2. STRATEGIC ISSUES

2.1 Environmental Impact Assessment

2.1.1 Environmental Impact Assessment (EIA) is the process of predicting and evaluating an action's impacts on the environment, the conclusions to be used as a tool in decision-making. It aims to prevent environmental degradation by giving decision-makers better information about the consequences that development actions could have on the environment. Briefly, EIA involves:

- Reviewing the existing state of the environment and the characteristics of the proposed action (and possibly alternative actions).
- Predicting the state of the future environment with and without the action (the difference between the two is the action's impact).
- Considering methods for reducing or eliminating any negative impacts; preparing an EIA report that discusses these points.
- After a decision is made about whether the action should proceed, possibly monitoring the actual impacts of the action.

2.1.2 EIA, as an approach to environmental issues, can be characterised as multi-disciplinary and predictive. Project-based environmental assessment systems have been operating well in Hong Kong for more than 15 years, with formal legislation since April 1998, the EIA process has also been applied to major policies and planning strategies.

2.1.3 In addition to project level assessment, it is recognised that environmental assessment should also be applied to the earlier, more strategic tiers of decision-making – policies, plans, and programmes (referred to generically as PPPs). Consideration of environmental issues at these higher levels is known as Strategic Environmental Assessment (SEA).

2.1.4 The development of the proposed evaluation framework for the SEA for this Study has taken into account all existing environmental (and related) legislation. Of particular note are the Environmental Impact Assessment Ordinance (Cap 499, S.16) and Technical Memorandum that were formally adopted in April 1998. Under the EIAO, "designated projects" are projects and proposals that may create an adverse environmental impact. For the two landfill extensions the applicable designated projects are as follows:

G1 A landfill for waste as defined in the Waste Disposal Ordinance (Cap. 354); and
G4 A waste disposal facility, or waste disposal activity, for refuse.

2.1.5 For the new marine disposal sites, the types of designated projects would include the above and also the following:

C1 Reclamation of > 5 hectares (including associated dredging works);
C10 A marine dumping area; and
C11 A public dumping area of not less than 2 hectares in size.

2.1.6 To aid identification of key issues, other designated projects that may apply to marine disposal sites on a case-by-case basis are introduced under the respective assessments in Part B.

2.2 Strategic Environmental Assessments – International Perspective

2.2.1 There is no single SEA process that can be applied in all circumstances, rather there are principles and key elements that should be integrated into existing procedures for the formulation of PPPs.

2.2.2 Different countries adopt different approaches to SEA. For example, the European Union (EU) formally adopted SEA Directive 2001/42/EC on 5th June 2001. Forward thinking countries have already enacted such legislation, e.g. the Netherlands Government set up a statutory SEA system in 1987 and is currently strengthening it. The New Zealand authorities have required the preparation of SEAs since late 1991. The UK's Department of the Environment, Food and Rural Affairs (DEFRA) has recently recommended procedures resembling those of SEA.

2.2.3 In some instances, SEA is seen solely as an extension of EIA for projects at an earlier stage in the decision-making process. However, in other instances it is seen as being closely linked to the concept of sustainability; SEA may be the most direct way of making judgements about sustainability operational.

2.2.4 In May 2001, the Final Report was released on S*EA and Integration of the Environment into Strategic Decision-Making* (Icon Consultants Limited, UK) which aimed to evaluate the role of SEA in integrating the environment into strategic decision-making. The focus of that study was on the way in which environmental considerations are included in PPP in all sectors, rather than simply raising the profile of environment policies.

2.2.5 The study reviewed 20 detailed case studies from the EU (e.g. Austria, Denmark, Germany, UK, etc.) and non-EU countries (e.g. Canada, New Zealand, etc.) and from one international financing institution (the World Bank), reflecting a range of SEA and integration mechanisms and geographical spread. This enabled the identification of four broad models of SEA that embrace environmental integration and SEA's role within it:

- ***EIA-Inspired SEA –*** Originating from ecological and/or resource management disciplines, and includes a baseline assessment of the preferred option or alternative locations. There is more emphasis on technical methodologies and a necessity to undergo a systematic assessment procedure. This form of SEA is generally used at the programme level and is often an incremental development from EIA.
- ***Policy Analysis / Appraisal-inspired SEA –*** Originating from political science, impacts of a preferred option are appraised against objectives. There is no baseline survey and often little or no direct public participation. This model is often seen within regional / spatial land use planning and sustainability appraisal.
- ***Integrationary SEA –*** This focuses on an objective-led process and is a combination of the first two models. Impacts are appraised against a combination of an environmental baseline survey and objectives. The process begins early in the development of the policy and investigates alternative means of achieving these objectives. Public participation is normally an important component of the process. This form of SEA is most likely to be found where there is a strong national environmental legislation and policy framework.
- ***Ad Hoc Mechanisms of Environmental Integration –*** These are a collection of independent institutions and processes such as roundtables, audit committees and state-of-the-environment reports. These tools often fulfil similar roles found within elements of an SEA. However, there is no systematic process providing discrete hooks into the developing policy.

