

Appendix C

Vulnerability and Adaptation Assessment

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*ANNEXES**ANNEX A POTENTIAL CLIMATE CHANGE CONSEQUENCES BY SECTOR**ANNEX B REVIEW OF EXISTANT ADAPTIVE CAPACITY IN HONG KONG BY SECTOR*

1 *INTERNATIONAL BEST PRACTICE FOR CLIMATE CHANGE IMPACT AND ADAPTATION ASSESSMENT*

This section provides an overview of the current best practice regarding methodological approaches for assessing the potential impacts of future climate change and evaluating appropriate adaptation strategies and measures. It is primarily based on international literature including the *UNFCCC User Manual* ⁽¹⁾, *IPCC Technical Guidelines* ⁽²⁾, the *UNFCCC Handbook* ⁽³⁾ and the *UNEP Handbook* ⁽⁴⁾.

A review of the literature indicates that approaches are being continually developed to reflect current knowledge. Furthermore, there is no single preferred method as “*methodologies, approaches and/or guidelines to be used in the V&A assessment will depend on the national circumstances... with respect to the availability of data, and technical, financial and human resources* ⁽¹⁾”.

The general framework for conducting a climate change impacts and adaptation analysis as defined by the UN and IPCC involves the following steps:

- Definition of the problem;
- Selection of the method;
- Testing the method;
- Selection of scenarios;
- Definition of the environmental and socio-economic baseline;
- Assessment of biophysical and socio-economic impacts;
- Assessment of autonomous adjustments and evaluation of adaptation strategies.

Each of these steps is explained in more detail in the following sections.

1.1 *DEFINITION OF THE PROBLEM*

As presented in the *IPCC Technical Guidelines*, the *UNFCCC Handbook* and the *UNEP Handbook*, this involves asking the following questions:

Table 1.1 *Climate Change Impacts and Adaptation Assessment*

Question	Description	In the Present Study
Goals of the assessment	Study objectives	<ul style="list-style-type: none"> • To characterise the impacts of climate change in Hong Kong • To evaluate existing and recommend additional strategies and measures to facilitate adequate adaptation to climate change

Question	Description	In the Present Study
Assessment boundary	Geographic boundary	Hong Kong SAR boundary
	Depth of the assessment	Literature review of relevant studies published by Government departments, international and national authorities, and the scientific community
Exposure unit to be studied	Scope of the assessment	The socio-economic and natural systems in Hong Kong
Time frame	Time horizon for study	Around 18 months
	Time frame of projections / impacts	Up to 2100
	Timeframe of adaptation strategies / measures	Up to 2030

1.2

SELECTION OF THE METHOD

Predicting future impacts is one of the major goals of climate change impact assessment. There is a wide range of different methods and approaches available, such as quantitative modelling, empirical study, expert judgement and experimentation, as well as stakeholder involvement. Since each of these has its own strengths and weaknesses, the use of a combination of approaches in different parts of the assessment or at different stages of the analysis is recommended by the *UNEP Handbook*. Geographic information systems and remote sensing are amongst other tools that may be also used.

1.2.1

Quantitative Models

Where the variables can be expressed in quantitative terms and where feasible, the use of models is desirable to enable sensitivity analysis, for example, to be carried out. Climate impact studies often involve the use of biophysical models, socio-economic models and integrated system models. Many of the models are simple cause and effect models but the reality is a complex interactive system. This complexity is being addressed by an on-going effort to develop integrated systems models.

It is important to keep in mind that although the model results generated may look very precise, there are underlying assumptions in the climate change and socio-economic scenarios, in addition to those inherent in the models. As a result numerical quantitative data generated by these models should be treated as informed estimations rather than the definitive 'answer'. Models that address only one sector or aspect of a system may simulate that sector or aspect well but may be unable to incorporate interactions from related sectors or other aspects of the system. For these reasons, the choice of models should be conducted by experienced modellers who have detailed foreknowledge of the problems likely to be encountered.

Given the timeframe, scope and available data the present study has not undertaken any detailed quantitative modelling. However, this study serves as an important step in identifying the current knowledge gaps and

uncertainties, and hence the areas where further more detailed research would be especially valuable in responding to climate change in Hong Kong.

1.2.2 *Empirical Studies*

Empirical observations of the interactions of climate and society and natural systems are commonly achieved through analogue methods, such as historical events, historical trends, and regional or spatial analogues of present climate. These enable questions to be asked about how stakeholders adapt or have adapted in the past.

Case studies have been included in this study to illustrate the need for a holistic response in the event of an unexpected crisis, and to illustrate that such crises can have consequences for the broader economy. The IPCC notes that whilst the consequences of climate change will be greater in low income countries “no matter what the degree of preparedness is, projections suggest that some future extreme events will be catastrophic because of the unexpected intensity of the event and the underlying vulnerability of the affected population. The European heatwave in 2003 and Hurricane Katrina are examples” (5).

1.2.3 *Expert and stakeholder judgement and participation*

Expert judgement and opinions enable a relatively rapid assessment of the current state of knowledge concerning the likely impacts of climate change, especially in preliminary or pilot studies to assist with the design of such studies. Policy analysis may also incorporate decision-making support systems that combine dynamic simulation with expert judgement.

In this vulnerability and adaptation assessment independent expert judgement has been utilised. For example, local and overseas health experts have been consulted to guide the analysis for human health, and engineers have provided support in areas including the built environment and infrastructure, as well as water resources.

1.2.4 *Remote Sensing and GIS*

Data about features located on the earth’s surface is collected by remote sensing from aircraft and satellites, and is analysed to provide useful information. Remote sensing can very effectively be used in combination with Geographic Information System (GIS), which allows the analysis of geographically referenced data in complex ways. One of the main limitations to this method is that effective use of GIS requires substantial data sets, which for some features, often needs to be regularly updated.

GIS has been applied in this climate change impact and vulnerability assessment to indicate areas of the territory that are more likely to be at risk in a changing climate and to illustrate the distribution of various features including infrastructure, population density and ecosystems across the Hong Kong SAR.

1.3 TESTING THE METHOD

The selection of the assessment methods should be tested in preparation for the main evaluation tasks. Feasibility studies, data acquisition and compilation, and model testing may be useful in evaluating the methods. This present vulnerability and adaptation assessment serves as a feasibility study to provide information on the effectiveness of alternative approaches, of models, of data acquisition and monitoring, and of research collaboration.

1.4 SELECTION OF SCENARIOS

Climate change impacts are estimated as the difference between conditions (both environmental and socio-economic) expected to exist over the period of analysis in the absence of, and with, climate change. Studies may elect to analyse several different climate change scenarios where the science is uncertain regarding the direction and/or magnitude of future trends.

1.4.1 *Climatological Scenarios*

The climatological baseline should be consistent with the present-day or recent average climate in the study region; it should be of sufficient duration to encompass a range of climatic variations; it should cover a period for which data on all climatological variables are abundant, adequately distributed and readily available; and, it should include data of sufficient quality for use in evaluating impacts. The standard WMO baseline period (1961-90) should be adopted in assessments where appropriate.

The climate change scenarios used for impact assessment should be consistent with the broad range of global warming projections based on higher atmospheric concentrations of GHGs and regional variability. The scenarios should not violate the basic laws of physics, i.e. they should be physically plausible. The scenarios should also cover a sufficient number of variables on a spatial and temporal scale to enable impacts assessment. Lastly, the scenarios should, to a reasonable extent, reflect the potential range of future regional climate change.

1.4.2 *Socio-Economic Scenarios*

There is tremendous uncertainty about future socio-economic conditions. Socio-economic scenarios are scenarios of the state and size of the population and economy. Scenarios are often based on a combination of expert judgement, extrapolation of trends, international comparisons and model runs; simple extrapolation should be avoided. Socio-economic scenarios may comprise of a wide range of elements as illustrated in *Table 1.2*.

Table 1.2 *Examples of Indicators*

Economy	Demography	Environment
GDP	Population	Land
Relative importance of sectors	Age structure	Water
Imports and exports	Education	Air
Unemployment	Health	Biota
Comparative advantages	Gender	Principal and unique resources
Technology	Religion	Quantity and quality
Infrastructure		
Institutions		

Socio-economic scenarios are developed to identify what socio-economic variables are most likely to be more or less vulnerability to climate change. Multiple scenarios (at least three) should be used as a single scenario for future developments may transmit a false sense of certainty to the study’s audience. The use of multiple scenarios enables a better understanding of the system under consideration and is in fact a sensitivity analysis. Baseline scenarios may be developed beyond the middle of this century and even up to approximately the end of the century. This allows the scenarios to be on the same scale as typical climate change scenarios. However, socio-economic scenarios covering such long periods of time tend to have very low credibility.

IPCC Special Report on Emissions Scenarios

The future evolution of human society, technological development, and the global economy is largely unpredictable over long time horizons. Projecting future climate is complicated by the fact that it will also be influenced by emissions of GHGs which we, (and those that have yet to be born) have yet to emit. The IPCC *Special Report on Emissions Scenarios* ⁽⁶⁾ outlines a range of plausible descriptions of alternative futures based on different assumptions regarding population growth, socio-economic and technological change and other factors, known as A1, A2, B1 and B2, and within A1, there are a further three sub-scenarios A1FI, A1T and A1B, making a total of six emissions scenarios. The characteristics of these emissions scenarios are summarized in *Table 1.3*. The projected trends of global GHG emissions under the various emissions scenarios and their associated temperature increase are shown in *Figure 1.1*.

Table 1.3 *SRES Emissions Storylines*

A1 (A1FI, A1T and A1B)

Rapid economic growth, low population growth. Rapid introduction of new more efficient technologies. Convergence in regional differences in per capita income. The A1 scenario has 3 alternative future energy use storylines: fossil fuel intensive A1FI, the non-fossil fuel (nuclear and renewable) A1T, and A1B which is a balance between the two.

A2

A very heterogeneous world, fertility patterns across regions converge very slowly, which results in high population growth. Economic development is primarily regionally oriented and per capita economic growth and technological change is more fragmented and slower.

B1

A convergent world with low population growth. Rapid changes toward a service /

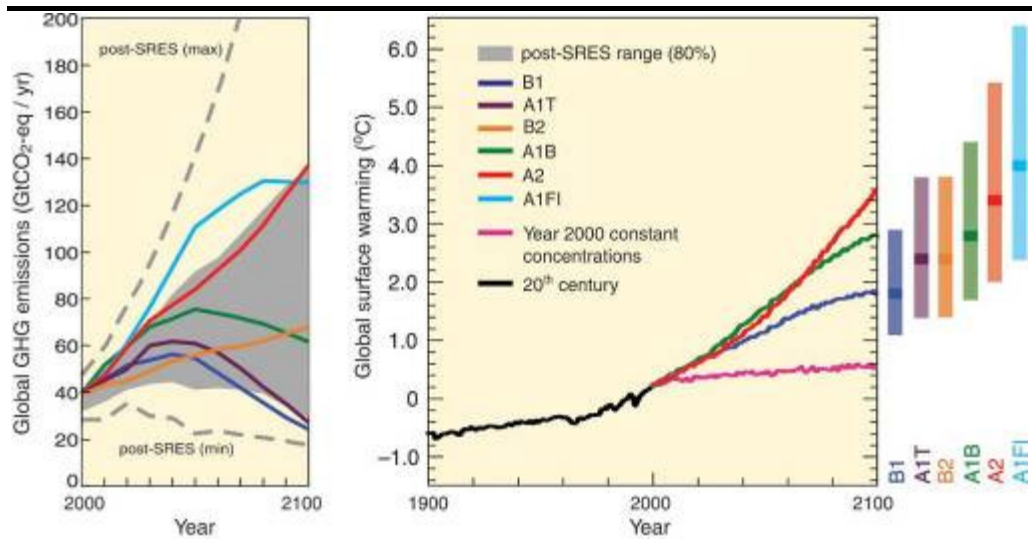
A1 (A1FI, A1T and A1B)

information economy. Reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to sustainability.

B2

Emphasis is on local solutions to development and sustainability. Moderate population growth, intermediate economic development, less rapid and more diverse technological change.

Figure 1.1 *SRES Emissions Scenarios in terms of CO₂ Emissions and Likely Future Temperature Rises*



IPCC, 2007 ⁽⁷⁾

The IPCC is currently in the process of updating its SRES emissions scenarios to incorporate actual emissions pathways over the last decade and to update socio-economic and technical projections. A watching brief is thus advised in this area.

1.4.3 *Climate Change Scenarios*

Three generic types of climate change scenarios have been used in climate change impacts research: scenarios based on outputs from GCMs, synthetic scenarios and analogue scenarios.

Global Climate Models (GCMs)

While climate change in the past can be reconstructed from paleo-climatic evidence (from tree ring and ice core data, for example) and instrumental data (historic records), scientists attempt to make forecasts of future climate change through the construction and use of global climate models (GCMs). GCMs are mathematical representations of atmosphere, ocean, ice cap and land surface processes based on physical laws and physically-based empirical relationships. GCMs have quite a coarse resolution as they estimate changes for meteorological variables for grid boxes that are typically 3-4° latitude / longitude, i.e. 250 km in width and 600 km in length. Coupled ocean-atmosphere GCMs are the most advanced. These complex GCMs mimic how the Earth's atmosphere is affected by different factors that can influence the weather such as the carbon cycle, variations in solar intensity, volcanic

emissions and anthropogenic GHG emissions. GCMs have evolved considerably over time and they are often validated by testing their ability to recreate the observed climate record. Although it should be stressed that ability to recreate the historic climatic record is not necessarily indicative of accuracy in projecting future climatic trends.

Both equilibrium experiments and transient experiments are two types of GCM runs that can be useful for impact assessments. Equilibrium experiments concerns with the difference between the simulation of current ($1 \times \text{CO}_2$) and future ($2 \times \text{CO}_2$ or occasionally $4 \times \text{CO}_2$) climates, i.e. a scenario of how climate may change with an effective doubling (or quadrupling) of atmospheric CO_2 concentrations. Both the current and future climates are assumed by modellers to be in equilibrium (i.e. stationary) but this is an oversimplification as Earth's climate is never in equilibrium.

In a transient experiment, a coupled GCM simulates current climate ($1 \times \text{CO}_2$) and future climate as it responds to a steady increase in GHG concentrations beyond $1 \times \text{CO}_2$ concentrations. This model is typically run for 100 years or more into the future. As computing power increases with time, transient experiments become less expensive to run and output from these has been used more frequently in climate change impact studies.

Synthetic Scenarios

Synthetic scenarios (also known as arbitrary scenarios) are based on incremental changes in meteorological variables such as temperature and precipitation. For instance, temperature increases of 2°C and 4°C can be combined with precipitation changes of +10% or -20% or no change in precipitation to create a synthetic scenario. Incremental changes are usually combined with a baseline daily climate database to yield an altered 30-year record of daily climate.

Analogue Scenarios

In analogue scenarios, past warm climates are used as a scenarios of future climate (temporal analogue scenario), current climate in another (usually warmer) location as a scenario of future climate in the study area (spatial analogue scenario). Temporal analogue scenarios may come from the instrumental record (weather observations) or the paleoclimatic record.

Temporal analogues of global warming were not contributed by anthropogenic emissions of GHGs while spatial analogues are unlikely to be plausible scenarios of future climate change. For these reasons, these types of scenarios should only be used under two conditions:

- The limitations of this approach should be clearly explained, pointing out that analogue scenarios may not be accurate representations of GHG induced climate change; and,

- Other approaches such as synthetic or GCM-based scenarios are also used in the same study to ensure that a broader range of climate changes is included in the scenarios.

Each of the above options has their own advantages and disadvantages (*Table 1.4*), and none of these fully satisfies all scenario selection conditions described earlier in this *Section*. As a result, the use of a combination of scenarios based on outputs from GCMs and synthetic scenarios is recommended as they allow for a wider range of potential climate change at the regional level and are easier to construct and apply.

The choice of creating climate change scenarios should depend on the available resources, as well as how quickly the scenarios are needed by impacts researchers. Despite the evolving techniques in climate change scenario construction; fundamental uncertainty about regional climate change remains, including uncertainties such as the magnitudes and even the direction of change of many important variables, particularly extreme weather/climate events. Precipitation is another area which has proved difficult to model over the long time horizons used in climate change impact assessments. It is crucial to bear in mind that climate change scenarios only help us to understand the potential implications of climate change and the vulnerability of human and natural systems to this change; they are not predictions of the future.

Table 1.4 Advantages and Disadvantages of Different Types of Climate Change Scenarios

Scenario Types	Advantages	Disadvantages
Global Climate Models (GCMs)	<ul style="list-style-type: none"> GCMs are the only tool that can provide the best information on how global and regional climate may change as a result of increasing atmospheric concentrations of GHGs for a large number of climate variables (e.g. temperature, precipitation, pressure, wind, humidity, solar radiation) in a physically consistent manner. 	<ul style="list-style-type: none"> Although GCMs accurately represent global climate, their simulations of current regional climate are often inaccurate. The GCM output on a geographic and temporal scale produced are not fine enough for many impact assessments due to the uniform climate changes projected in grid boxes several hundred kilometers across. A single GCM, or even several GCMs, may not represent the full range of potential climate changes in a region. The influence of a number of climatic variables and features i.e. water vapour, have yet to be modeled and incorporated in a quantitative manner into GCMs.
Synthetic Scenarios	<ul style="list-style-type: none"> Synthetic scenarios are easy to use and transparent to policy makers and other readers of impact studies. Synthetic scenarios can capture a wide range of potential climate changes. They help to identify the relative sensitivities of sectors to changes in specific meteorological variables by changing individual variables independently of each other. Different studies can use the same set of scenarios to compare sensitivities. They are inexpensive, quick and easy to construct, and generally require few computing resources. 	<ul style="list-style-type: none"> They may not be physically plausible; particularly if uniform changes are applied over a very large area or if assumed changes in variables are not physically consistent with each other. It is therefore important to not arbitrarily select changes in variables that are not internally consistent with each other. These scenarios may not be consistent with estimates of changes in average global climate. Nevertheless, this limitation can be overcome by using the outputs of GCMs to guide the development of synthetic scenarios.
Temporal analogue scenarios	<ul style="list-style-type: none"> The use of instrumental record as the basis for a climate change scenario is advantageous as climate change data is available on a daily and local scale and at a finer temporal and spatial resolution than those based on GCMs. The advantage of using paleoclimatic data over instrumental data for scenario construction is that temperature fluctuations in the distant past compared to current climate tend to be greater than those within the instrumental record, so they may be more consistent with potential changes in average global temperature in this century. 	<ul style="list-style-type: none"> The primary drawback is that these scenarios are not based on human-induced increases in GHGs. For scenarios that are based on instrumental records, complete instrumental records for the period in question may not exist in many countries. The collection or collation the relevant paleoclimatic data for scenario construction for the required region may be a costly and time-consuming exercise. Furthermore, paleoclimatic data is generally available only for seasonal changes in temperature and precipitation, and is not available in many locations, particularly in tropical areas. Temporal analogue scenarios (except those from millions of years ago, which have very low resolution of data) tend to be at the low end or even below the range of potential future climate warming.

Scenario Types	Advantages	Disadvantages
Spatial analogue scenarios	<ul style="list-style-type: none"> • These scenarios can be used to examine how social and natural systems have adapted to different climates, therefore are particularly helpful in examining the potential for adaptation. • They provide an often graphic means of communicating the broad significance of climate change to the public. • They can also introduce changes in spatial and temporal variability. • They can enable approximate or relative costs of impacts to be more easily inferred although geographic differences in asset values and clustering have to be understood. 	<ul style="list-style-type: none"> • Due to geographical and other differences, the future climate in the study area is unlikely to be the same as the current climate in another location, even with a similar average annual temperature. Hence, the level of detail available from an analogue site may give a false sense of precision. • Extensive continental or global climate data sets are necessary to search for an analogue region, and such data sets may not be easy to obtain.

1.4.4

Other Environmental Factors

The environmental baseline presents the present state of other non-climatic environmental factors that affect the exposure unit, such as groundwater levels, soil pH, elevation, the extent of wetlands etc.

The present state of all the non-environmental factors, including geographical (e.g. land use), technological (e.g. pollution control), managerial (e.g. forest rotation), legislative (e.g. air quality standards), economic (e.g. commodity prices), social (e.g. population), or political (e.g. land tenure) that influence the exposure unit is described by the socio-economic baseline.

The present study has adopted the climatological data made available by the Hong Kong Observatory for local conditions. Where such information is not available, the global or regional averages provided in the IPCC AR4 WGI report have been used. Socio-economic variables such as population and GDP data have been obtained from the Census and Statistics Department (C&SD). The baseline conditions of each of the sectors within present day Hong Kong are summarized.

1.5

ASSESSMENT OF BIOPHYSICAL AND SOCIO-ECONOMIC IMPACTS

Impacts are estimated as the differences over the study period between the environmental and socio-economic baseline conditions (without climate change) and conditions projected to exist with climate change. Assessments may include:

- Qualitative description – which requires the experience and interpretive skills of the analyst, especially the analyst’s ability to consider all factors of importance and their interrelationships;
- Indicators of change – certain regions, activities or organisms that are intrinsically sensitive to climate may provide an early or accurate indication of effects due to climate change.
- Compliance to standards – which may provide a reference or an objective against which to measure the impacts of climate change.
- Costs and benefits – quantitative estimates should be given to the extent possible and expressed in economic terms. This approach can also examine the costs or benefits of “doing nothing” in mitigation.
- Geographical analysis – the spatial variation in impacts is of concern to policy makers operating at regional, national or internal scales as they may have policy and planning implications.
- Dealing with uncertainty – uncertainties pervade all levels of a climate impact assessment, from the projection of future GHG emissions to

evaluation of adaptation strategies. Both the uncertainty analysis and risk analysis attempt to account for these uncertainties.

1.6

ASSESSMENT OF AUTONOMOUS ADJUSTMENTS AND EVALUATION OF ADAPTATION STRATEGIES

Two broad types of response to climate change can be identified: while mitigation attempts to deal with the causes of climate change, adaptation refers to any adjustment, whether passive, reactive or anticipatory, that can respond to anticipated or actual consequences (both adverse and positive) associated with climate change.

The framework for the evaluation of adaptation strategies generally involves the following stages:

- Define the objectives: Any analysis of adaptation must be guided by some agreed overall goals and evaluation principle, commonly the promotion of sustainable development and the reduction of vulnerability. The definition of specific objectives, derived from public involvement, by legislation etc, will be needed.
- Specify the climatic impacts of importance: Climatic events that are expected to cause damage need to be specified so that the most appropriate adaptation options can be identified.
- Identify the adaptation options: A list of possible adaptive responses that might be employed to cope with the effects of climate is to be compiled in this stage. Existing practices or those previously adopted, along with new or possible alternative strategies should be considered.
- Examine the constraints: Constraints (e.g. legal, financial, social) should be examined including how they might affect the range of feasible choices available.
- Quantify measures and formulate alternative strategies: This stage assesses the performance of each adaptation measure with respect to the stated objectives under different climatic scenarios using simulation models, if appropriate data and analytical tools exist. Uncertainty analysis and risk assessment are also considered in this step.
- Weight objectives and evaluate trade-offs: This evaluation step involves weighing the objectives according to assigned preferences and then comparing between the effectiveness of different strategies in meeting these objectives, as well as the associated trade-offs.
- Recommend adaptation measures: The outcome of the evaluation process should provide policy advisers and decision makers with information on the best available adaptation strategies that covers some of the assumptions and uncertainties involved in the evaluation procedure and the rationale used.

2.1 CLIMATE CHANGE WITHIN A REGIONAL CONTEXT

The GCMs used to project the future climate scenarios are designed for planetary level analysis, and the resolution is rather “coarse”. Therefore, ERM supplemented the data available from international studies with those from regional and local sources.

Table 2.1 provides an overview of the observed and projected changes at the global and regional level for East Asia. Some regional projections produced by the PRECIS model for China are also included. PRECIS, developed at the Hadley Centre of the UK Met Office, is a regional climate modeling system and is used to generate high-resolution climate change projections for many regions of the world.

Table 2.1 *High Level Overview of Global and Regional Climate Change and Climate*

Observed Changes in the Past	Projected Changes in Future
<i>Temperature will continue to rise...</i>	
<i>Global:</i>	
<ul style="list-style-type: none"> • Average surface temperature increased by 0.74°C between 1906 and 2005 and has risen at a rate of 0.13°C per decade in the last 50 years (IPCC, 2007). 	<ul style="list-style-type: none"> • Global: temperature is <i>likely</i> to rise by 1.1-6.4 °C at 2090-99 relative to 1980-99 (IPCC, 2007).
<i>Regional:</i>	
<ul style="list-style-type: none"> • In China, annual average air temperature increased by 0.5-0.8°C in last 100 years. Most of the warming was observed over the last 50 years ⁽⁸⁾. • More significant warming in western, eastern and northern China ⁽⁸⁾. • Most significant temperature increase occurred in winter, and 20 consecutive warm winters were observed nationwide during 1986-2005 ⁽⁸⁾. 	<ul style="list-style-type: none"> • <i>Likely</i> that warming is above the global mean in East Asia (IPCC, 2007), and that warming tends to be largest in winter. • Nationwide annual mean air temperature to increase by 1.3-2.1°C (2020) and 2.3-3.3°C (2050) cf. ⁽⁸⁾ • Warming magnitude to increase from south to north in China, particularly in northwestern and northeastern China ⁽⁸⁾.
<i>Temperature extremes</i>	
<i>Global:</i>	
<ul style="list-style-type: none"> • Warmer and fewer cold days/nights were <i>very likely</i> (IPCC, 2007). • Warmer and more frequent hot days/nights over most land areas were <i>very likely</i> (IPCC, 2007). • <i>Likely</i> that warm spells/heat wave frequency increased over most land areas (IPCC, 2007). 	<ul style="list-style-type: none"> • Warmer and fewer cold days and nights are <i>virtually certain</i> (IPCC, 2007). • Warmer and more frequent hot days/nights over most land areas are <i>virtually certain</i> (IPCC, 2007). • <i>Very likely</i> that warm spells/heat waves frequency will increase over most land areas (IPCC, 2007).

Observed Changes in the Past	Projected Changes in Future
<p><i>Regional:</i></p>	<ul style="list-style-type: none"> • <i>Very likely</i> that summer heat waves/hot spells in East Asia will be of longer duration, more intense and more frequent (IPCC, 2007). • Fewer very cold days in East Asia is <i>very likely</i> (IPCC, 2007).
<p><i>Precipitation patterns will change...</i></p>	
<p><i>Global:</i></p> <ul style="list-style-type: none"> • Precipitation has increased significantly in eastern North and South America, northern Europe, northern and central Asia between 1900 and 2005; drying occurred in the Sahel, the Mediterranean, southern Africa and parts of southern Asia (IPCC, 2007). 	<ul style="list-style-type: none"> • Precipitation <i>very likely</i> to increase at high latitudes in the 21st century, but <i>likely</i> to decrease in most subtropical land regions (IPCC, 2007).
<p><i>Regional:</i></p> <ul style="list-style-type: none"> • For China, no obvious trend of change in annual precipitation in the past 100 years; considerable variation among regions ⁽⁸⁾. There is an increasing trend in precipitation in the western and southern part of China, but a decreasing trend in northern and north-eastern China. • Annual precipitation decreased gradually since 1950s (average rate of 2.9 mm/decade, with northern China being most severe ⁽⁸⁾). 	<ul style="list-style-type: none"> • Average increases of precipitation over China relative to the reference period 1961-90 is projected to be 4.5% for 2011-40, 8% for 2041-70 and 13% for 2071-2100 (Personal Communications ⁽⁹⁾). Both winter and summer precipitations are <i>very likely</i> and <i>likely</i>, respectively, to increase in East Asia (IPCC, 2007). • Nationwide precipitation increase is projected for the next 50 years by 2-3% (2020) and 5-7% (2050), with southeastern coastal regions being the most significant ⁽⁸⁾.
<p>Precipitation extremes</p>	
<p><i>Global:</i></p> <ul style="list-style-type: none"> • <i>Likely</i> that frequency of heavy precipitation events has increased over most areas (IPCC, 2007). • <i>Likely</i> that area affected by droughts increased in many regions since 1970s (IPCC, 2007). 	<ul style="list-style-type: none"> • <i>Very likely</i> that frequency of heavy precipitation events has increased over most areas (IPCC, 2007). • <i>Likely</i> that area affected by droughts to increase (IPCC, 2007).
<p><i>Regional:</i></p> <ul style="list-style-type: none"> • Drought in northern and north-eastern China, and flood in the middle and lower reaches of the Yangtze River and south-eastern China have become more severe ⁽⁸⁾. • Annual precipitation in most years since 1990 has been larger than normal, with the precipitation pattern being a dipole, corresponding to frequent disasters in the North and flood in the South ⁽⁸⁾. 	<ul style="list-style-type: none"> • <i>Very likely</i> that frequency of intense precipitation events in East Asia will increase (IPCC, 2007). • The arid area in China is to become larger and the risk of desertification might increase ⁽⁸⁾.
<p><i>Sea level will change...</i></p>	
<p><i>Global:</i></p> <ul style="list-style-type: none"> • Global mean sea level has risen at an average rate of 1.8 mm per year (the rise is consistent with warming) between 1961 and 2003. The rate increased to 3.1 mm per year in the period 1993-2003 (IPCC, 2007). • Rate of sea level change varies by region (IPCC, 2007). 	<ul style="list-style-type: none"> • Global mean sea level to rise by 0.18-0.59 m at 2090-99 relative to 1980-99 (excluding future rapid dynamical changes in ice flow). It is <i>very likely</i> that average rate of sea level rise during the 21st century exceeds the 1961-2003 average rate (IPCC, 2007). • Sea level rise during the 21st century will not be geographically uniform (IPCC, 2007).

Observed Changes in the Past	Projected Changes in Future
<i>Regional:</i>	
<ul style="list-style-type: none"> • Rate of sea level rise along China's coasts during the past 50 years was 2.5 mm/year ⁽⁸⁾. 	<ul style="list-style-type: none"> • Sea level along China's coasts to continue to rise ⁽⁸⁾.
<i>The magnitude and/or frequency of some weather extremes will change...</i>	
Tropical cyclones	
<i>Global:</i>	
<ul style="list-style-type: none"> • Intense tropical cyclone activity in the North Atlantic has increased since 1970s, but there is limited evidence elsewhere. However, there is no clear trend in the annual numbers of tropical cyclones (IPCC, 2007). 	<ul style="list-style-type: none"> • Globally, it is expected that peak wind intensities and mean and peak precipitation intensities in future tropical cyclones to increase; the number of relatively weak tropical cyclones may decrease but the numbers of intense tropical cyclones is to increase. Total number of tropical cyclones globally to decrease (IPCC, 2007).
<i>Regional:</i>	
<ul style="list-style-type: none"> • Whether tropical cyclone activity in the western North Pacific has increased remains unclear (Yeung, 2006 ⁽¹⁰⁾). 	<ul style="list-style-type: none"> • Whether tropical cyclone activity in the western North Pacific will increase in a warmer world remains uncertain (Yeung, 2006 ⁽¹⁰⁾). • An increase in the number of tropical cyclones is expected when the current quiet phase changes to an active phase in the western North Pacific (Yeung, 2006 ⁽¹⁰⁾). • <i>Likely</i> that extreme rainfall and winds associated with tropical cyclones will increase in East Asia (IPCC, 2007).

IPCC 2007 references refer to IPCC AR4 (2007) ⁽¹¹⁾

2.2

CLIMATE CHANGE IN HONG KONG

The climate change vulnerability assessment for Hong Kong has been carried out using scenarios that are based upon the science in the IPCC AR4 and publications by the Hong Kong Observatory. *Table 2.2* presents a high-level overview of the observed changes in past climate of Hong Kong and climate change projections for future climate. The precautionary principle has been adopted in this Study by using the IPCC SRES ^(a) A1FI (ie the high) emissions scenario in the assessment as this storyline most accurately portrays the world's actual historic GHG emissions.

(a) More information on the IPCC SRES emission scenarios is available at http://www.grida.no/publications/other/ipcc_sr/.

Table 2.2 Baseline Climatic Conditions and Climate Change Scenarios for Hong Kong

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
Temperature and Extreme Temperatures								
Decadal mean annual temperature °C	23.1 (1980-1999)	A rising trend of 0.12°C per decade has been observed by the HKO over the past 124 years.	27.9 ^(a) (+4.8)	24.5 ^(b) (+1.4)	32.3 ^(c) (+9.2)	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007a ⁽¹²⁾	High, this study was conducted using AR4	Low. No information on diurnal range or seasonality of temperature increases.
Mean daily diurnal range °C	4.5 (1971-2000)	There is a decreasing trend of 0.28°C per decade (1947-2002). This is likely to reduce as nights get warmer.	n/a	n/a	n/a	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2004 ⁽¹³⁾	n/a	Medium-High. More research is needed in this area.
Hot nights ^(d) (no. days in JJA)	Annual: 13.1; JJA: 12.2 (1971-2000)	Increasing trend of 1.5 nights per decade from 1885-2008 ⁽¹⁴⁾ . A rising trend has already been observed, up from 8 nights per year in the 1960s to 15 nights per year in the period 1980-99.	41.2 ^(a) by 2090-99	22.0 by 2090-99	68.7 by 2090-99	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007a ⁽¹²⁾ Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁵⁾	Medium	Medium. Mean temperature data are used for generating the regression relationships as gridded projected minimum and maximum temperature data in most models used in AR4. The lower bound assumes no further urbanization occurs post 2006, the upper assumes current rates.
Very hot days ^(e) (no. days in JJA)	Annual: 9.8;	There is no clear observed trend regarding very hot days	15.3 ^(a) by 2090-99	9.6 by 2090-99	23.5 by 2090-99	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007a ⁽¹²⁾	Low-Medium	Medium-High. Mean temperature data are

(a) Average of the scenarios as well as of the two situations regarding urbanization

(b) The lower end of the projection range with "urbanization frozen at 2006"

(c) The upper end of the projection range with "constant urbanization rate"

(d) Hot nights are defined as those with a minimum temperature of 28°C or above

(e) Very hot days are defined as those with a daily maximum temperature of 33°C or above

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
	JJA: 8.2 (1971-2000)	in Hong Kong.				Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁶⁾		used for generating the regression relationships as gridded projected minimum and maximum temperature data in most models used in AR4. HKO is beginning to study extreme temperature projections using higher temporal resolution model data (daily) and more statistically superior downscaling techniques. The study for extreme temperature events is expected to be completed in 2010.
Cold days ^(a) (no. days in DJF)	Annual: 18.6; DJF: 16.3 (1971-2000)	Decreasing trend of 1.2 days per decade from 1885-2008 ⁽¹⁴⁾ . The number of cold days in Hong Kong has fallen dramatically in recent years from a norm of 21 in the 1960s, to under 15 per year by 1999. This trend is likely to continue, with annual mean no. of cold days decreasing to	< 1	< 1	< 1	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007a ⁽¹²⁾ Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁵⁾	Medium	Medium. Mean temperature data are used for generating the regression relationships as gridded projected minimum and maximum temperature data in most models used in AR4.

(a) Cold days are defined as those with a minimum temperature of 12°C or below

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
		< 1 c. 2030-49						The lower bound assumes no further urbanization occurs post 2006, the upper assumes current rates.
The Water Cycle								
Average annual rainfall (mm)	2382.7 (1971-2000)	A rising trend of about 25 mm (~1.1%) per decade between 1885 and 2008 has been observed.	2572.0 (+248) by 2090-2099	1763.1 (-560.9) by 2090-2099	3235.3 (+911.3) by 2090-2099	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾ Regional. NCC of CMA for Guangdong (http://www.ipcc.cma.gov.cn/cn/MapSys/)	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. The ability of global climate models at forecasting rainfall is low, particularly at regional level. There is a wide data spread between scenarios. 73% of model runs indicate a positive rainfall trend in the 21 st century.
Annual rain days (no. days per year)	104 (1971-2000)	A decreasing trend of 0.12 days/year is observed in the period 1947-2007	142.1 by 2070-2099	120.7 by 2070-2099	152.1 by 2070-2099	Local. Hong Kong Observatory, Wu <i>et al.</i> , 2006 ⁽¹⁸⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. There is no information on seasonality of precipitation. HKO will extend the study using higher temporal resolution model data (daily) from IPCC
Frequency of heavy rain ^(a) (no. days per year)	6.1 (1971-2000)	Increasing trend of 0.2 days per decade from 1885-2008 (statistically significant at 5%)	6.5 by 2070-2099	2.5 by 2070-2099	8.3 by 2070-2099	Local. Hong Kong Observatory, Wu <i>et al.</i> , 2006 ⁽¹⁸⁾ Hong Kong Observatory, Wong and Mok,	Low. The skills of global climate models in	High. This assessment is based on available IPCC AR4 monthly

(a) Heavy rain is defined as days where hourly rainfall exceeds 30mm, which is one of the criteria for issuing an amber rainstorm warning

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
		level) ⁽¹⁴⁾ . Observed rising trend from 4.8 to 6.8 from 1947 to 2002 (not statistically significant at 5% level).				2009 ⁽¹⁵⁾	forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	projection data. There is no information on seasonality of heavy rain days. HKO will extend the study using higher temporal resolution model data (daily) from IPCC.
<i>Extreme Rainfalls of Different Durations</i>								
Extreme Rainfalls of Different Durations	n/a	An Analysis of Effects of Climate Change on Stormwater Drainage System” reveals that the long-term trends of annual total and extreme rainfall of different durations are increasing. The percentage increase in these trends is less high for longer rainfall durations. For example, for those rainfall durations of less than or equal to 30 min., the percentage changes of annual maxima are substantially higher than the data for rainfall events from 60 min. to 24 hours as well as the annual total.	n/a	n/a	n/a	Local: Drainage Services Department, R&D Report no. 1036	Low.	Medium. More research is needed in this area.
<i>Annual Extreme Rainfall</i>								
Annual maximum 1-hourly rainfall	n/a	An increasing trend of 1.7 mm per decade between 1885 and 2008.	n/a	n/a	n/a	Local. Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁴⁾	Low	High. There is currently no information on seasonal variability.

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
		Return values for fixed return periods (10-year, 20-year, 50-year, 100-year) increased by 1.1 mm per decade between 1885 and 2008.						
Annual maximum 2-hourly rainfall	n/a	Return period of ≥ 100 mm shortened from 37 years (1900) to 18 years (2000). An increasing trend of 2.1 mm per decade between 1885 and 2008.	n/a	n/a	n/a	Local. Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁴⁾	Low	High. There is currently no information on seasonal variability.
		Return values for fixed return periods (10-year, 20-year, 50-year, 100-year) increased by 1.8 mm per decade between 1885 and 2008.						
Annual maximum 3-hourly rainfall	n/a	Return period of ≥ 150 mm shortened from 32 years (1900) to 14 years (2000). An increasing trend of 1.7 mm per decade between 1885 and 2008 (trend is marginally insignificant at 5% level).	n/a	n/a	n/a	Local. Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁴⁾	Low	High. There is currently no information on seasonal variability.
		Return values for fixed return periods (10-year, 20-year, 50-year, 100-year) increased by 2.0 mm per decade between 1885 and 2008.						
		Return period of ≥ 200 mm shortened from 41 years (1900) to 21 years (2000).						

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
<i>Extreme Annual Rainfall</i>								
Years with extremely low annual rainfall ^(a)	2 (1885-2008)	n/a	3.6 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.
Years with extremely high annual rainfall ^(a)	3 (1885-2008)	According to the findings of the report entitled "An Analysis of Effects of Climate Change on Stormwater Drainage System", the long-term trend of rainfall is moving upwards. The percentage changes of annual trend of rainfall data generally decrease with an increase in duration. For durations less than or equal to 30 min., the percentage changes of annual maxima are substantially higher than the data for 60 min. to 24 hours as well as the annual total. This indicates the intensity of short rainfall duration is likely to become more extreme than long rainfall duration.	9.7 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.

(a) Extremely low annual rainfall is defined as years where rainfall is less than 1282mm p/a

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
Mean number of occurrences of two consecutive of extremely dry years	No occurrence since 1885	n/a	0.4 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.
Mean number of occurrences of two consecutive of extremely wet years	No occurrence since 1885	n/a	1.8 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.
Mean number of occurrences of alternative extremely dry and extremely wet year	No occurrence since 1885	n/a	0.4 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.
Mean number of years of the occurrence of annual rainfall	n/a	n/a	6.9 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate models in forecasting	High. This assessment is based on available IPCC AR4 monthly projection data.

(a) Extremely high annual rainfall is defined as years where rainfall exceeds 3187mm p/a

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
above 3343 mm (record high)							rainfall vary widely and the confidence in model estimates is usually low at the regional level.	
Mean number of years of the occurrence of annual rainfall below 901 mm (record low)	n/a	n/a	0.8 in the 21st century	n/a	n/a	Local. Hong Kong Observatory, Lee <i>et al.</i> , 2008 ⁽¹⁷⁾	Low. The skills of global climate forecasting models in rainfall vary widely and the confidence in model estimates is usually low at the regional level.	High. This assessment is based on available IPCC AR4 monthly projection data.
Run-off levels	n/a	The IPCC has high confidence that by mid-century, annual river runoff & water availability are projected to decrease, however no local observations are available.	n/a	n/a	n/a	International, IPCC 2007 ⁽¹⁹⁾	Low	High. More research is needed in this area ^(a)
Evaporation (mm)	1343.4 (1971-2000)	A decrease in global solar radiation reduced the annual total evaporation by 40% from the 1960s to 2002. This is a decline of 184mm per decade.	n/a	n/a	n/a	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2004b ⁽¹³⁾	Low	High. More research is needed in this area.
Extreme Weather Events								
Thunderstorm frequency (no. days per year)	37.1 (1971-2000)	Thunderstorms are a common occurrence in Hong Kong between April and September. The annual number of days with a thunderstorm has been increasing at a rate of 1.7 days	55.3	n/a	n/a	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2004b ⁽¹³⁾	Low	High. More research is needed in this area. The estimated impact has been obtained by mapping the currently observed linear trend

(a) Actual run-off levels are location dependent and therefore any international research is likely to be of limited value to the Hong Kong situation, except where this relates to general design approaches e.g. greening of catchments.

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
		per decade from 1947 to 2002, and is linked to the increase in heavy rainfall days.						forwards.
Tropical cyclone (TC) frequency ^(a) (annual number)	2.4 (1971-2000)	Tropical cyclones threaten Hong Kong during the summer months. Recently a decline in the number of typhoons occurring in the South China Sea has been observed from an average annual frequency of 5.5 from 1961-90, to 3.7 a year from 1996-2005, probably due to interdecadal variations. Fewer TCs occur in El Nino years.	n/a	n/a	n/a	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007b ⁽²¹⁾	n/a	High. Globally there is a great deal of uncertainty in this area. There is a broad suggestion that TCs frequency may decrease, but their range and severity may increase (likely acc. to AR4). More research is needed in this area.
Average annual incidence of category 4 and 5 tropical cyclones	0.2	Recent decline in severity of TCs affecting Hong Kong has been observed. In 1961-90, 1.9 TCs a year would be cat4-5, from 1996-2005 only 0.2 were. The recent decline appears to be due to interdecadal variations. No significant trends in the	n/a	n/a	n/a	Local. Hong Kong Observatory, Leung <i>et al.</i> , 2007b ⁽²¹⁾ Hong Kong Observatory, Wong and Mok, 2009 ⁽¹⁵⁾ International, IPCC 2007 ⁽²²⁾	Low	High. Poor statistical dataset due to low frequency of such events in Hong Kong.

(a) Tropical cyclone frequency defined as the annual number of tropical cyclones landing over the South China coast within 300km of Hong Kong. Category 4-5 is defined as 1-minute of maximum sustained wind \geq 114 knots

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
ENSO / monsoon activity	Neutral in late 2008	annual numbers of typhoons of any intensity passing within 100, 200 and 300 km of HK from 1961 to 2008 ⁽¹⁴⁾ . For an El Niño year or the year following onset of El Niño, Hong Kong tends to be wetter. The annual number of tropical cyclones is predominantly less (more) than normal for El Niño (La Niña) onset year and the year after onset. During El Niño (La Niña) winters, the winter monsoon over southern China tends to be weak (strong), Hong Kong tends to have higher (lower) mean winter temperatures and there is an increase in the occurrence frequency of higher (lower) daily mean temperatures.	n/a	n/a	n/a	International , IPCC 2007 ⁽²²⁾ Local . Hong Kong Observatory, Lam (1993) ⁽²³⁾ , Leung and Leung (2002) ⁽²⁴⁾ , Wu and Leung (2008) ⁽²⁵⁾ ,	n/a	High. More research needed in this area. Models suggest a weakening of the ENSO-monsoon relationship in a future warmer climate, although this may not be applicable for Hong Kong.
Sky Conditions								
Cloud amount (%)	Annual: 67.4% (1971-2000)	Increasing at an annual rate of 1.8% per decade over the period 1961 – 2001	n/a	n/a	n/a	Local . Hong Kong Observatory, Leung <i>et al.</i> , 2004 ⁽²⁰⁾	n/a	n/a. More research is needed in this area.
Global solar radiation (MJ/m ²)	Annual: 13.23 (1971-2000)	Has decreased by 26% (1964 – 2002) at a rate of 1MJ/m ² per decade.	n/a	n/a	n/a	Local . Hong Kong Observatory, Leung <i>et al.</i> , 2004 ⁽²⁰⁾	n/a	n/a. More research is needed in this area.
Sea Conditions								
Sea level rise / SLR (mm)	Rising at 2.4-2.7 mm per year	Currently rising at 2.4 mm per year for the period 1954-2007 at North Point / Quarry Bay,	Not defined	260-590 mm	Not defined	Local , Hong Kong Observatory, Wong <i>et al.</i> , 2003 ⁽²⁶⁾ Regional , Huang 2004 ⁽²⁷⁾	Very Low. There are numerous uncertainties (see	High. More research is needed in this area (including assessing

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
	depending on location	and at an average rate of 2.7 mm per year for the period 1963-2007 at Tolo Harbour.				International , IPCC 2007 ⁽²²⁾ There is no international consensus on upper bound and most likely SLR by 2100. The IPCC AR4 projections are used in this study for identifying the lower bound of likely SLR, but should not be construed as the most likely or upper bound, as they are incomplete.	<i>Section 2.3</i>). The upper bound could be considerably higher should ice sheet melt at Greenland / Antarctic occur in a rapid nonlinear fashion. Emerging scientific studies suggest that SLR could be in the order of 500–2000 mm by 2100.	the rapid melt seen at the North Pole for the last 2 summers) ^(a) . The IPCC recently stated that it failed to include the contribution from dynamic ice flow (at the Arctic and Antarctic) into its SLR projections. This means that effectively there is no upper bound estimate.
	Rising at 2.4 mm/year at South Sea, China	The sea level at South Sea has risen by 72 mm over the last 30 years	Sea level will raise by 470 mm at the area near Pearl River Delta, China	Raise by 310 mm	Raise by 560.mm	Regional : Regional, National Oceanography Bureau of CPG, 2009	Very low as they lack of long term monitoring data and research in this area.	High as most of the researches are based on computer modelling to predict the impact of global climate change on ocean and coastal areas.
Sea Surface Temperatures	Rising	The global mean temperature increase for the 0- to 300-metre layer was 0.31C (1950-90)	n/a	n/a	n/a	International , Levitus <i>et al.</i> , 2000 ⁽²⁸⁾	Low	High. More research and measurement needed.
Acidity (pH) of Seawater	8.104	Between 1751 - 1994 surface ocean pH is estimated to have decreased from approx 8.179 to 8.104, as increasing	7.824 (-0.28)	7.964 (0.14)	(- 7.754 (-0.35)	International , Orr <i>et al.</i> , 2005 ⁽²⁹⁾	Low. Feedback mechanisms are poorly understood.	High. Concern that uptake of CO ₂ by the ocean appears to have slowed suggesting

(a) Sea level rise is a global issue and there is much ongoing international research in this area. Therefore, it is considered that sea level rise projections relevant to Hong Kong are likely to emerge from such international research.

Climatic Hazard	Current Conditions	Observed Change	Impact by 2100	Lower Bound	Upper Bound	Source and Nature of Study (i.e. local, regional, international)	Confidence	Uncertainties
		atmospheric CO ₂ lowers oceanic pH and carbonate ion concentrations					Impact could be much higher.	saturation.

2.3

UNCERTAINTIES IN CLIMATE CHANGE SCIENCE

The subject of climate change is relatively new and the science is constantly evolving. There are considerable scientific uncertainties associated with lack of information and disagreement about what is known or even knowable embedded in the current state of climate change science. It is important to remember that climate *projections* should not be misinterpreted as climate *predictions*. The scientific community adopts the term *projections* (and not *predictions*) when describing future changes in climate as *projections* involve assumptions in parameters, e.g. future socio-economic and technological developments, and are therefore subject to substantial uncertainty.

The IPCC AR4 currently represents the best available international consensus on the likely impacts of climate change, upon which the current vulnerability analysis for Hong Kong is based. Nonetheless, ERM has noted areas where the risks are such that a watching brief needs to be maintained on the latest science to ensure that appropriate responses are developed.

Some of the key uncertainties that are inherent in climate change science and impact assessment should be kept in mind during the consideration of likely impacts and when devising adaptive responses. These include ⁽³⁰⁾:

2.3.1 *“Real World” Environmental Uncertainty; Inherent and Natural Internal Variability*

Many environmental processes, including the weather and climate which are variable over all spatial and temporal scales, can only be described probabilistically (pure “risk”). In addition to human activities, climate change may also be associated with natural variability, i.e. natural external factors (e.g. solar output, volcanic activity) and/or natural internal variation of the climate system. Uncertainty due to natural variability also include future choices made by societies, business or individuals that affect the social and economic environment in which climate adaptation decisions are taken and implemented, as well as variability in stock markets, social and some ecological systems.

2.3.2 *Data Uncertainty*

Data uncertainty may arise due to:

- Measurement error, both random and systematic (e.g. bias);
- Incomplete or insufficient data due to limited temporal and spatial resolution (e.g. accurate long term observational data are lacking, particularly in the developing world and oceanic data); and,
- Extrapolation based on uncertain data.

Data uncertainty can be particularly acute when attempting to determine the risk associated with extreme events as they are rare and the consequences may also be more uncertain.

2.3.3 *Knowledge Uncertainty*

The available theoretical and empirical knowledge is unlikely to provide complete, sufficient or even partial understanding of the problem a decision-maker may face. Knowledge uncertainty also includes uncertainty about the future. "Ignorance" should be acknowledged in circumstances where there is a chronic lack of knowledge.

- Future emissions: The SRES scenarios make no assumptions about future fossil fuel supplies, but assume that the supply of conventional fossil fuels will be able to keep up with demand which contradicts expert opinion from the energy modelling sector.
- Uncertainties regarding sea level rise (SLR) projection: The rate and magnitude of future SLR remain one of the largest areas of uncertainties in climate change impact assessments worldwide due to our limited understanding of many of the oceanic processes and the role of oceans in climate change. Although the SLR projections in IPCC AR4 take into account the increased Greenland and Antarctic ice flow at the rates observed for 1993-2003, this rate could change in the future, hence the projections have not captured the full effects of changes in ice sheet flow. Some studies published since the IPCC AR4 indicated that sea levels could potentially rise by substantially more than the levels predicted in AR4. Hence in this study, the IPCC's figures are presented as the lower bound of SLR projections. This area deserves more attention and regular review on the latest scientific developments regarding SLR, as well as the range of alternative SLR figures that have recently emerged in the scientific literature.
- Atmospheric inertia: The inertia of the climate system delays the responses in the atmosphere to both external and internal forces. *"Even if all greenhouse gas emissions could be stopped today, the immense inertia in the Earth's climate systems means that changes to our climate for the rest of the century are unavoidable⁽³¹⁾".* Committed climate change indicates that there could be another 0.6°C in temperature rise and changing weather patterns for the next 40 years from emissions already emitted⁽¹¹⁾.
- Uncertainties regarding dangerous / run-away climate change: There are increasingly concerns that "dangerous"⁽³¹⁾ warming (2°C exceeding pre-industrial levels) may instigate a number of positive feedback mechanisms, whereby natural tipping points are exceeded and self reinforcing, run-away warming is initiated⁽³¹⁾. Most GCMs do not yet include the effect any warming might have on the positive feedback loops. The tipping point of catastrophic climate change may be approaching sooner, and at a lower atmospheric concentration of GHGs

than was previously thought. Examples of such feedback mechanisms, which could all trigger further warming, are illustrated in *Table 2.3*.

Table 2.3 *Climate Change Positive Feedback Mechanisms*

Feedback Mechanism	Status c.2008	Source
Release of methane from previously frozen deposits i.e. permafrost, methane hydrates.	Already occurring in Northern Siberia and North America	<i>International Siberian Shelf Study 2008</i> ⁽³²⁾
The die-back of tropical forests and the release of their embodied carbon through forest fires.	Already occurring in the Amazon.	Lancaster University, University of East Anglia, 2008 ⁽³³⁾
Change to the albedo balance of the polar regions, as sea ice is reduced, and allowing oceans to absorb more warmth.	Already occurring in the Arctic and Antarctic	<i>Scientific American</i> , 2004 ⁽³⁴⁾
Higher CO ₂ levels in the atmosphere reduce the ocean's ability to store CO ₂ by increasing the acidity of the ocean and harming plankton and crustaceans.	Already occurring (particularly in the Southern Ocean).	<i>Science</i> , 2007 ⁽³⁵⁾

Whether climate as a whole is now approaching a tipping point is difficult to judge at present. ERM recommends that adopting the precautionary principle is appropriate in these circumstances.

- Atmospheric sensitivity to GHG and saturation thresholds: The sensitivity of the planet to increased atmospheric GHG concentrations and the rate with which the climate could change remains uncertain. The impacts of climate change could be considerably worse than that stated in the IPCC AR4.

2.3.4 *Model Uncertainty*

Model uncertainty is a particular example of knowledge uncertainty. Models may be conceptual or heuristic (learning by trial and error). Other technical models describe data (statistical models), known processes (e.g. environmental systems models), assess risks (risk assessment and stochastic process models) and impacts (impact and valuation models), examine the influence of decision on future (decision models) and study the influence of the future social / environmental systems on the outcomes of decisions. The sources of uncertainty arise from:

- Model choice and structure: Many aspects and physical processes of the climate system, such as the roles played by clouds, aerosols, the oceans etc, are yet to be fully understood and quantified in GCMs. Secondly, there is no “right” or “wrong” in climate change projections. It is not possible to determine whether one GCM is more accurate/reliable than the other as different GCMs, with different characteristics, produce different climate change patterns. Lastly, a GCM that can reasonably reproduce the observed trends and patterns does not necessary imply its capability in accurately simulating the future climate.

- Model input values: The values of the variables needed as inputs to models may be uncertain, as described by a range as a fuzzy set, or taken from a probability distribution of potential values for use in a quantitative Monte Carlo-based risk model.
- Model parameters: Parameter values may be known with high confidence in some of the models that are based on fundamental understanding of the underlying physical processes. However, these are estimated from limited data of uncertain quality through the process of model or parameter-fitting for many climate forecasting, downscaling and impact assessment models used in climate impact risk assessments.
- Model output variables and values: Uncertainty and sensitivity analysis are used to determine the consequences of model uncertainties for model output variables. Uncertainty propagates through the impact assessment process. It is essential in developing or using a particular model that important assumptions are identified and assessed for their possible consequence for any analysis, and that subsequent users are aware of their limitations when arriving at their decision.

The IPCC also has its limitations: The IPCC's schedule for producing reports requires a deadline for submissions up to two years prior to the report's final release in order to reach consensus agreement from all signatory governments to the UNFCCC. This is a limitation especially in an area of science where our understanding is rapidly changing, as expressed by the IPCC themselves. Some of the recent research omitted from IPCC AR4 includes the shutdown of the thermohaline circulation (the Gulf Stream), disintegration of the West Antarctic and Greenland ice sheets, and widespread bleaching of coral reefs.

The findings of the IPCC have been used as the basis for the climate change scenarios in this study as it is the best available international consensus; however it is recommended that a watching brief is kept on the latest scientific development.

2.3.5 *Recognising and Dealing with Uncertainty*

Uncertainties may arise from a variety of sources for a particular outcome or decision and categorizing these, and ranking or estimating their magnitude often relies on expert, subjective judgement. There is not always a "right" categorization, and acknowledging the presence of uncertainty is more important than assigning a category.

Science cannot and will not be able to prove any statement with absolute certainty and confidence. Any climate change adaptation strategies should be flexible enough to be effective in the face of variability, the reasonable worst case scenario, as well as any new evidence as it arises. In order to avoid the development of considerable maladaptation in infrastructure, we should not wait for 100% consensus to emerge on any aspect in the academic record of climate change. Furthermore, as highlighted in the *Stern Review* (2006) ⁽³⁶⁾, an early proactive approach against climate change will be less

expensive and more effective than a reactionary, retrospective or emergency response.

2.4 *SECTOR COVERAGE*

The sectors covered within this assessment and the assumptions regarding the baseline conditions of each of the sectors within present day Hong Kong are summarized in *Table 2.4*.

Table 2.4 Sectoral Baseline

Sector	Characteristics of the Sector Being Assessed	Significance to Hong Kong			Present Vulnerability	
		GDP	Employment (workforce)	Distribution of Infrastructure		Socio-cultural Importance
Agriculture	Including poultry production, pig husbandry, dairy farming and cattle husbandry, and fruit, flower and vegetable growing.	<1%	4,870 (0.1%)	Sector centered in the New Territories and Lantau Island with ~ 2,550 farms and 800 ha.	High	Low
Aquaculture (including fisheries)	Including marine capture fisheries, marine aquaculture, inland pond aquaculture, and oyster culture.	<1%	10,888 ^(a) (0.3%)	Offshore, coastal and rural regions of the New Territories. Oyster culture is centered on Deep Bay	High	Medium
Biodiversity / Nature Conservation	Including terrestrial, aquatic and marine biodiversity, and nature conservation	n/a	>1,830 (0.1%)	Across the territory although nature conservation efforts are concentrated at designated sites such as country and marine parks.	Low-medium	High
Built Environment and Infrastructure	Including construction and maintenance, building stock, transport infrastructure, communications infrastructure, drainage and sewage infrastructure	n/a	287,900 (7.9%)	Hong Kong's steep slopes are poorly suited to development. Infrastructure and building stock is concentrated on flat coastal strips (often reclaimed).	Medium	High
Business and Industry	Including: trading and logistics, manufacturing, professional services and producer services	41.18%	1,418,000 (39.1%)	Distributed across the territory centered on major commercial and logistics centres (i.e. ports and airport)	High	High
Energy Supply	Including electricity generation, electricity distribution and transmission, primary fuel imports and supply	2-3% (direct)	12,400 (0.3%)	Infrastructure across the territory, fuel and 20% electricity from outside Hong Kong. 4 plants located in Hong Kong in Lamma, Tuen Mun and Lantau.	High	High

(a) This figure does not include the approximate 4,700 mainland deckhands that are employed in Hong Kong.

Sector	Characteristics of the Sector Being Assessed	Significance to Hong Kong				Present Vulnerability
		GDP	Employment (workforce)	Distribution of Infrastructure	Socio-cultural Importance	
Financial Services (including insurance)	Including: banking, financial trading, brokerage and speculation, asset management, insurance, reinsurance and other financial services	15.9%	192,700 (5.3%)	Centred on Yau Tsim Mong, Kowloon City, Wan Chai and Central and Western Districts. Global assets and sensitivities.	High	High
Food Resources (agriculture, aquaculture and imports from the mainland / overseas)	Including agriculture, aquaculture and fisheries in Hong Kong, overseas food imports and food wholesale and retail trade	n/a	14,392 (0.4%)	Retail distributed across the Territory. Importers concentrated in the port warehouse districts in Kwai Tsing District, important import origins include Mainland China and Thailand	Medium	High
Human Health	Healthcare infrastructure, also changes to mortality and morbidity re accidents, chronic health conditions, air water and vector borne diseases and impacts on external infrastructure i.e. water	n/a	50,232 (1.4%)	Distributed across the territory, although focusing on the major centres of population	High	Medium
Leisure and Tourism (including cultural heritage assets)	Hotels, tourist attractions and services, transport	3.2%	193,800 (5.3%)	Tourism attractions and accommodation are focussed either side of Victoria Harbour. Key transport nodes include the cruise ship terminals in Tsim Sha Tsui and the airport at Chek Lap Kok, the Macau Ferry Terminal and road/rail links with the Mainland	Medium/High	Medium

Sector	Characteristics of the Sector Being Assessed	Significance to Hong Kong			Present Vulnerability	
		GDP	Employment (workforce)	Distribution of Infrastructure		
Water Resources	Including local yield and treatment, and Dongjiang imports	2-3% direct	4,463 ^(a) (0.1%)	Distribution network located across the territory, reservoirs primarily in the New Territories. Imported component comes from the Dongjiang in Guangdong, via the Shenzhen reservoir and the Dongshen supply line	Medium	High

(a) Employment figures for the Water Resources sector only cover the local Hong Kong employment sector and do not include jobs on the Mainland associated with providing Hong Kong's water supply.

ERM has conducted this study by subdividing the vulnerability assessment into economic sectors as per the *Study Brief*. Some other climate change adaptation studies have carried out the assessment by climate change impact type (e.g. heatwaves, flooding); others have chosen a geographic method of ordering their findings. The IPCC notes that there is no “single preferred method” providing analysis follows the key steps identified as best practice ⁽³⁷⁾, as all approaches have their inherent strengths and weaknesses.

It should be noted that there is some overlap between the delineations of these sectors, and that some sectors have a natural symbiosis with others, as a result none of the sectors should be considered in isolation. Additionally, one sector’s adaptation response could aggravate another sectors capacity to respond if response strategies are formulated without adequate cross-sectoral consultation. Vulnerability assessments and adaptation responses for all sectors should be considered in a holistic manner with broad stakeholder consultation.

2.5 HONG KONG CLIMATE CHANGE VULNERABILITY ASSESSMENT

The following sections outline the framework that was used for the vulnerability assessment for each of the systems (ie the sub-sectors), hence the determination of key vulnerable sectors. This framework follows the best practice identified in the international literature review and involves four main stages as follows:

2.5.1 Exposure and Sensitivity Analysis

This section introduces the exposure (i.e. the background climate conditions and their changes) that impact on a system/receptor for each of the sectors. The earlier introduction on certainty of climate change scenarios will be used to focus the assessment. This section also examines the sensitivity (i.e. the responsiveness) of a system/receptor to climatic influences i.e. what are the impacts (primary and secondary i.e. direct and indirect) that may affect the system, and what is the probability of this occurring. This includes a review of the level of confidence with respect to the exposure and sensitivity of the sector in Hong Kong; the sources of uncertainties will also be identified.

2.5.2 Identification of Potential Consequences

This section identifies the potential impact upon addressing the elements of exposure and sensitivity in the above section i.e. who and what will be affected. This includes a review of confidence with respect to the potential impacts in Hong Kong; the sources of uncertainties will also be identified.

2.5.3 Climate Change Impacts and Vulnerability Assessment

This section provides an overview on how vulnerable each system is to the potential impacts associated with the changing climate i.e. how exposed is this

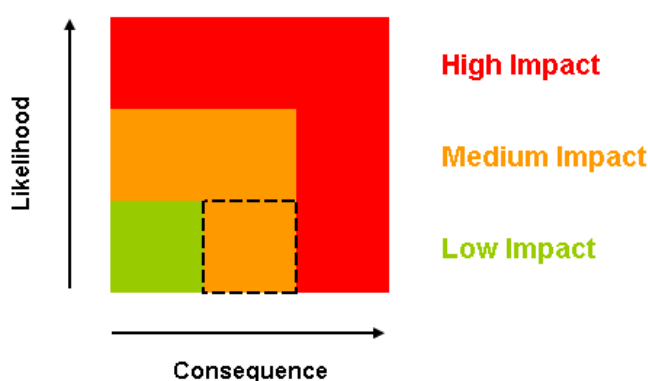
system to the impact, how sensitive are they to the change, and what is their capacity of the system/receptor to adapt.

The vulnerability of a system is influenced by its *sensitivity*, which in turn determines the impacts; it also depends on its *adaptive capacity*. The definition of “vulnerability” used in this assessment is that defined by the IPCC.

Climate Change Impact

Climate change impact is defined in this Study as the product of the likelihood and the consequence of a consequence occurring, including an assessment of its magnitude. In addition, impacts are assigned as high (H), medium (M) or low (L). Our methodology in assigning these terms is illustrated below:

Figure 2.1 *Methodology for Defining Impacts*



As per international best practice, and in line with the precautionary principle, ERM has taken a precautionary approach to defining impacts, hence a high consequence event, with a low likelihood of occurrence is still defined as a high impact. The highlighted square in *Figure 2.1*, whilst having a low likelihood of occurring, has been assigned to medium impact as the consequences of it occurring are medium.

Following international literature, the definitions of likelihood used in this Study are based on a combination of probability and frequency of an impact occurring, as illustrated in *Table 2.5*.

Table 2.5 *Defining Likelihood*

Likelihood	Definition
High	Likely ^(a) to occur several times a year
Medium	Likely to occur on an annual basis
Low	Likely to occur on a decadal basis

(a) Likely here refers to the IPCC’s definition of ‘likely’ i.e. more than 60% probability

Consequence is a definition of the severity of the given impact should it occur (Table 2.6). These are based upon best practice in risk management i.e. the ALARP (as low as reasonably practicable) model and Hong Kong risk guidelines, and draw upon those used from literature review.

Table 2.6 *Defining Consequence*

Consequence	Definition
High	<p>Likely¹ to cause:</p> <ul style="list-style-type: none"> • Serious loss of life and limb (over 100 affected) • Creation of large number of permanent or temporary climate change refugees (over 5,000 people) • Permanent loss or irreversible change to ecosystem or majority of component species • Permanent loss of majority of sector revenue • Destruction or serious damage to key assets • Serious interruption to sector activities for over 1 month
Medium	<p>Likely to cause:</p> <ul style="list-style-type: none"> • Some loss of life and limb (over 10 affected) • Creation of permanent or temporary climate change refugees (<5000 people) • Permanent loss or irreversible change to some component species within ecosystem • Permanent loss of minority of sector revenue, temporary loss of majority of sector revenue • Damage to key assets • Interruption to sector activities for over 1 week
Low	<p>Likely to cause:</p> <ul style="list-style-type: none"> • Risk of non life threatening injury • Creation of temporary climate change refugees (0-500) • Temporary damage, reversible change to ecosystem, loss of small number of component species • Temporary loss of minority of sector revenue • Minor damage to assets • Minor interruption to sector activities for < 1 week

Adaptive Capacity

Resilience is an important concept in understanding vulnerability. When a system (e.g. a community or society) is exposed to a hazard, it may resist or change in order to reach and maintain an acceptable level of functioning and structure.

Resilience in human-ecological systems is characterised by ⁽³⁸⁾:

- The amount of disturbance a society can absorb and still remain within the state of domain of attraction;
- The degree to which the society is capable of self-organisation or adjustment; and,
- The degree to which the society can build and increase the capacity for learning and adaptation.

Societies have inherent capacities to adapt to climate change. Adaptive capacity can reduce the likelihood and magnitude of adverse climate change impacts, as well as exploit beneficial opportunities. It is also a necessary condition for the design and implementation of effective adaptation strategies.

A system requires time to realise its adaptive capacity as adaptation, hence adaptive capacity represents *potential* adaptation, i.e. a high level of adaptive capacity only reduces a system’s vulnerability to future hazards (e.g. anticipated future storms, extreme rainfall events) or to continuous hazards (e.g. increases in mean temperatures over decades), to which the system can adapt reactively. In contrast, current levels of vulnerability are determined by existing adaptations resulting from the past realization of adaptive capacity ⁽³⁹⁾.

Climate change vulnerability assessments have facilitated our understanding of adaptive capacity. The indicators selected for vulnerability assessments often provide important insights on the factors, processes and structures that influence adaptive capacity. The term “adaptive capacity” is used to cover a multitude of factors, but to date, there is little agreement as to what these factors should be. Some dimensions of adaptive capacity are generic (such as education, income, health), while others are specific to particular climate change impacts (such as drought, heatwaves). Some studies argue on the usefulness of indicators of generic adaptive capacity and the robustness of the results.

The table below presents some of the elements that may be considered when assessing the adaptive capacity of a system.

Table 2.7 *Elements Used for Assessing Adaptive Capacity* ⁽⁴⁰⁾

• Economic development / resources	• Social capital (made up of the networks and relationships between individuals and social groups that facilitate economic well-being and security)
• Technology	
• Innovation, i.e. the development of new strategies or technologies	
• Existing anticipatory ^(a) / autonomous ^(b) / planned adaptation ^(c)	• Values
• Infrastructure	• Perceptions
• Information, skills and management	• Customs
• Governance structures	• Income
• Equity	• Traditions
• Human capital	• Level of cognition / education

The definitions of adaptive capacity adopted in this Study are illustrated in *Table 2.8* and are based upon the recent World Bank definitions of adaptive capacity outlined in the Climate Resilient Cities project ⁽³⁸⁾. It may be difficult to evaluate the adaptive capacity for some sectors. Evidence and experience

(a) Adaptation that takes place before impacts of climate change are observed.

(b) Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems.

(c) Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

from the past may be used to guide judgement and priority assessment in this aspect. It should be emphasized that “[E]ven societies with high adaptive capacity remain vulnerable to climate change, variability, and extreme events” (38).

Table 2.8 *Defining Adaptive Capacity*

Adaptive Capacity	Definition
High	<ul style="list-style-type: none"> • Low sensitivity (high tolerance) to change • High likelihood and significance of autonomous adaptation • Planned adaptation may not be necessary, or is no/low cost • Low risk of maladaptation
Medium	<ul style="list-style-type: none"> • Medium sensitivity (tolerance) to change • Moderate likelihood and significance of autonomous adaptation • Planned adaptation is low cost / win-win • Moderate risk of maladaptation
Low	<ul style="list-style-type: none"> • High sensitivity (low tolerance) to change • Low likelihood or significance (where it occurs) of autonomous adaptation. • Planned adaptation may not be feasible, or is financially prohibitive. • High risk of maladaptation.

2.5.4 *Selecting “Key” Vulnerabilities*

Policy processes can be informed by scientific analysis but substantial scientific uncertainties and value judgements are inherent in the assessment of key vulnerabilities. Therefore, the determination of which impacts of climate change are potentially “key” and what is “dangerous” is a dynamic process. Table 2.9 shows some of the criteria / elements that may be considered when identifying key vulnerabilities. These provide a basis for determining the priorities for action and/or management in Hong Kong.

Table 2.9 *Criteria Used for Identifying Key Vulnerabilities* (41)

Factual / Objective Elements	Normative / Subjective Elements
<ul style="list-style-type: none"> • Magnitude of impacts • Timing of impacts • Persistence and reversibility of impacts 	<ul style="list-style-type: none"> • Likelihood of impacts and vulnerabilities, and confidence in those estimates • Potential for adaptation • Distributional aspects of impacts and vulnerabilities • Importance of the vulnerable system(s)

Magnitude

Both the scale (e.g. the area or number of people affected) and the intensity (e.g. the degree of damage caused) of an impact affect its magnitude. Large magnitude impacts are more likely to be evaluated as “key”. Some of the metrics that have been used to describe the magnitude of climate impacts include:

- Monetary units, e.g. welfare, income, revenue losses, costs of anticipating and adapting to certain biophysical impacts, estimates of people’s willingness to pay to avoid (or accept as compensation for) certain climate impacts

- Non-monetary indicator, e.g. number of people affected, morbidity and mortality, forced migration, species extinction numbers or rates.

Timing

An adverse impact that is expected to happen soon is more likely to be evaluated as “key”. Those occurring in the distant future which are caused by nearer-term events or forcings, such as the disintegration of the West Antarctic ice sheet, may also be considered “key”. More significant impacts may also include those occurring suddenly (and surprisingly), as opposed to those occurring gradually – i.e. the rate at which impacts occur. In addition, very rapid change in a non-linear system can exacerbate other vulnerabilities (e.g. human vulnerability to disease may be influenced by impacts on agriculture and nutrition).

Persistence and Reversibility

Persistent or irreversible impacts are more likely to be considered “key”. The emergence of near-permanent drought conditions and intensified cycles of extreme flooding that were previously regarded as “one-off” events are some examples of impacts that are persistent. Irreversible impacts (at least on time-scales of many generations) include the loss of unique cultures and the extinction of species.

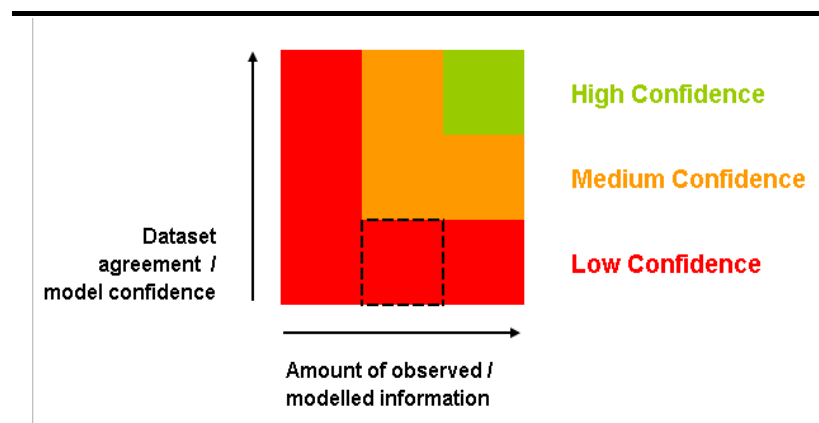
Likelihood and Confidence

Uncertainty of climate change and the associated impacts are often characterized by the likelihood of impacts and our confidence in their assessment. Likelihood represents the probability of an outcome having occurred or occurring in the future while confidence is the subjective assessment that any statement about an outcome will prove correct.

In the vulnerability assessment, confidence levels are attached to the projected climate change for Hong Kong and the identified potential consequences to indicate the level of confidence in the “correctness” of a result. This method of assigning confidence levels follows that adopted by the United Kingdom (UK) Marine Climate Change Impacts Partnership (MCCIP), which is based upon the framework used by the IPCC and that adopted by the UK Climate Impact Programme (UKCIP).

Qualitative assessment of both the amount and consistency of the available information leads to an overall confidence rating of high, medium or low. A high confidence denotes that the available evidence is high in both the quantity and agreement of information available. As per international best practice, a low confidence is assigned if **either** is insufficient due to a high degree of uncertainty.

Figure 2.2 Methodology for Defining Confidence Statements



The square highlighted in *Figure 2.2* represents a hypothetical topic where there is a “moderate” amount of information but where the agreement between different sources of information is “low”. This square falls into the red area which gives us an overall confidence rating of “low”.

Confidence estimates have been assigned to the potential climate scenarios and the possible resultant impacts for Hong Kong as illustrated in *Table 2.2* and *Table 2.11*, respectively.

Potential for Adaptation

“Key” vulnerabilities generally involve those impacts that have lower availability and feasibility of effective adaptation. For instance, there is relatively little scope for adaptation to loss of land resulted from sea-level rise, and there are no realistic options for preserving many endemic species in areas that become climatically unsuitable. The adaptive capacity of human systems is likely to be constrained when key assets are long lived and, once in place, cannot be readily modified or adjusted. In addition, any system may be overwhelmed by sufficiently rapid and extreme changes. Adaptation assessments should consider the technical feasibility of certain adaptations, the availability of required resources, the costs and side-effects of adaptation, the knowledge about those adaptations, their timeliness, the (dis-)incentives for adaptation actors to actually implement them, and their compatibility with individual or cultural preferences.

Distribution

Equity issues are often raised when concerning distributional impacts of climate change. “Key” impacts and vulnerabilities tend to be those that are highly heterogeneous or which have significant distributional consequences. Factors such as income, gender, age, regional/national/sectoral groupings and others may be considered.

Importance of the vulnerable system(s)

Different people and groups of society may value the significance of impacts and vulnerabilities on human and natural systems differently. In this assessment, the significance of a system is determined by considering elements that include workforce, contribution to GDP, geographic distribution, socio-cultural importance, as well as (but are not limited to) other factors such as ecological importance / value, ecosystem services, interdependencies.

2.5.5 *Remarks*

This vulnerability assessment aims to identify the potential key vulnerable areas. This assessment does not, however, attempt to order the vulnerabilities by priority or severity as “no single metric can adequately describe the diversity of key vulnerabilities, nor determine their ranking”⁽⁴⁰⁾. The vulnerabilities are determined by considering the elements identified in *Table 2.9*, upon which the prime criteria for “key vulnerability” are based; this assessment has also taken into account the discussions with, and amongst, the stakeholders during the *Vulnerability and Adaptation Assessment Workshop*.

The categories of High (H), Medium (M), and Low (L) assigned in this assessment are indicative and are presented for illustrative purposes only. It should also be noted that this climate change impacts and vulnerability assessment is based upon the current knowledge and understanding of climate change science and the associated consequences, as well as the data and information available (in particular, with reference to the local situation) during the time of the assessment. Such an assessment should be reviewed on a regular basis in order to take into account updated data and information (on the science, the methodology, for example) as they become available. Furthermore, detailed sectoral climate change impact assessments are encouraged to identify specific receptors that can potentially be impacted and their vulnerabilities.

2.6 *CLIMATE CHANGE IN HONG KONG – SECTORAL IMPACTS AND VULNERABILITY*

2.6.1 *Hong Kong Climate Change Vulnerability Assessment*

An overview of the exposure units and the receptors that may be sensitive, and the sensitivity (or responsiveness) of a receptor to climate change, along with the climatic and non-climatic drivers that may have an influence on these, are illustrated in *Table 2.10*. The full exposure and potential consequences for each of the sectors are detailed in *Annex A*.

Table 2.10 Exposure and Sensitivity of the Sectors

Sector	Exposure and Sensitivity
Agriculture	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in frequency and/or severity of extreme weather events; • Changes in precipitation patterns; • Decreased global solar radiation; • Sea level rise; • Changes to soil moisture levels; • Changes to planting, transplanting and harvesting timetables; • Impacts on agricultural production; • Impacts on assets and infrastructure; and, • Health and safety of workforce.
Aquaculture	<ul style="list-style-type: none"> • Increase in sea surface temperatures; • Potential change in ocean currents; • Ocean acidification; • Changes in frequency and/or severity of extreme weather events; • Changes in precipitation patterns; • Sea level rise; • Onset of hypoxic conditions; • Changes in species distribution and breeding patterns, marine productivity; • Changes in capture fisheries operations; • Changes in species selection; • Changes in fish pond water levels; • Coastal flooding / inundation of low lying coastal areas; • Impacts on assets and infrastructure; and, • Health and safety of workforce.
Biodiversity / Nature Conservation	<ul style="list-style-type: none"> • Increase in surface and sea surface temperatures; • Changes in frequency and/or severity of extreme weather events; • Changes in precipitation patterns; • Ocean acidification; • Onset of hypoxic conditions; • More frequent hyposaline events; • Changes in terrestrial and marine species distribution/occurrence; • Changes to Montane habitat; • Changes in Hong Kong ecological communities; • Wash out of streams; • Increased risk of storm damage to woodlands; and • Changes in the size of intertidal habitats and sedimentation rates due to sea level rise.
Built Environment and Infrastructure	<ul style="list-style-type: none"> • Increase in surface temperatures; • Changes in frequency and/or severity of extreme weather events; • Changes in precipitation patterns; • Sea level rise; • Impacts on the building stock and slope stability; • Impacts on transport, communication and drainage (including stormwater drainage, sewerage systems and wastewater treatment facilities) infrastructure; and, • Health and safety of workforce, building occupants and tenants.

Sector	Exposure and Sensitivity
Business and Industry	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Changes in frequency and/or severity of extreme climate / weather events; • Sea level rise; • Reduced visibility (or at least the perception of poor air quality); • Impacts on manufacturing facilities in the Pearl River Delta Economic Zone (PRDEZ) and locally; • Allocation of public funds to disaster management and adaptation; and, • Impacts on supply chain, assets and infrastructure; and, • Health and safety of workforce.
Energy Supply	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Changes in frequency and/or severity of extreme climate / weather events; • Sea level rise; • Impacts beyond the HKSAR border at the origins of imports and impacts on its supplier trading partners; • Knock-on socio-economic consequences in the Broader economy; • Electricity production, increased import insecurity due to rising international demand and increased national stockpiling, rising prices; • Logistical delays to international cargo transportation; • Increased competition for electricity in the region; • Changes in electricity demand and supply patterns; • Impacts on assets and infrastructure (e.g. electricity generation and transmission, and those associated with fuel distribution); and, • Health and safety of workforce.
Financial Services	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Changes in frequency and/or severity of extreme climate / weather events; • Sea level rise; • Changes to water resources; • Impacts on telecommunications networks; • Impacts on insurers and reinsurers; • Changes to the risk profile of individual businesses; • Implications for business operations, investments, insurance, corporate pension funds and corporate reputation; • Changes in market demand for goods and services; • Impacts on assets and infrastructure; and, • Health and safety of workforce.
Food Resources	<ul style="list-style-type: none"> • Changes in surface temperature; • Changes to soil moisture levels; • Changes in frequency and/or severity of extreme climate / weather events; • Changes in precipitation patterns; • Decreased global solar radiation; • Sea level rise; • Changes to water resources; • Impacts on agricultural production at the origins of food imports, notably China and Thailand; • Impacts on supply chain, assets and infrastructure; and, • Health and safety of workforce.

Sector	Exposure and Sensitivity
Human Health	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Changes in frequency and/or severity of extreme climate / weather events; • Decreased global solar radiation; • Changes in the survival of some pathogens and disease patterns; • Changes in respiratory, vector-borne, water-borne and food-borne diseases; • Impacts on health and external infrastructure; and, • Health and safety of workforce and the general population.
Leisure and Tourism	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Changes in frequency and/or severity of extreme climate / weather events; • Reduction in visibility; • Sea level rise; • Impacts on Hong Kong's competitors; • Impacts on tour operators, tourist attractions, assets and infrastructure; and, • Health and safety of workforce.
Water Resources	<ul style="list-style-type: none"> • Increase in surface temperature; • Changes in precipitation patterns; • Increase in evaporation; • Changes to water resources; • Changes in frequency and/or severity of extreme climate / weather events; • Sea level rise; • Impacts on water quantity and quality; • Impacts on water supply chain, assets and infrastructure; and, • Health and safety of workforce.

2.6.2

Uncertainties and Limitations of Vulnerability Assessment

Based on the detailed evaluation of individual sectors and the assessment as in *Section 2.6, Table 2.11* summarises the vulnerabilities for each of the systems assessed. This is the first comprehensive assessment of vulnerability to climate change in Hong Kong. It has been carried out based upon the current state of knowledge and the information available in the Fourth Assessment Report (AR4) of IPCC as well as consultant's and expert's judgments so as to make the best possible assessment of potential areas of greatest risk. It should be acknowledged that the quality and quantity of information available to make the assessment vary between systems. Moreover, there are uncertainties and limitations associated with the information in AR4 and hence the outcome of the vulnerability assessment. For instance, there is high uncertainty in fisheries and biodiversity compared to some other highly managed systems such as engineered slopes. The gradings in *Table 2.11* are derived based on various prime criteria for "Key" Vulnerability such as Distribution, Timing, Importance, Magnitude as well as the Consultant and their expert's opinion while *Table 2.12* provides further details on rationales behind the assessment for each system presented in the *Table 2.11*. The

sources of uncertainties and areas for further research from this vulnerability assessment are further illustrated under *Section 2.6.3*.

There are many areas in climate change that lack of or do not have sufficient “local” scientific information at the time of preparing the vulnerability assessment, for example, information on the health impacts to the sub-tropical regions like Hong Kong is not extensive. Where there is a lack of “local” scientific data to support a research-driven approach to assessing the vulnerability and adaptation of a particular sector, ERM has exercised expert judgement to determine the risk rankings of this sector, for example, the risk rankings under Human Health sector in *Table 2.11*. At the time of preparing this report, IPCC is preparing the Fifth Assessment Report (AR5) due for publication in 2015. Much work is being undertaken, including the development of new scenarios for impacts, adaptation and vulnerability (IAV) assessments. With the rapid evolution in the climate change science, the vulnerability assessment should be considered as a dynamic process and the findings of this risk based assessment should be regularly reviewed and updated.

As shown in *Table 2.11*, the key vulnerabilities, represented as “High (H)” vulnerability, have been identified. This vulnerability assessment highlights the current priorities for adaptation research and supplementary action; the adaptation options for these areas are discussed in *Section 6* of this Report.

It should be noted that this vulnerability assessment provides a high-level “screening” of the key vulnerabilities that are currently considered critical. More detailed and focused assessments using more sophisticated methodology (e.g. modelling) are likely to be needed for identifying specific vulnerabilities.

Table 2.11 Vulnerabilities of the Sectors

Systems	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
	Climate Change Impacts		Confidence	Potential for Adaptation		Importance	Prime Criteria for "Key" Vulnerability	Vulnerability
	Adverse Implications	Potential to Benefit		Present Day Capacity	Adaptive Capacity			
A Agriculture								
A1 Poultry Production	M	L	L/M	M/H	M/H	M	Magnitude, Importance	L/M
A2 Pig Husbandry	M	L	L/M	M/H	M/H	L/M	Magnitude, Importance	L/M
A3 Dairy Farming / Cattle Husbandry	M	L	L/M	M/H	M/H	L	Magnitude	L/M
A4 Fruit, Flower and Vegetable Production	M/H	L	L/M	M	M	L	Persistence, Irreversibility, Magnitude, Timing, Importance	M
B Aquaculture & Fisheries								
B1 Marine Capture Fishery	H	Uncertain	L	M	L	L	Persistence, Irreversibility, Magnitude, Timing, Confidence	M
B2 Marine Culture Fishery	H	Uncertain	L	M	L	L	Persistence, Irreversibility, Magnitude, Timing, Confidence	M
B3 Inland Pond Aquaculture	M/H	L	L	M/H	L/M	L	Persistence, Irreversibility, Magnitude, Timing, Confidence	L/M
B4 Oyster Culture Fishery	M/H	L	L	M/H	L/M	L	Magnitude, Timing, Confidence	L
C Biodiversity & Nature Conservation								
C1 Terrestrial / Aquatic Ecosystems and Biodiversity	H	L	L/M	L	L	H	Persistence, Irreversibility, Magnitude, Timing, Low Adaptive Capacity, Confidence, Importance	H
C2 Marine Ecosystems and Biodiversity	H	Uncertain	L	L	L	H	Persistence, Irreversibility, Magnitude, Timing, Low Adaptive Capacity, Confidence, Importance	H
D Built Environment & Infrastructure								
D1 Building Stock	H	L	L/M	M/H	L	H	Distribution, Magnitude, Timing, Low Adaptive Capacity, Importance, Irreversibility, Confidence	H
D2 Transport Infrastructure	H	L	L	M/H	L	H	Magnitude, Timing, Low Adaptive Capacity, Importance, Irreversibility,	H

Systems	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
	Climate Change Impacts		Confidence	Potential for Adaptation		Importance	Prime Criteria for "Key" Vulnerability	Vulnerability
	Adverse Implications	Potential to Benefit		Present Day Capacity	Adaptive Capacity			
D3 Communications Infrastructure	H	L	L	M/H	L/M	H	Confidence Magnitude, Timing, Low Adaptive Capacity, Importance, Irreversibility, Confidence	M/H
D4 Stormwater Drainage Systems	H	L	L/M	M	L	H	Magnitude, Timing, Low Adaptive Capacity, Importance, Persistence, Irreversibility, Confidence	H
D5 Sewerage Systems	H	L	L	M/H	L	H	Magnitude, Timing, Low Adaptive Capacity, Importance, Persistence, Irreversibility, Confidence	H
D6 Slope Stability	H	L	M	M	L/M	H	Distribution, Timing, Persistence, Importance	H
E Business & Industry								
E1 Trading and Logistics	M	L/M	L/M	M	M	H	Distribution, Magnitude, Timing, Confidence, Importance	H
E2 Manufacturing (Hong Kong)	M	L/M	L/M	M	M	M	Distribution, Timing, Confidence	M
E3 Manufacturing (Pearl River Delta)	M/H	L/M	L	L/M	L/M	M/H	Distribution, Timing, Confidence, Lower Adaptive Capacity	M/H
E4 Professional and Producer Services	M	L/M	L/M	M	M	M/H	Distribution, Timing, Confidence	M
F Energy Supply								
F1 Electricity Generation	M/H	L/M	L/M	M/H	M	H	Magnitude, Timing, Importance	H
F2 Electricity Transmission and Distribution	M	L	L	M/H	M	H	Magnitude, Timing, Importance, Confidence	H
F3 Primary Fuel Imports and Supply	M/H	L	L	M/H	L/M	H	Magnitude, Timing, Importance, Confidence	H
G Financial Services								
G1 Banking	M/H	L/M	L	L/M	L/M	H	Distribution, Magnitude, Timing, Confidence, Importance	H
G2 Insurance	M/H	L/M	L/M	L/M	M	H	Distribution, Magnitude, Timing, Confidence, Importance	H

		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Systems	Climate Change Impacts		Confidence	Potential for Adaptation		Importance	Prime Criteria for "Key" Vulnerability	Vulnerability	
	Adverse Implications	Potential to Benefit		Present Day Capacity	Adaptive Capacity				
G3	Other Financial Services	M/H	L/M	L	L/M	L/M	H	Distribution, Magnitude, Timing, Confidence, Importance	M/H
H Food Resources									
H1	Food Imports	H	L	L	M	L	H	Distribution, Magnitude, Confidence, Importance	H
H2	Food Wholesale and Retail	M	L	L/M	M	L/M	H	Distribution, Confidence, Importance	M
I Human Health									
I1	Accidents / External Health Stresses	M/H	L	L/M	M/H	M	M/H	Distribution, Timing, Importance	H
I2	Air Quality and Respiratory Disease	M/H	L	L/M	M	L/M	H	Distribution, Magnitude, Timing, Importance	M/H
I3	Chronic Health Conditions	M/H	L	L/M	M	L/M	H	Distribution, Magnitude, Timing, Importance	H
I4	General Communicable Diseases	M/H	L	M	M/H	M	H	Distribution, Timing, Persistence, Irreversibility, Importance	H
I5	Vector Borne Disease	M/H	L	L/M	M/H	M	H	Distribution, Timing, Persistence, Importance	H
I6	Water Borne Disease	M/H	L	L/M	M/H	M	H	Distribution, Magnitude, Timing, Irreversibility, Importance	M/H
I7	Food Borne Disease	M	L	M	M/H	M	H	Distribution, Timing, Irreversibility, Importance	M
I8	Health Infrastructure	M	L	L/M	M/H	L/M	H	Distribution, Magnitude, Timing, Persistence, Importance	M/H
I9	External Infrastructure	M	L	L	M/H	L/M	H	Distribution, Magnitude, Timing, Importance, Confidence	M
I10	Occupational Health and Safety	M/H	L	M	M/H	M	H	Distribution, Timing, Irreversibility, Importance	M/H
J Leisure & Tourism									
J1	Hotels	M	L	L/M	M/H	L/M	M/H	Distribution, Magnitude, Timing, Importance	M/H
J2	Tourist Attractions / Tourism	M	L	L/M	M/H	M	M/H	Distribution, Magnitude, Timing,	M

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Systems	Climate Change Impacts		Confidence	Potential for Adaptation		Importance	Prime Criteria for "Key" Vulnerability	Vulnerability
	Adverse Implications	Potential to Benefit		Present Day Capacity	Adaptive Capacity			
Services							Importance	
K Water Resources								
K1 Impounding and Service Reservoirs	M/H	L	L	M/H	L/M	M	Distribution, Magnitude, Timing, Importance	M/H
K2 External Supply from Dongjiang	H	L	L	M/H	L	H	Distribution, Magnitude, Timing, Importance	H

Table 2.12 Sector Vulnerability Assessment Explanation

Agriculture

- A(i)** • The majority of the potential consequences arising from climate change are likely to be negative (e.g. rising commodity prices and falling production), and these could occur on an annual basis.
- A(ii)** • Few beneficial climate change effects are anticipated in the sub-tropics.
- A(iii)** • Little is known about how local agriculture could be impacted by climate change, e.g. from an increased atmospheric CO₂ concentrations, the thermal tolerance of plant and livestock species, changes to pest and animal disease distribution.
 - Local agriculture could have an important role in enhancing Hong Kong's future food security but its potential to contribute requires further investigation.
- A(iv)** • Farmers may suffer from present day weather and extreme events but are generally capable of recovering in a relatively short time period.
- A(v)** • Agriculture is particularly sensitive to changes in the climate. However, agriculture is one of the highly managed sectors that has relatively high potential to adapt through selection of new breeds, changes to planting / transplanting / harvesting timetables, use of new cultivars and climate controlled greenhouses etc.
 - [A4(v)] Arable land may be more susceptible to flooding or loss of land as a result of sea-level rise, relocation may be less flexible.
- A(vi)** • This sector accounts for a minority of the local food demand although it could strategically be valuable in terms of local food security. This sector may also have an importance from the historical and socio-cultural perspective.
 - Local poultry production [A1] and pig husbandry [A2] satisfies around 45% and 20% of local demands, respectively.
- A(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The agriculture sector in general is highly managed and has higher potential for adaptation, and therefore the impacts reduced. Poultry production and pig husbandry have significance in meeting local demands and impacts on these may have wider repercussions. Impacts on arable land may be more severe as low-lying land may suffer from re-occurring flooding events or permanent land loss and relocation may be more difficult. As adaptive capacity for arable farmers may be lower compared to others, the potential impacts could be more significant.

Aquaculture & Fisheries

- B(i)** • The majority of the potential consequences arising from climate change are likely to be negative (e.g. changes in species distribution / occurrence), and that could occur on an annual basis.
 - The impacts on marine capture fishery [B1] and marine culture fishery [B2] could potentially be greater due to lack of clear understanding of the potential changes in the marine environment and therefore the lack of preparedness.
- B(ii)** • There is currently no information on the potential to benefits from climate change to the marine environment.
- B(iii)** • Very high uncertainties in the future marine environment (e.g. ocean acidification, future changes in ocean currents, salinity levels) and the associated impacts.
 - The socio-economic significance of this sector to Hong Kong is not apparent.
- B(iv)** • This sector may suffer from present day weather and extreme events (e.g. impacts on fishing operations) but are generally capable of recovering in a relatively short time period.
 - Marine capture fishery [B1] and marine culture fishery [B2] are more dependant and sensitive to extreme weather events and others such as overfishing.
- B(v)** • The potential to adapt is uncertain. Some aquaculture operations and species operating at the limits of heat tolerance may have limited adaptive capacity.
 - Due to the uncertainties in the future marine environment, human interventions in marine capture fishery [B1] and marine culture fishery [B2] are likely to be more difficult, and that these sectors may be less easily managed.
- B(vi)** • This sector accounts for a relatively small proportion of the local food demand

although it could strategically be valuable in terms of local food security. This sector, however, has an importance from the historical and socio-cultural perspective.

- B(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

Overall, the aquaculture and fishery sector has relatively low economic importance. Very little is known about the future marine environment and this contributes to the uncertainties in predicting the potential consequences on this sector. Nevertheless, the anticipated magnitude and rate of changes are expected to negatively impact the marine food chain and therefore marine species occurrence and distribution, especially for species that are at the edge of their thermal tolerance limits. Some impacts or effects on the marine capture or culture species and operations may be persistent (e.g. the extent and frequency of hypoxia events) or irreversible (e.g. loss of fish diversity, species extinction), and this may affect fisheries operations. Potential for human intervention in inland pond aquaculture is higher and thereby minimising the impact. The potential loss of mudflats due to sea-level rise may affect oyster culture operations, however, the significance of oyster farm aquaculture is relatively low.

Biodiversity & Nature Conservation

- C(i)** • Increasing loss of biodiversity and colonisation of invasive species are expected, and these could occur on an annual basis.
- C(ii)** • There is currently little information on the potential to benefits from climate change to the terrestrial or marine environment.
- C(iii)** • Knowledge of the full extent of Hong Kong's ecosystems and biodiversity is incomplete and much of the baseline data / information are missing.
- Very high uncertainties in climate change impacts on Hong Kong's ecosystems and biodiversity, such as the implications of seasonal changes and in particular those on marine ecosystems and biodiversity.
- C(iv)** • Local biodiversity is already under substantial pressures from human activities, such as urban development, hill fires, pollution and introduction of foreign species.
- C(v)** • Ecosystems and biodiversity is highly sensitive to climate change and autonomous adaptation is unlikely to take place given the rate of change.
- Despite conservation efforts that aim to limit non-climate stress on species and habitats, real adaptation options to preserve some or many of Hong Kong's endemic species and habitats are likely to be limited.
- C(vi)** • Ecosystems, biodiversity and ecosystem services have intrinsic values that cannot easily be quantified in monetary term.
- C(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

Hong Kong has a variety of endemic species and is disproportionately rich in biodiversity. Many ecosystems are already under intense human-induced stresses; losses of biodiversity have been documented and extirpations are a continuing threat. Many of the ecosystems are highly sensitive to climate change (e.g. coral reefs) and are likely to have limited inherent capacity to adapt to the anticipated magnitude and rate of change. Some changes may be persistent (e.g. a prolonged period of wet or dry conditions, reoccurring drought or flooding events) and some consequences may be irreversible (e.g. the extinction of species). There are limited realistic options for preserving many endemic species in areas that become climatically unsuitable and these species may be replaced by better suited or invasive species as an outcome of natural selection. Prediction of the potential consequences of climate change to this sector is constrained by the high uncertainties in the future conditions, in particular, of the marine environment. In addition, many of the species and habitats have not been well studied or understood.

Built Environment & Infrastructure

- D(i)** • Damage to buildings, assets and infrastructure could have very significant implications for individuals, sectors / industries and social activities and increased

risk to human life is likely.

- Insurance industry may withdraw coverage in some high risk areas and for climate induced damages and/or increase premiums.
 - A majority of the potential consequences are likely to occur on an annual basis and the consequences could potentially be significant to the broader economy (e.g. serious interruption to activities and serious damage to key assets).
 - [D6] The increase in frequency and severity of extreme rainstorms events brought about by climate change could have significant adverse implications and consequences on slope safety in Hong Kong, e.g. the increase in possible damage to buildings, infrastructures, public facilities, and potential risks to the public.
- D(ii)** • Given the long term impact of planning decisions, Hong Kong could potentially benefit from early attention and adaptation planning. However, flat land is at a premium in Hong Kong for conventional development.
- D(iii)** • Very high uncertainties in the magnitude and rate of sea level rise and the associated flood risk (areas at risk and the degree of risk)
- There are relatively lower uncertainties in some areas / systems, e.g. loss of thermal comfort and increased use of mechanical cooling are expected with warmer temperatures [D1]; studies on the impacts of climate change on the drainage systems are emerging [D4]; The adverse effects of climate change on slope safety in Hong Kong are uncertain and relevant risk management strategies have not yet established [D6].
- D(iv)** • Relatively few buildings and infrastructure suffer from damages from present day weather such as extreme weather events and flooding.
- [D4] Stormwater drainage systems are already challenged under present day conditions e.g. existing rainfall patterns.
 - [D6] Although most of the sub-standard high-risk man-made slopes have been dealt with under the GEO's LPM programme which was completed in Apr 2010, there are still significant landslide risks associated with the remaining sub-standard and old technology man-made slopes, and natural hillside catchments of which their susceptibility to rain-induced failures is sensitive to effects of climate change.
- D(v)** • Developments located on low-lying areas / reclaimed land on either side of Victoria Harbour are prone to flooding and storm surges, and therefore are highly sensitive to climate change.
- There is relatively little scope for adaptation to loss of land resulted from sea-level rise.
 - High risk of mal-adaptation due to the long investment and planning decisions. Buildings, assets and infrastructure tend to be long lived.
 - [D3] The "hardware" of communications infrastructure is relatively less extensive compared to other systems e.g. the building stock and transport infrastructure, and may therefore be more capable of adapting.
 - [D6] The stability of natural hillsides is particularly sensitive to severe rainfall conditions. GEO's studies have shown that the number of natural terrain landslides would increase exponentially with rainfall intensity. The scale of failures and mobility of debris flows would also increase significantly with rainfall intensity. For man-made slopes, there could be more frequent, large scale erosion and wash-out type failures due to increase in frequency of short duration heavy precipitation.
- D(vi)** • The built environment and infrastructure provide much of the key infrastructure upon which economic and social activities within Hong Kong depends.
- D(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The built environment is essential for the city of Hong Kong. Buildings and infrastructure have long investment decisions and asset lives. Once built, the buildings and infrastructures have low potential for adaptation and some impacts could be irreversible, e.g. there is little scope for adapting existing development against loss of land in low-lying or reclaimed areas in the latter half of this century. There are substantial uncertainties in the magnitude and rate of change in future sea-levels and storm surges events, in particular, and this further limits the level of preparedness. Uncertainties in the mechanisms of sea-level changes, for example,

imply that sea-level rise may not be linear, and this could result in significant negative impacts across the territory's coastal development. Infrastructures at most risk is unknown. Some groups (e.g. the less wealthy population, and smaller businesses and corporates) may be more susceptible to impacts as they cannot afford to relocate or have difficulties to recover from major events. Changes in rainfall patterns may bring about prolonged periods of heavy rainfall, which may challenge drainage and sewerage infrastructure. The increase in frequency and severity of extreme rainstorm events will significantly increase the number, scale and mobility of rain-induced landslides on both natural hillsides and man-made slopes posing higher landslide risks to the public.

Communication infrastructure may have relatively high potential for adaptation as they are relatively less extensive and have relatively less resource implications, compared to say the building stock or transport infrastructure.

Business & Industry

- E(i)**
- This sector may be vulnerable to impacts on other areas such as infrastructure, and also international supply chains (e.g. the shipping industry) due to its global coverage. Impacts or disruption on this sector could potentially have significant adverse implications on the broader economy (e.g. employment and contribution to GDP), and these could occur on an annual basis.
 - [E3] Impacts on the PRD region could potentially be more severe due to lower availability in resource and technology which help businesses to cope with or recover from challenges.
- E(ii)**
- Climate change could bring about new business opportunities and service areas.
- E(iii)**
- The business and industry sector is very broad and a wide range of impacts could be felt across the sector. The types and extent of impacts on different industries require further investigation.
 - [E3] Climate change impacts on the PRD region require further investigation; their implications on the supply chain for Hong Kong businesses and operations are also areas of concern.
- E(iv)**
- The recent financial crisis suggests that some industries or services may already be vulnerable to non-climate risks.
 - [E3] Electricity supply problems do hamper business operations in the PRD.
- E(v)**
- Different segments of the sector each have differing risks and opportunities, which suggest varying capabilities of adapting.
 - [E3] Manufacturing in the PRD region may be less capable of absorbing disturbance due to resource and technological constraints.
- E(vi)**
- This sector is an integral part of the territory's self image and international reputation. It has significant contribution to Hong Kong's employment and GDP, in particular trading and logistics [E1].
 - [E3] There has been an increased trend in off-shoring manufacturing activities to the Mainland and particularly the Pearl River Delta Economic Zone. Impacts on this area could significantly affect the businesses and operations in Hong Kong.
- E(viii)**
- The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The business and industry sector (trading and logistics, in particular) has significant economic importance for Hong Kong and in terms of employment and impacts on this sector could potentially have implications for the whole economy. Due to the diverse nature of this sector, differential impacts (both risks and opportunities) are expected to be felt across different segments of this sector, which require further investigation. This sector is sensitive to impacts on other areas locally and overseas, such as those along the supply chain (the supply of raw materials, manufacturing), impacts on international trade partners and financial markets, disruption in transport or communication infrastructures resulted from extreme weather events etc, and some of these impacts could occur rapidly and unexpectedly. Climate change impacts on manufacturing in the PRD may be less capable of coping with disturbances and recover from these events due to resource and technical constraints.

Energy Supply

- F(i) • Any interruptions in power supply are likely to result in significant economic and social costs, and these could occur on an annual basis, e.g. from prolonged periods of hot weather and extreme high temperatures in the summer.
 - [F2] Impacts on the transmission and distribution may be more localised and the implications may be confined to certain areas.
- F(ii) • Electricity demand for heating in winters may be reduced.
- F(iii) • High uncertainties in impacts along the supply chain [F3] and effects of warmer climate on transmission infrastructure [F2] in the sub-tropics.
 - [F1] Uncertainties in future energy demand and supply patterns.
- F(iv) • Few power supply interruptions have occurred in the past.
- F(v) • [F3] Long term planning could be possible to reduce vulnerabilities along the international supply chain. Short term capacity may be limited due to the infrastructure currently in place, long term purchase agreements etc.
- F(vi) • This sector enables virtually all socio-economic activities in Hong Kong and is vital for Hong Kong population's lives and livelihoods.
- F(viii) • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

Energy supply and infrastructure is fundamental for all activities in Hong Kong and any supply interruptions are likely to result in significant social and economic costs. Demand for energy is partly associated with climate and climate change is expected to change demand patterns. Reliability of power supply may be challenged by unexpected accelerated demand growth. Warmer climate and changes in extreme weather events could potentially affect production and transmission efficiencies. Little is known about how climate change could impact the supply chain of primary fuel imports and supply, and also on the transmission and distribution infrastructures.

Financial Services

- G(i) • This sector may be vulnerable to impacts on other areas such as infrastructure (notably the landmark waterfront assets), and also international supply chains due to its global coverage. Impacts or disruption on this sector could potentially have significant adverse implications for the broader economy (e.g. employment and contribution to GDP), and these could occur on an annual basis.
- G(ii) • Climate change could bring about new business opportunities and service areas.
- G(iii) • The climate change risks and opportunities this sector may face require further investigation.
 - Many of the data (e.g. insurance claims) and findings of research carried out by insurers and re-insurers, for example, are highly sensitive and are not available in the public domain.
- G(iv) • The recent financial crisis suggests that this sector may already be vulnerable to non-climate risks.
- G(v) • Different segments of the sector each have differing risks and opportunities, which suggest varying capabilities of adapting.
 - [G2] Many insurers and re-insurers are already exploring potential business opportunities and identifying climate change impacts and risks they may face. Its role in climate risk management suggests that the insurance industry has relatively higher adaptive capacity.
- G(vi) • Financial services is a very important prestige sector for Hong Kong, as well as an important element of the territory's international reputation and self image. It is also a significant contributor to Hong Kong's employment and GDP.
- G(viii) • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The financial services sector is very important for Hong Kong economically and in terms of employment. This sector, in particular the insurance and banking industry, may suffer from sudden and unexpected climate impacts both locally and overseas. The time taken for the maturation of asset values against which loans and pensions are secured or derivatives traded could heighten its vulnerability. Differential risks and opportunities are expected to be felt across different segments of this sector.

Larger corporates are more capable of adapting, through the purchase of (more expensive) insurance to spread the costs, for example. Few studies have been carried out to investigate the risks and opportunities corporates may face under climate change. Because of this, they have limited preparedness to minimise the impacts, which could potentially be severe - this could have wider repercussions on the territory.

Food Resources

- H(i)**
- Extreme weather events could reduce agricultural outputs at sources of food imported to Hong Kong (namely Mainland China and Thailand), and rising commodity prices could be resulted. These could occur on an annual basis especially during the wet season or the summer months.
 - Impacts on local wholesale and retail [H2] may be relatively easier to manage and therefore their severity minimised.
- H(ii)**
- The implications of increased atmospheric CO₂ concentrations on agricultural outputs, as well as the net effects of climate change, are currently unclear.
- H(iii)**
- [H1] Very high uncertainties in the vulnerability of Hong Kong's key food producer partners, namely Thailand and China, to climate change, and also the implications of the wholesale and retail industry.
 - High uncertainties in how the vulnerable groups (e.g. the less wealthy communities) in Hong Kong could be impacted.
- H(iv)**
- Food supply in Hong Kong is sensitive to weather events, e.g. the impacts of rainstorm on vegetable imports.
- H(v)**
- Although agricultural production at source is sensitive to climate change, this sector is likely to have the capacity to adapt. However, Hong Kong may suffer from international vulnerabilities and have limited capacity to adapt due to its heavy reliance on food imports, in particular on few key trade partners.
 - Impacts on local wholesale and retail [H2] may be easier to manage and therefore its vulnerability reduced.
- H(vi)**
- Hong Kong is not self-sufficient in its food supply and relies heavily on imports.
- H(viii)**
- The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The food resources sector provides an essential service for humans. Food imports may be affected by climate change impacts at sources of agricultural production and also the impacts along the supply chain. Hong Kong's over-reliance upon a few key food producer partners makes it particularly vulnerable - for instance, the implications for Hong Kong could be severe should rice production in Thailand be impacted by floods or drought. Falling agricultural production elsewhere may raise commodity prices, thereby most notably affecting the poor. Lower availability of food and increase prices could have knock-on effects on the wholesale and retail industry, although these impacts require further investigation. Larger businesses are likely to be able to cope with any disturbance.

Human Health

- I(i)**
- The majority of the potential consequences arising from climate change are likely to be negative, and these could occur on an annual basis.
 - More accidents and emergency situation [I1] could result from increased frequency and/or intensity of extreme weather events.
 - Cardio-respiratory related morbidity and mortality [I3] may become more significant in general with the anticipated aging population.
 - New / non-endemic and vector-borne diseases [I4 and I5] could pose particular threat to Hong Kong.
- I(ii)**
- Reduced cold harvesting of vulnerable populations is expected.
- I(iii)**
- Uncertainties in climate change impacts in the sub-tropics.
 - Climate change is expected to disproportionately affect the vulnerable groups such as the aged, sick and poor. How these groups could be impacted requires further investigation.
 - [I9] Human vulnerability to diseases may be aggravated by impacts on agriculture,

-
- fisheries, nutrition etc. These relationships have not been well studied.
 - I(iv)** • Hong Kong has world leading facilities and services in protecting and maintaining the population's health. Despite these, some impacts are inevitable although the scale / magnitude of events will be reduced.
 - [I2 and I3] Respiratory diseases and chronic health conditions may be less "manageable" or "controllable" due to factors such as air quality issues.
 - I(v)** • The aging population in Hong Kong may be more susceptible to cardio-respiratory morbidity and mortality [I2 and I3] and these may be less easy to manage compared to other areas (having sufficient resources to deal with accidents and emergency situations). Also, the adaptive capacities of health and external infrastructure [I8 and I9] may partly be determined by impacts on other areas.
 - I(vi)** • The health of the local population plays a significant role in enabling GDP growth and maintenance - although quantifying its value into monetary terms is a difficult and subjective exercise.
 - I(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

All aspects of human health are important. Climate change may alter disease / pathogen patterns temporarily or permanently (e.g. warmer temperatures may increase the likelihood of occurrence of food borne diseases and heat stress), and may give rise to new emerging diseases, as well as accidents or emergency situations. The impacts of communicable diseases (such as vector borne diseases) are likely to be reduced owing to the increased preventive, monitoring, surveillance and reactive measures in these areas. Food borne diseases tend to be isolated or localised events should they occur. On the other hand, should water supplies be contaminated, the implications could be more significant, although the likelihood of such events is rather low. Vulnerable groups of the population may be particularly impacted: the sick and aged may be weaker in defending against diseases or recovering from injuries. In particular, with an aging population, mortalities and morbidity of cardio-respiratory diseases may become more significant. There are high uncertainties in the potential implications of impacts on external systems and infrastructure (e.g. food supplies, energy demand and supply patterns, environmental migration).

Leisure & Tourism

- J(i)** • This sector may be vulnerable to impacts on other areas such as infrastructure, business and retail sectors. Impacts on physical and environmental assets (e.g. infrastructure) are likely to be more severe than those on tourism services.
 - In general, impacts on this industry could potentially have significant adverse implications for the broader economy (e.g. employment and contribution to GDP).
- J(ii)** • Some tourism operators may benefit from new business opportunities such as new tourist locations.
- J(iii)** • Uncertainties in the economic impact of climate change on Hong Kong's tourism industry.
 - Uncertainties in tourist climate preference and destination loyalty and how future tourism will operate in a changing climate.
- J(iv)** • Overall, this sector has been shown to be capable of recovering from major negative events such as SARS, H1N1 and terrorism activities.
- J(v)** • Climate is one of the factors that determine the suitability of locations for a wide range of tourist activities. The dynamic nature of the tourism industry suggests that it is capable of adapting to future climate. However, assets that have longer investment decisions may have lower adaptive capacity - e.g. hotels or resorts located at / near the waterfront may be more vulnerable to flooding or storm surges.
- J(vi)** • Tourism is one of the four key industries in the Hong Kong economy.
- J(viii)** • The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

Tourism is an important industry for Hong Kong. Impacts on this sector may have implications for the wider economy. This sector is sensitive to the climate and environment. It may also be particularly susceptible to sudden and unexpected

events such as new emerging disease (e.g. SARS, H1N1), although the tourism industry is generally able to recover. Like other infrastructure, hotels and some tourist attractions tend to have long investment decisions and some may be located near the waterfront and they may be less capable of adapting to flooding, sea-level rise and storm surges, for instance. Larger corporate and tourism operators are likely to have higher capability of adapting.

Water Resources

- K(i)**
- Although the average annual rainfall is projected to increase, the annual distribution of rainfall may change. This, together with rising demand in the Mainland, may have implications for the sustainability of the water supply both locally and in Guangdong.
 - [K2] Potential increases in incidence of flood along the Dongjiang catchment area could give rise to contamination from industrial pollutants, for example.
- K(ii)**
- Few beneficial climate change effects are anticipated.
- K(iii)**
- Very high uncertainties in future rainfall amount and distribution.
 - High uncertainties in future indigenous demand in Guangdong which could lead to water stress in Dongjiang and have implications for the supply to Hong Kong.
- K(iv)**
- Water shortages and water restrictions have occurred in the past but these events are rare in recent decades.
- K(v)**
- Despite the Total Water Management Strategy, a significant proportion of Hong Kong's water is imported and this limits its adaptive capacity. In particular, water supply from Dongjiang [K2] may have lower adaptive capacity due to other non-climate stresses such as rising indigenous demand resulted from economic growth and indirect impacts from flooding or extreme weather events.
- K(vi)**
- Virtually all social and economic activities and natural resources in Hong Kong are dependent on water availability.
 - [K2] Imported water accounts for a majority (70-80%) of the raw water in Hong Kong.
- K(viii)**
- The relative vulnerability is determined primarily by considering the criteria listed in Column (vii) of Table 3.11.

The water resources sector provides an essential service for humans; many sectors and other natural resources are dependent on water availability. The supply of water is dependent upon rainfall amount and distribution, the future changes of these (e.g. the fluctuation in rainfall amount) are difficult to project. Water availability in Hong Kong may be constrained by physical or contractual reasons, and this could have wider repercussions for the population's lives and livelihoods. Imported water from Dongjiang, which constitutes a majority of Hong Kong's water supply, may be particularly vulnerable due to the anticipated increased competition for water from the region and indirect impacts (e.g. contamination from flooding events), as well as the limited direct control the local government may have on this. Vulnerable groups of the population may be particularly affected should water resources be impacted in terms of quantity and quality.

2.6.3

Uncertainties and Further Research

The sources of uncertainties and keys areas identified for further research from this vulnerability assessment for each of the sectors are illustrated in *Table 2.13*.

Table 2.13 *Uncertainties and Areas for Further Research of Each Sector*

Sector	Uncertainties and Key Areas for Further Research
Agriculture	<ul style="list-style-type: none"> • Research into the local climate change impacts on this sector. • Examination into the role of local agriculture in Hong Kong's future food security.
Aquaculture	<ul style="list-style-type: none"> • Forward planning and adaptation strategies for the sector are likely to be very difficult for this sector as research into the local climate change scenarios and the associated impacts are needed. • Warming of local sea surface temperatures and any affects on the ocean current regime of the South China Sea are largely unknown. • The implication of ocean acidification on marine fishes, in particular fish reproduction and stock replenishment, is largely unknown. • There is high uncertainty in climate change related (e.g. from an increase in precipitation and the associated increases in freshwater discharges of the Pearl River) changes in salinity levels of Hong Kong western waters. • There is little data on the number of people who depend upon this sector both officially, unofficially and on a casual basis for either their income, or as a major source of protein.
Biodiversity / Nature Conservation	<ul style="list-style-type: none"> • Research into the local climate change impacts on this sector, in particular, the marine environment (e.g. sea surface temperatures, changes in the ocean current regime of the South China Sea, ocean acidification) and the effects of seasonality on the impacts of terrestrial / aquatic ecology. • Considerable data gaps are present in our understanding of Hong Kong's biodiversity baseline.
Built Environment and Infrastructure	<ul style="list-style-type: none"> • Future global average and extreme sea level rise is a critically important area of research for scientists worldwide as the associated impacts are obviously highly dependent on the quantum of the actual rise which eventually transpire. • Research into the changes in local sea levels and storm surges under future climate conditions • The Drainage Master Planning (DMP) Studies by DSD would be a first point of reference for the further research into the limitations of the existing of storm water drainage systems, and how they would be impacted as climate changes. Areas for further research would be identified from any gaps in the coverage of the existing DMPs. • A schedule of the cope level of coastal infrastructure for Hong Kong is not readily available. • Research into implications of effects of Climate Change on Slope Safety, as well as their associated adaptation strategies and mitigation measures, is necessary.
Business and Industry	<ul style="list-style-type: none"> • As this sector is a very broad delineation, detailed climate change impact assessments may need to be carried out, perhaps at the trade association level, to ascertain the risks to individual business sectors within Hong Kong. • Manufacturing in the PRD region which could impact on the supply chain deserves further investigation.

Sector	Uncertainties and Key Areas for Further Research
Energy Supply	<ul style="list-style-type: none"> • Elevation modelling of key generation capacity within Hong Kong to ensure continuance of supply in the future under a range of climate changed and sea level rise scenarios. • Examination of the impacts of warming on transmission infrastructure in the sub-tropics as most of the research done in this field has been carried out by temperate countries.
Financial Services	<ul style="list-style-type: none"> • Many of the findings of the research carried out by insurers and reinsurers, for example, are highly sensitive and are not publicised. This lack of transparency is a major component of the sectors' risk. Where this information is made available, there is a disconnect for businesses to implement recommendations to boost their adaptive capacity where financial reward is not visible in the short. Research is necessary to understand how best to bridge this incentive gap and how to translate the urgency expressed scientifically into an urgent business response whilst there is still time to respond in an anticipatory manner.
Food Resources	<ul style="list-style-type: none"> • More research is needed into the implications of increased atmospheric CO₂ concentrations on agricultural outputs, as well as the net effects of climate change. • The vulnerability of key food producer partners to climate change should be investigated by Hong Kong. • Building resilience at key food resource "nodal" points should also be a research priority.
Human Health	<ul style="list-style-type: none"> • The health impacts of climate change resulted from causal processes are difficult to quantify, such as health risks due to the social, demographic, and economic disruptions of climate change (e.g. from changes in agricultural yields, disruption to fisheries, loss of livelihoods and population displacement). • Few studies have been carried out to investigate the societal impacts in Hong Kong, such as on vulnerable groups (ie the poor, sick and aged).
Leisure and Tourism	<ul style="list-style-type: none"> • The tourism industry generally has relatively high adaptive capacity. Hence, adaptation options deserve further research in order to further enhance resilience. • The United Nation's World Tourism Organisation (UNWTO) attempted to assess qualitatively the most at-risk tourism destinations as a result of climate change by 2100 ⁽⁴²⁾. However, systematic regional level assessments are needed for a definitive statement on the net economic or social impacts and they found insufficient information for some regions to complete the exercise, with East Asia being one of them. • There are considerable uncertainties associated with tourist climate preference and destination loyalty and how future tourism will operate in a changing climate. Understanding the potential long-range shifts in tourist demand requires more information on how tourists perceive environmental impacts related to travel and their willingness to pay to reduce this impact, tourists' views on the impacts of global climate change at destinations (e.g. perceptions of coral bleaching, reduced biodiversity etc), and tourist climate preferences and key thresholds (e.g. "what is too hot for a beach holiday").
Water Resources	<ul style="list-style-type: none"> • There are considerable uncertainties associated with future climate, in particular the rainfall patterns in Hong Kong, the level of annual and decadal variations and precipitation extremes. • Other areas for further research include assessing the impacts of climate change on the sector in the light of more extreme sea level rise projections to assess resilience under a reasonable worst case scenario.

Several features of Hong Kong's geography, demographics and economy make it vulnerable to climate change, namely:

- (i) According to international literature, the city is located in a region of Asia that is already prone to vector borne diseases and extreme weather events (e.g. typhoons), and is vulnerable to future sea level rise, loss of water supplies, the resulting food insecurity and environmental displacement of population;
- (ii) Hong Kong is located in the PRD with a significant proportion of low-lying high asset value reclaimed land (including key infrastructure such as the airport);
- (iii) Hong Kong is vulnerable to climate change beyond its borders due to its heavy reliance on imports of water, food, and both primary energy sources and electricity;
- (iv) The territory depends on highly complex infrastructure (particularly mass transit systems) which has multiple potential failure points;
- (v) The territory's economy is highly dependant on international trade and logistics, and the financial sector, which are highly vulnerable to climate change; and
- (vi) Urban areas are inherently vulnerable due to the density of people, and high concentration of key infrastructure and high asset values ⁽³¹⁾.

Sectors that are potentially more vulnerable to the physical impacts of climate change have been identified for prioritisation as key areas where the Government may need to work with stakeholders to develop an effective adaptation response. The key vulnerabilities are summarised as follows.

Biodiversity and Nature Conservation

Biodiversity can be highly adaptable but the rate of climate change may be beyond some species' abilities to adapt. The biodiversity sector is already highly vulnerable to external stress and is globally considered to be amongst the most climate sensitive of sectors, due to the innate lack of planned adaptive capacity internally and the limitations of human attempts to assist planned adaptation for wider ecosystems.

Biodiversity in Hong Kong is a highly interconnected system. It also has complex interrelationships with many other sectors within Hong Kong. The loss of one type of species or habitat could potentially disrupt whole food chains and ecosystem services. This could have significant wider repercussions for Hong Kong's economy and society as it provides key ecosystem services (e.g. mitigation of air pollution, carbon sequestration, rainfall catchments) upon which they depend. Therefore, Hong Kong's

resilience to climate change is, in many ways, only as strong as the resilience of Hong Kong's ecosystems.

Despite the uncertainties (such as the lack of information on the future changes in seasonal climate and the marine environment), changes and loss of biodiversity are anticipated under the current projected climate change. Both terrestrial and aquatic flora and fauna are considered highly vulnerable with low adaptive capacity. Invasive species are also likely to profit in a climate-disturbed environment. Intertidal areas are likely to be impacted, with resulting losses in biodiversity such as seagrasses. Hard coral communities are highly vulnerable to ocean acidification, sea temperature increases etc. Very limited measures have been identified currently that could prevent their loss that are technologically viable.

Biodiversity in Hong Kong may be affected by climate change impacts overseas (e.g. in the case of migrant birds should higher latitudes become warmer). Improvements in the adaptive capacity of Hong Kong's biodiversity require national and international efforts, alongside strong leadership and commitment of resources by the Hong Kong SAR Government.

Built Environment and Infrastructure

The built environment and infrastructure provide much of the key infrastructure upon which economic and social activity within Hong Kong depends. As a result any interruptions within this sector may have considerable widespread consequences across the territory. The sector's vulnerability is heightened by the predominance of extensive interconnected infrastructure with multiple failure points. The resilience of key functional nodes including sewerage treatment plants, major transport routes and interchange stations needs to be guaranteed to ensure systemic robustness.

Some sections of the existing storm water drainage systems are already challenged under existing rainfall and sea level conditions. The potential increase in frequency and/or intensity of rainfall, together with future sea levels, could impact the entire drainage infrastructure and is therefore considered to be highly vulnerable. Areas which are currently prone to flooding are likely to suffer more frequent and severe flooding events. Furthermore, new areas where flooding events are rare, or have never previously occurred, may become prone to regular flooding in the future.

This sector is exposed over a long temporal time range with investment decisions that may have implications for many decades. The potential to design in mal-adaptation and constrain future adaptation options is significant unless the possible climate change impacts are considered at the design stage. This is however a highly complex process and there is a risk of over and under engineering future infrastructure given the considerable uncertainties in climate change science, in particular future sea levels, storm return periods etc.

The sector's vulnerability is complicated by the wide number, type and range of actors operating. