be transported by sea

directly to the landfill at Nim Wan, avoiding the required land transport for delivery of the residues from TTAL to the landfill at Nim Wan;

(b) TTAL and SKC are both remote locations, and SKC is even farther from major population clusters than TTAL. There is a residential population of about 300 on the island. SKC is about 3.5 km to 5 km away from Cheung Chau which is not located in the prevailing downwind direction (i.e. northeasterly wind towards southwest in the sea). It is also worth noting that there are no other emissions sources within 10 km of the SKC site. The cumulative impact on the air quality would be relatively small;

(c) The IWMF could generate positive economic synergy with nearby islands, particularly Cheung Chau during the construction and operation stages, in terms of an increase in employment opportunities, ferry service and other economic activities from people who work at or visit the facility); and

(d) With regard to the medium to long term planning strategy for waste management facilities, the selection of the IWMF site at the artificial island near SKC will achieve a well-balanced spatial distribution for waste management facilities for Hong Kong as a whole.

25. Developing the first modern IWMF on the artificial island near SKC will require a relatively longer construction period and a higher capital cost. On balance, we consider it important to achieve a more balanced distribution of waste facilities and more efficient interface with the refuse transfer station network. It would further minimize the impact on air quality, and reduce greenhouse gas emissions. The reclamation works will absorb about 4.6 million tonnes of construction waste, which would otherwise occupy space at our fill banks.

26. The first IWMF will have a capacity of 3,000 tonnes a day. We plan to seek funding approval from the LegCo in early 2012 and the facility is expected to be commissioned in 2018 to alleviate the pressure on the landfills. We shall review the need for a second IWMF when the Phase 1 project is underway, taking into account the progress of our waste reduction initiatives.

Reduction of greenhouse gas emissions

27. As stated in Hong Kong's Climate Change Strategy and Action Agenda, the electricity generated from waste in the incineration process is a form of renewable energy. Since fossil fuel is not used in the generation of electricity, this will reduce greenhouse gas emissions from power plants. It is estimated that the first IWMF will reduce 440,000 tonnes of carbon dioxide a year.

The Way Forward

28. The public is welcome to give their views on the EIA report of the IWMF Phase 1 in accordance with the Environmental Impact Assessment Ordinance. We will discuss with stakeholders about the EIA report and the preferred location of the IWMF. In order to expedite the preparation for the project, the EPD and Lands Department, pursuant to the Foreshore and Sea-bed (Reclamations) Ordinance (Cap.127), are preparing the pre-gazettal

work on the limit of works area of the IWMF and that of the foreshore and sea-bed to be affected by such works. We are also working with Planning Department on the advance work for the preparation of Shek Kwu Chau Outline Zoning Plan (OZP), which is to be drafted by the Town Planning Board pursuant to the Town Planning Ordinance. The scope of the OZP will include SKC and the site required for providing the IWMF. We expect the gazettal in accordance with the requirements of the said two Ordinances would be made in April this year.

29. We will conduct the pre-qualification of the IWMF works in the fourth quarter of 2011 and seek LegCo funding in early 2012. If the artificial island near SKC is chosen as the site, the IWMF is expected to be completed for operation in 2018. We will pay close attention to each step of the preparation work and expedite all the necessary actions if possible so that the IWMF can be commissioned as early as possible. Meanwhile, we will continue to actively promote reduction, reuse and recycling of waste and eco-responsibility in order to reduce the amount of waste generated.

Environmental Protection Department
February 2011

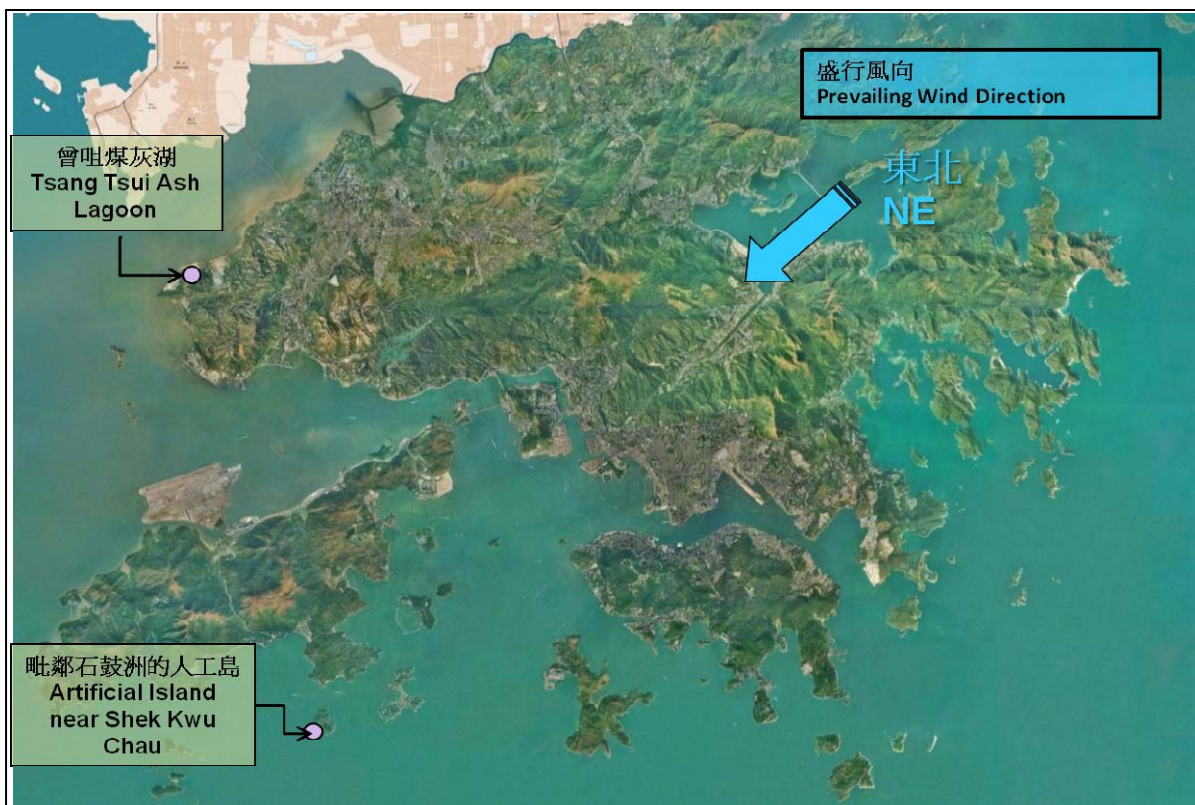


Figure 1 – Possible locations for development of the IWMF Phase 1.



Figure 2 – Photomontage of the IWMF Phase 1 (on the artificial island near SKC)
[the visual aspect of the development will be subject to detailed design and we would engage the community in the design process]

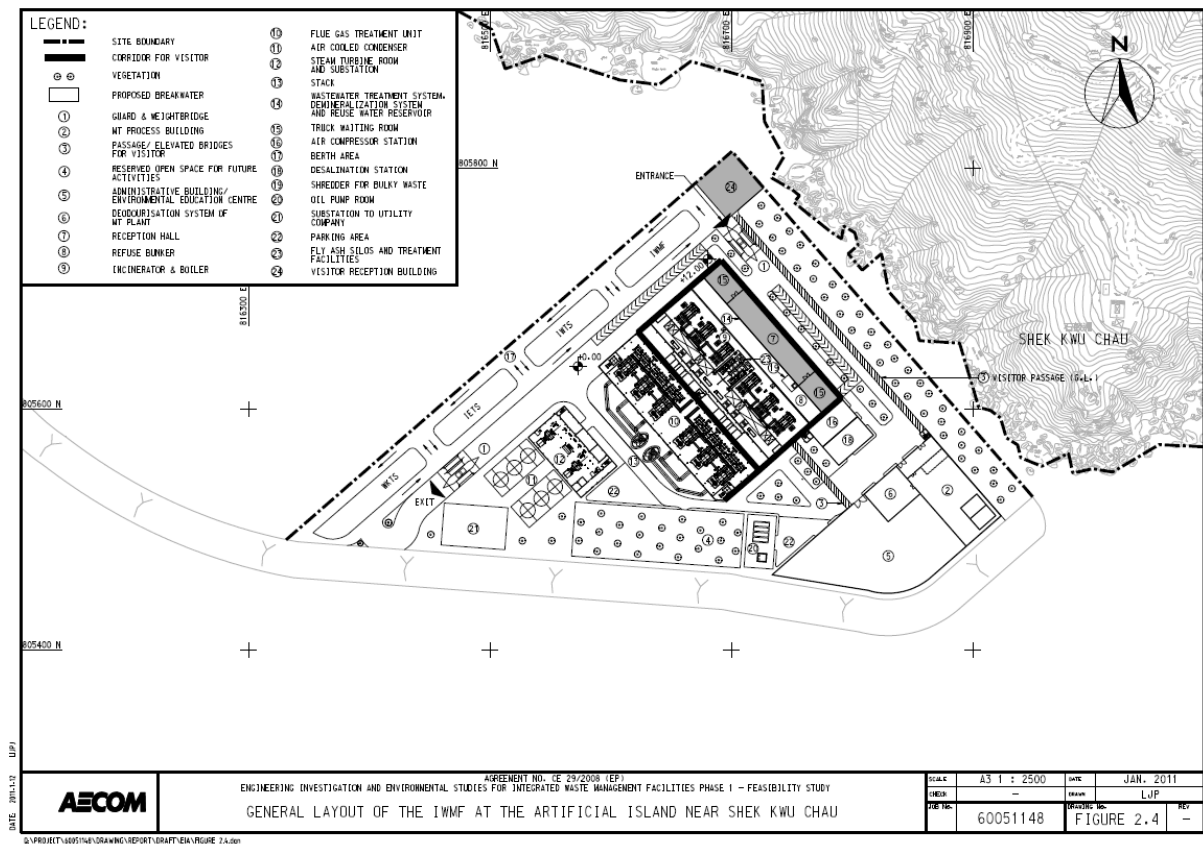


Figure 3 – Layout plan of the proposed IWMF Phase 1 (on the artificial island near SKC)

EIA Study for the IWMF development

Results of the EIA Study on development of the IWMF Phase 1 on the Artificial Island at SKC:

(a) Air Quality Impact

Construction Phase - Air quality impact (dust impact) from the construction works of the Project would be minimal.

Operation Phase - During the operation of the IWMF, the potential sources of air quality impact would be: air emissions from the incinerator stacks and the odour nuisance from the waste reception halls, the waste storage area and the mechanical treatment plant. Advanced air pollution control system, including selective catalytic reduction (SCR) for nitrogen oxides (NO_x) removal and activated carbon for dioxins removal and continuous emissions monitoring system will be installed for the IWMF to ensure that the emissions from the IWMF stacks will meet the target emission limits that are the same as or more stringent than those stipulated in the Hong Kong and the European Commission for waste incineration. Cumulative air quality impact assessment has been undertaken for the Project at the artificial island near SKC taking into account the emissions from both regional and local sources, including the emissions within the Pearl River Delta Economic Zone and major local air pollution sources in Hong Kong. The predicted maximum cumulative concentrations of relevant Air Quality Objectives (AQOs) parameters at the representative air sensitive receivers in areas that might be impacted by the IWMF emission all complied with the corresponding AQOs. Besides, odour nuisance may arise from the operation of the on-site wastewater treatment plant, the waste reception halls, the waste storage areas and the mechanical treatment plant of the IWMF. The wastewater treatment plant, the waste reception halls and the waste storage areas would be fully enclosed and the odorous air in these facilities would be extracted and used as combustion air for incineration to remove the odorous compounds. For the mechanical plant, they would be equipped with deodorizing system of 95% odour removal efficiency. Besides, these areas would also be operated under negative pressure to prevent odour leaking to the outdoor environment. The predicted cumulative odour concentrations would comply with the criteria required in the Technical Memorandum on EIA Process (EIAO-TM). Adverse odour impact on nearby ASRs would not be expected.

(b) Noise Impact

Construction Phase – Study result shows that without mitigation, it is anticipated that construction noise will not exceed the daytime noise criteria. Having said that, it is still proposed to use good methods to control noise emitted from construction sites so as to eliminate any potential noise.

Operation Phase – Noise impact from stationary machinery during operation can be mitigated effectively by including the noise sources in noise control treatment at the design stage. The same method can be used during operation phase. Therefore it is anticipated adverse

residual noise during operation will not be created.

(c) Water Quality Impact

Construction Phase - With the implementation of recommended mitigation measures and site practices, no unacceptable residual impact on water quality arising during the construction phase from the construction site is expected. In order to minimize dredging and filling work of the Project and its environmental impacts, the study proposed to use cellular cofferdam and breakwater to replace sloping seawall. It therefore proposed not to carry out large-scale sediment dredging work during both reclamation work and breakwater construction work on the artificial island near SKC. However, small-scale dredging work will be needed to remove the top 1-metre of clayey marine deposit for installing an anti-scouring protection layer. The study model showed that when mitigation measures were being taken, water quality impact arising from the dredging work would be localized and slight and no such impact in significant scale would be caused. However, the study also recommended various measures including silt curtain system, control over dredging rate and filling rate and so on, so as to ensure that no unacceptable water quality impact would be created. Moreover, the study analyzed that stirred up sediment during the submarine power cable laying process would be resettled in the area within 80 metres along the cable alignment. Since all known water quality sensitive receivers are located outside this strip of impact zone, and the submarine cable laying work would be completed in a short time, potential water quality impact would be short and acceptable.

Operation Phase – An on-site wastewater treatment plant will be provided and all generated wastewater will be discharged to the plant for treatment. The treated effluent from the wastewater treatment plant will be reused in the incineration plant and mechanical treatment plant or for washing and landscape irrigation within the IWMPF site. There would not be any wastewater effluent discharged to the coastal waters of the Southern WCZ. An on-site desalination plant will be provided for supplying fresh water to the IWMPF. Saline water would be discharged from the desalination plant at a low discharge rate. The saline water has been quantitatively assessed to be minor and acceptable, and adverse impact on water quality due to the saline water discharge would not be expected.

(d) Waste Management Implications

Construction Phase - The types of waste that would be generated during the construction phase of the Project include dredged marine sediment, construction and demolition (C&D) materials from foundation works and piling works, general refuse from the workforce and chemical wastes from the maintenance of construction plant and equipment. Provided that the wastes are handled, transported and disposed of properly and good site practices and waste reduction measures are implemented accordingly, adverse environmental impact is not expected during the construction phase of the Project.

Operation Phase - The end product from the incineration process of the IWMPF would include bottom ash, fly ash and air pollution control residues, which would be disposed of at landfill after checking for compliance with the proposed incineration residue pollution control limits. Pre-treatment of fly ash and air pollution control residues by cement solidification or

chemical stabilization will be undertaken prior to disposal at landfill to ensure that pollutants would not leach to the environment. Limited amount of chemicals or chemical wastes would be used or generated from the operation of the IWMF. Good practices and response procedures for contamination prevention have been recommended. With proper implementation of the recommended practices and response procedures, the potential for land contamination due to the IWMF operation is expected to be minimal.

(e) Ecology

The waters to the south of Lantau and Lamma Island, including the area near SKC is an important habitat for Finless Porpoise (*Neophocaena phocaenoides*), a species of conservation interest due to their high occurrence in the area. A total of 15 species of corals, including one uncommon species, have been identified along the shore of SKC within and in the vicinity of the Project site. An active nest of White-bellied Sea Eagle (*Haliaeetus leucogaster*), an uncommon species with limited number of known breeding sites in Hong Kong, had been recorded near the proposed reclamation area. The key potential direct impact identified under the Project include permanent loss of 31 hectares (ha) of important habitat for Finless Porpoise, covering the proposed reclamation area and the embayment area within the breakwaters. Mitigation measures proposed to mitigate the loss include designating a marine park of approximately 700 ha in the waters between Soko Islands and SKC, in accordance with the statutory process stipulated in the Marine Parks Ordinance. A marine park study will be conducted to identify the suitable location and area for establishing the park. Marine ecological enhancement measures that should be implemented in the proposed marine park, such as deployment of artificial reef and release of fish fry, will also be drawn up. For the indirect impacts on Finless Porpoise, such as acoustic disturbance, collision with vessels, and alteration of behavioural pattern during construction and operation phases, mitigation measures proposed include avoidance of noisy works during peak Finless Porpoise season, monitoring of exclusion zone, adoption of regular traffic route, and limitation of vessel speed to ten knots at areas with high Finless Porpoise sighting density. With the implementation of the proposed mitigation measures, adverse impacts on Finless Porpoise would be mitigated to acceptable level. A total of 198 coral colonies of small sizes and low coverage (<1%), comprising one hard coral and 7 octocoral species, within the proposed reclamation area may be directly affected by the Project. As all the corals to be affected were recorded to be trans-locatable, coral translocation has been recommended to avoid any direct loss. Other corals, including the one uncommon species that are located along the shore of SKC may be indirectly affected by the potential elevation in suspended solid level during construction phase; however the impact could be effectively mitigated through water quality control measures. With the implementation of the proposed measures, unacceptable impacts on corals are not anticipated.

The pair of White-bellied Sea Eagles (WBSE) in breeding and their nest may experience indirect disturbances during the construction and operation of the IWMF. Such impact could be mitigated through avoiding noisy works during the breeding season of WBSE, restricting vessel access near the nest of WBSE, avoiding unnecessary lighting and providing shields for lights to minimize glare disturbance from the IWMF. With these measures, it is expected that the potential impact on WBSE could be reduced to an acceptable level.

Apart from the above-mentioned marine works, the Project also involves laying submarine cables between SKC and Cheung Sha as well as constructing a landing portal at Cheung Sha. The benthos communities of the temporarily affected areas are expected to recolonise the seabed after the short period of the submarine cable laying works (about 20 working days). In view of the low-to-moderate ecological value of the subtidal habitats and the temporary nature of the impact, the potential impact on these habitats and their benthos communities due to submarine cable laying is considered to be low. Moreover, considering the localized nature of sediment plumes and the short duration of the works, as well as the innate adaptability of fish, no significant impacts are expected on the potential fish spawning and nursing ground due to the cable laying. As to the construction of the Cheung Sha landing portal, given the small scale of this Project, the existing turbid condition of the waters and the absence of ecologically-sensitive receivers along the shoreline, it is believed that with the adoption of good site practices and water quality control measures, the potential impact on ecological resources during the construction of the Cheung Sha portal will be acceptable. To assess the effectiveness of the proposed mitigation measures, monitoring programmes for Finless Porpoises, coral colonies and WBSE have also been recommended. With the implementation of recommended mitigation measures and the EM&A programme, the adverse ecological impacts due to the construction and operation of the proposed IWMF would be minimized to an acceptable level.

(f) Fisheries

It is expected that the waters of SKC will permanently lose 31 ha of fishing area, of which 15.9 ha used for proposed reclamation area and breakwaters are fisheries spawning and nursery grounds previously discovered. The indirect impact on fisheries caused by the increase in concentration of suspended solid in seawater during the construction stage will be temporary and localized. Various mitigation measures have been proposed in the study, such as using a silt curtain, reducing the dredging rate and carrying out marine works in phases with a view to reducing adverse impacts of the works on water quality and protecting fisheries resources. During operation stage, although the rate of water intake of the desalination plant of IWMF will be quite slow, a mesh trap can still be installed at the seawater intake point to further reduce the potential impact on fisheries resources being disturbed and washed away. If the proposed mitigation measures can be properly implemented, the possible impact of the works on fisheries will be acceptable.

(g) Health Impact

The cancer risk arising from exposure to compounds of potential concern (COPCs) associated with the emissions of the IWMF has been evaluated in this EIA Study. The highest incremental (excess) cancer risk arising from the IWMF is predicted to be 2.76×10^{-6} which is well below the screening level of 1×10^{-5} adopted by the USEPA and it is considered that the Project would not present an unacceptable risk and no further analysis is necessary. The highest predicted total Hazard Index (HI) at all receptors is well below 0.25, which is an initial screening exposure benchmark derived from a conservative approach by the USEPA. Cumulative acute non-carcinogenic health impact of the IWMF imposed to the worst impacted human receptors were assessed and compared with local and overseas guideline levels. It was concluded that the levels of non-carcinogenic chemicals were found to be

insignificant when compared to the adopted/ derived reference levels.

As the vast majority of foods in Hong Kong are imported, the impact of waste facility emissions on any one individual's exposure through ingestion of home-grown foods is likely to be very limited. Nonetheless, assessment was undertaken to determine the concentration of certain metals present in home-grown foods in the vicinity of the Project site due to the deposition of the emissions from the Project. The predicted concentrations of Antimony, Arsenic, Cadmium, Chromium, Lead and Mercury in all eatable plants nearby fall under the maximum permitted concentrations listed in the "Food Adulteration (Metallic Contamination) Regulations" stipulated by the Centre for Food Safety..

The existing practices of transporting wastes in enclosed containers will be followed. With regards to the storage and handling of waste and ash, given that all the reception halls and ash storage pits will be fully enclosed with slightly negative air pressure and a closed grab will be used to grab waste and ash, leakage of any fugitive emissions to the outdoor environment is not expected. With the implementation of the recommended health risk control measures, the potential health impacts associated with the transportation, storage and handling of waste and ash are considered to be insignificant.

The IWMF will be designed and operated to the most up-to-date standards and practices. The operator must be well trained to avoid any accidental events as well as to implement industry best practice with reference to international standards and guidelines. To avoid or minimize potential health impacts associated with potential accidental events, an emergency response plan will be developed and properly implemented for the IWMF. The recommended preventive measures include the use of best available techniques, continuous and regular stack emission monitoring, as well as conducting regular safety monitoring and auditing. With the implementation of recommended preventive measures and an effective emergency response plan for the IWMF, the health impact associated with any potential accidental events could be minimized if not avoided.

(h) Landscape and Visual Impact

In order not to bring about direct impact on high valued landscape resources such as SKC natural coastline, the reclamation area will not link up with SKC island. The coast of SKC and the reclamation area would be separated by a water channel (a width of 10m to 40m, length 350m) with a depth of up to 9m. The study has proposed various alleviating measures so that the facilities with industrial nature of the Project can tally with SKC's landscape resources and landscape character areas. These measures include the introduction of architectural design and landscape design with natural concept, use of stone texture similar to the stones of SKC coast in building the coastline of breakwaters and the reclamation zone in a bid that it will fit in with the SKC existing natural coastline. The rooftop and vertical external wall of every building will be greened up so as to enhance the landscape value of the IWMF. And the most important of all is to fuse the facilities into the surrounding green environment. There will be landscaping for the chimneys and the purpose is to strengthen the overall natural and green concept.

The Project has adopted many other means such as provision of efficient site layout arrangements and design for the Project work sites, use of cellular cofferdam to build the

breakwaters and the artificial island and so on. The ultimate purpose is to reduce the proposed Project coverage and its impact to the minimal. Moreover, the environmental education centre of the Project would not only bring about new value to the landscape character area and SKC, but will also promote the environmental awareness of the society.

Regarding the visual impact induced by the reclamation and construction of facilities, mitigation measures are proposed by the study, which include an aesthetic design with a view to enhancing the aesthetic quality of the Project and to blend the proposed works into the natural surroundings, at the same time reducing the visual mass of the structures. This is achieved by rooftop and vertical greening along the building façades, use of natural materials with recessive colour, provision of sky gardens between the stacks, provision of observation deck to diminish the feeling of chimney and so on.

To maximize the visual compatibility between the IWMF and the existing natural coastline of SKC, the implementation of various mitigation measures such as using natural boulders with similar textures of the rocky shores at SKC for the construction of breakwaters and artificial coastline are recommended. This will improve the visual quality of the proposed site. In conclusion, the potential landscape and visual impact can be reduced by implementing the proposed mitigation measures during construction and operation phases. With reference to the criteria defined in Annex 10 of the EIAO-TM, the overall residual impact is considered as “marginally acceptable with mitigation measures” after implementing the mitigation measures, and that is to say “there would be some adverse effects, but these can be eliminated, reduced or offset by specific measures”.

(i) Cultural heritage impact

According to review of historical documents and surveys, the area covered by the study does not have any archaeological site. Therefore, this Project will not create any adverse archaeological impact. In order to explore the potential of marine archaeological potential around the reclamation area, breakwaters and cable alignment corridor of the IWMF, the study conducted geophysical surveys and diver inspections, only to conclude that there was not any archaeological resource in the proposed reclamation area. Therefore, the proposed reclamation work would not create adverse marine archaeological impact. A Grade 3 historical building, namely the landscaped Courtyard Complex of Shek Kwu Chau Treatment and Rehabilitation Centre of the Society for the Aid and Rehabilitation of Drugs Abusers (SARDA), as well as four ungraded built heritages were found in the study area. Given the large separation between these built heritages and the IWMF, no adverse impact during the construction and operation phases is anticipated.