2.3 Strategic Environmental Assessment – Hong Kong

2.3.1 With regards to the SEA for this Study, it is the intention that the SEA would fulfil the objectives of being both an environmental assessment of a plan / programme and would take the findings of the *SUSDEV21 Study* into account and so include the objectives of sustainability into the decision-making process.

2.3.2 Whilst Hong Kong has no formal SEA legislation, the following list of studies are examples where the environmental assessment has been applied at the strategic and regional level:

- Port and Airport Development Strategy, 1989.
- Tseung Kwan O New Town Feasibility Study of Opportunities for Further Development, 1989.
- North Lantau Development Plan, 1992.
- Railway Development Study, 1993.
- North West New Territories (Yuen Long District) Development Statement Study, 1994.
- Freight Transport Study, 1994.
- Territorial Development Strategy Review, 1996.
- Third Comprehensive Transport Study, 1999.
- Second Railway Development Study, 2000.
- Future Strategic Growth Areas - North Western New Territories, North Eastern New Territories, and Hong Kong Island South and Lamma, 2002.

2.3.3 From the examination of these Hong Kong SEAs, it can be concluded that SEA in Hong Kong generally follows the "EIA-Inspired" model described in paragraph 2.2.5.

2.3.4 The SEA Evaluation Framework, set out in Section 4, has been based on international good practice in the SEA field, including methods specified in the following:

- EU Directive 2001/42/EC on Strategic Environmental Assessment (EU June 2001).
- Guidance on the Methodology for Multi-Modal Studies (UK, DETR, 2000).
- A New Deal for Trunk Roads in England: Guidance on the New Approach to Appraisal (NATA). (DETR, 1998).
- Manual on SEA in the Framework of the Trans-European Transport Network - Strategic Environmental Assessment of Transport Infrastructure (European Commission, 1998).

2.3.5 Consideration has also been given to information in the following publications:

- Strategic Environmental Assessment (Therivel, Wilson, Thompson, Heaney and Pritchard: Earthscan, 1992).
- Environmental Assessment in Practice (Harrop and Nixon, 1999).

2.3.6 Within Hong Kong, there are a number of areas of global concern, which would need to be integrated into the SEA at a strategic level, rather that at a site-specific level. The two main areas are those of sustainability and of global warming – specifically greenhouse gases.

2.4 Sustainability

2.4.1 In 1997, Planning Department commissioned the *SUSDEV21 Study* – a study aimed at plotting Hong Kong's course towards sustainable development in the 21st Century. There are a number of guiding principles that were developed under *SUSDEV21* that are relevant to the SEA for this Study. The following principles of sustainable development in Hong Kong have been integrated into the proposed evaluation framework (the following information is derived from *SUSDEV21* publications):

Natural Resources

2.4.2 The *SUSDEV21* guiding principle for natural resources is:

> *" Hong Kong should promote the sustainable use of natural resources to minimise its ecological footprint through improving consumption efficiency, minimising the use of non-renewable resources and re-using, recycling waste and recovering energy from wastes. "*

2.4.3 Natural resources are finite, and the abstraction, processing and transport of those resources has multiple social, environmental and economic impacts locally, nationally and internationally. The efficient use of resources therefore plays a major role in economic, social and environmental sustainability, both within Hong Kong, nationally and internationally. Hong Kong has always been dependent upon natural resources lying beyond its boundaries. Thus, the sustainability of Hong Kong depends to a considerable extent upon the efficient use of both locally and externally sourced natural resources such as water and energy fuels.

2.4.4 The extraction of the maximum beneficial use from our natural resources minimises both the amounts consumed to meet our needs, and the amount of wastes requiring final disposal. This latter point relieves pressure upon another function that the environment performs, that of assimilating wastes and pollutants.

2.4.5 Human activity can relieve pressure on this assimilative role – an engineered landfill is a man-made enhancement of the natural methane-generating anaerobic process by which organic material decomposes. Extracting the energy from the collected methane reduces our dependence on other energy sources and reduces GHG contributions. Isolating polluting leachate from the environment (and subsequently treating it) reduces the need for the surrounding environment to assimilate this pollutant.

Biodiversity

2.4.6 The *SUSDEV21* guiding principle for biodiversity is:

> *" To maintain the biodiversity of Hong Kong and to minimise any threat which consumption in Hong Kong may have on biodiversity elsewhere. "*

2.4.7 Unlike other guiding principles, the value of biodiversity is not human centred; the protection of biodiversity recognises that Hong Kong's population, Government and activities should respect other species and their natural habitats, both within the SAR and in other regions affected by Hong Kong's cultural and economic development.

2.4.8 Hong Kong contains large areas of natural landscapes which support a diverse assemblage of plant and animal species ranging from rare mammals, such as the Chinese White Dolphin, to over two hundred species of butterflies and some 380 native species of trees. Hong Kong's highest values of biological diversity are concentrated in small habitat patches located throughout the SAR in both protected and unprotected areas.

2.4.9 The concept of biodiversity is also attracting greater attention on an international level as large-scale habitat destruction in some countries is increasingly being viewed as depleting global biodiversity resources. Biodiversity provides a number of important support functions for the world's human population, including food and fibre, genetic resources (e.g. medicines and chemical ingredients for a variety of products), and ecological insurance against catastrophic change. Aside from these functions, biodiversity also contributes to amenity resources, such as recreational and scenic areas, and the assimilative capacity of the environment. Although Hong Kong is not a formal signatory to the Convention on Biological Diversity, there is a growing recognition that Hong Kong's biodiversity resources must be protected in order to demonstrate support for global conservation efforts.

Environmental Quality

2.4.10 The *SUSDEV21* guiding principle for environmental quality is:

> *" Hong Kong should be pro-active in avoiding environmental problems for present and future generations, seek to find opportunities to enhance environmental quality, and minimise the unwanted side effects, locally, nationally and internationally, of development and inefficiencies such as air, noise and water pollution or land contamination. "*

2.4.11 Maintaining (or restoring) environmental quality is a basic concept of sustainability and is reflected in Agenda 21. It is important both for its own intrinsic value and for its defining role in the quality of life for the present and future human population.

2.4.12 High levels of environmental quality are generally associated with low levels of impact and low levels of wastage (inefficiencies) from human activities; increasing levels of pollution degrade the components of the environment (air, marine and freshwater, soil), and their ability to assimilate pollutants, with correspondingly poorer quality of life standards for the population of that environment as a result. This degradation manifests itself in many specific ways familiar to Hong Kong residents, such as declining air quality at street level, smog impeding visibility from local viewpoints, poor bathing water quality at beaches, and excessive noise throughout the urban areas.

2.4.13 The need for a good quality environment is not limited to the SAR; Hong Kong, as a highly developed economy, also shares global efforts in limiting its pollutant contributions to the global environment, for example the production and release of greenhouse gases. To preserve Hong Kong and global environmental quality for current and future generations, pollutant loading should be minimised and the environmental efficiency of current practices improved to restore and subsequently maintain the natural capital stock of the SAR.

Sustainability Assessment

2.4.14 On 31st October 2001, a question was asked in LegCo regarding the role of the Government's Sustainable Development Unit (set up in April 2001) and the establishment of Sustainability Assessment (SA). The Chief Secretary (CS) replied on the possible future need for a SA for "an initiative or major programme that may bring about significant or prolonged implications to the economic, social or environmental condition of Hong Kong". The CS added "an early assessment will help scope out cross-sectoral issues and sensitive areas that require special attention or further detailed examination by the relevant bureaux or departments".

2.4.15 In December 2001, the SDU issued guidelines to Government Bureaux and Departments, and the requirement to conduct SAs for major projects has been implemented since April 2002.

2.4.16 In terms of this Study, although the concept of sustainability is included in the SEA methodology and design approach, this SEA should not be viewed as a SA. The Sustainable Development Unit is presently finalising recommendations for conducting SA.

2.5 Global Warming – Greenhouse Gases

2.5.1 The Earth's atmosphere contains a naturally occurring shield of "greenhouse gases" (GHGs). Radiant (short-wave) energy from the sun passes through the atmosphere and warms the earth's surface. Some of this energy is reflected back to the atmosphere as infrared (long-wave) energy, which is blocked by the GHG shield and re-emitted back to the earth's surface. This further warms the surface of the earth and the lower atmosphere.

2.5.2 It has been estimated that without this natural greenhouse effect, the Earth would be around 30°C cooler, on average, and too cold to support human life. However, it has also been observed that concentrations of GHGs are rising above their natural levels as a result of anthropogenic (man-made) influences. The potential long-term effects of these higher concentrations of GHGs on global climate are the subject of much international debate.

2.5.3 Internationally, landfilling of wastes has a significant effect upon the generation of GHGs. This section provides background information on GHG and describes the conditions against which the site-specific greenhouse gas issues have been addressed. To this end, and in the spirit of the SEA process, the approach to addressing GHG issues in this Study is not quantitative in nature, although numeric justification has been provided where it has been deemed necessary to support a qualitative conclusion. Further assumptions on the generation of GHGs for this Study are presented in Section 4.3.

International Effort

2.5.4 The global nature of climate change, has presented a unique need for inter-governmental co-operation to address the issues. This is focused through the Inter-governmental Panel on Climate Change (IPCC) established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP).

2.5.5 Internationally, efforts to limit climate change caused by emissions of GHGs are centred on the United Nations Framework Convention on Climate Change (UNFCCC), established by the IPCC. This convention aims to stabilise the concentration of GHGs in the atmosphere at a level that would prevent dangerous interference with the climate system. The UNFCCC provides the overall policy framework for addressing climate change issues. The IPCC supports the UNFCCC through its work on methodologies for National Greenhouse Gas Inventories, which have been adopted by major Governments around the world.

2.5.6 The parties present at the Kyoto conference reached an agreement (the "*Kyoto Protocol*") for limiting GHG emissions from "Annex 1" countries. The commitment was to reduce their greenhouse gas emissions to least 5% below their 1990 levels by the period 2008-2012. The revised requirement is to now reduce the emission levels of 6 GHGs below their 1990 levels by 2008-12. Although China has ratified to Kyoto Protocol on 3 September 2002 at the Johannesburg Conference on Sustainable Development, China is not an Annex 1 country and so this does not apply to China.

Hong Kong Position

2.5.7 Currently, there is no relevant legislation and/or assessment criteria for GHGs in Hong Kong, However, in 1997 the Advisory Council on the Environment (ACE) indicated:

> *"Hong Kong cannot become party to the Convention. Nevertheless, Hong Kong recognises the objectives of the Convention. Although we have not announced the Convention's objectives as our official policy aims, we have used them as a basis for our actions*" (ACE paper 47/97)."

2.5.8 In the spirit of this commitment, Hong Kong is carrying out a number of initiatives to establish the extent to which Hong Kong's activities contribute to global warming and any actions needed to control emissions. The *Greenhouse Gas Emission Control Study* is currently being carried out by EPD to determine the extent and effect of Hong Kong's GHG emissions. This study will establish emission inventories for Hong Kong and assess the appropriate way forward in terms of emissions reductions.

Greenhouse Gas Assessment Rationale

2.5.9 To enable a standardised approach in determining emissions inventories, the IPCC guidelines establish the concept of Global Warming Potential (GWP) which is a measure of the warming capacity of the gas, relative to that of carbon dioxide (the most common GHG) over a 100-year time period. Actual values are then expressed in terms of the "carbon dioxide equivalent" to allow direct comparison. Carbon dioxide has a GWP of 1.0.

2.5.10 The aim of the Kyoto Protocol is to control the emissions of the six main GHGs, namely, Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6). Emissions of these gases are weighted GWP and the target is to reduce emissions in terms of total GWP. Thus, an increase in the emission of one gas can be offset by equivalent GWP reductions in others.

2.5.11 For the purpose of this assessment only CO_2, CH_4 and N_2O are considered. Emissions of HFCs, PFCs and SF_6 included in the Kyoto Protocol would not be significantly increased by either the transport of waste or the operation of a landfill facility.

2.5.12 The methodology adopted to evaluate emissions is based upon the guidelines provided by IPCC in which GWPs are utilised to combine emissions of different gases to arrive at a CO_2 equivalent emission level. Internationally accepted GWPs, as detailed by the IPCC, are presented *Table 2.1*, below. The listed GWP represent a 100-year time horizon.

Table 2.1: Global Warming Potentials of Greenhouse Gases (100 year time horizon)

Gas	GWP	Gas	GWP
CO_2	1	HFC-23	11,700
CH_4	21	HFC-32	650
N_2O	310	HFC-125	2,800
		HFC-134a	1,300
PFC-116	9,200	HFC-143a	3,800
PFC-218	7,000	HFC-152a	140
PFC-410	7,000	HFC-227ea	2,900
		HFC-236fa	6,300
SF_6	23,900	HFC-245ca	560

Greenhouse Gases – the Global Situation

2.5.13 The GWP of CO_2 is lower than either CH_4 or N_2O, however, it is the most common GHG produced by anthropogenic activities and accounts for about 60% of the increase in global warming (IPCC, 1992[1]). In addition, CO_2 also has a long (50-200yrs) life in the atmosphere. By far the largest source of CO_2 emissions is the oxidation of carbon from burning of fossil fuels, which accounts for 70-90% of total anthropogenic CO_2 emissions (IPCC, 1996).

2.5.14 The overall contribution of CH_4 to global warming is second only to CO_2. CH_4 contributes to approximately 24% of the global warming increase and N_2O about 10% (IPCC, 1996[2]). Primary sources of CH_4 include, livestock, coal and natural gas, solid wastes and wastewaters. Actual amounts and relative proportions contributed from the different sources vary between different countries considerably.

2.5.15 CH_4 from solid waste disposal contributes a significant proportion of annual global CH_4 emissions, although the estimation is subject to a great deal of uncertainty. Estimates of global CH_4 emissions from solid waste disposal range from about 5% to 20% of the total estimated emissions of 375Tg/yr from anthropogenic sources globally (IPCC, 1996[3]).

Greenhouse Gases – the Hong Kong Situation

2.5.16 At the time of writing, EPD's *Greenhouse Gas Emission Control Study* has not been completed and so any assumptions or reported data referred to in this Report are subject to verification.

2.5.17 The principal sources of relevant data for Hong Kong are the *Study on Sustainable Development for the 21st Century* and the information presented in the Discussion Paper on Greenhouse Gases for the LegCo Panel on Environmental Affairs (dated 3 July 2001), which presents a slightly updated set of data to that shown in the *SUSDEV21 Study*. Both papers concur in that Hong Kong emissions reflect the global trend with CO_2 being the most significant greenhouse gas, followed by CH_4 and then N_2O.

2.5.18 Between 1990 and 1997, CO_2 emissions constituted 83-88% of the total emissions of GHGs in Hong Kong. Methane contributed 11-14% and N_2O contributed 1-2%.

2.5.19 GHG emissions in Hong Kong have exhibited a general decline from the period from beginning 1994, This is as a result of a combination of factors, such as changes in modes of power generation, relocation of industry outside of Hong Kong and higher utilisation of public transport. Within this overall trend, the relative contribution of CO_2 to total GHG emissions declined in comparison with the other GHGs from 1992 to 1997.

2.5.20 The Final Report of the *SUSDEV21 Study* categorised the key sources of GHG emissions (in 1997) as follows:

- **Energy Industries** (combustion of fossil fuels by power stations, transport, manufacturing industries and construction), accounted for 97% of CO_2 emissions, 1% of CH_4 emissions and 78% of N_2O emissions. Of the 97% of CO_2 emissions, about 64% came from power generation, and 24% came from transport related emissions.

1 IPCC (1992), Climate Change 1992: The Supplementary Report to the IPCC Scientific Assessment. The Intergovernmental Panel on Climate Change (WMO/UNEP) Cambridge University Press, UK.

2 IPCC (1996): Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual.

3 IPCC (1996), Climate Change 1995. *The Science of Climate Change.* (J.T. Houghton, *et al.* (eds)). Published for IPCC World Meteorological Organization/UNEP, Cambridge University Press, UK.

- **Industrial Processes** (emissions from physical/chemical transformation of materials, e.g. cement manufacturing, "towngas", etc.) contributed to 3% of CO_2 emissions.
- **Agricultural Activities** (including livestock and manure management, cultivation, burning and soils) produced less than 1% of CO_2, CH_4 and N_2O emissions.
- **Waste Management** (including waste degradation in landfills, incinerators and wastewater and sludge treatment processes), accounted for less than 1% of CO_2 emissions, 98% of CH_4 emissions and 21% of N_2O emissions. The principal source of CH_4 emissions was from landfills.

2.5.21 The anaerobic degradation of wastes in a landfill results in the production of landfill gas, (LFG) which includes the GHGs CH_4 and CO_2. The proportion of CH_4 in LFG varies but is typically around 60%. The actual amount and rate of LFG produced is a function of the quantity of organic material as well as factors controlling methanogenic bacteria including the availability of nutrients, moisture, pH and temperature.

2.5.22 Whilst CO_2 is also a component of LFG, under the IPCC Guidelines, CO_2 emissions from waste degradation are considered to be biogenic, rather than anthropogenic in nature. Oxidation of waste to produce CO_2 is considered to be a natural process, which would occur with or without the processes of landfilling, and therefore is simply part of the natural process of carbon cycling. On the other hand, CH_4 production is considered to be anthropogenic, were it not for human intervention to create an artificially anaerobic environment by landfilling, the process of methane generation would not occur.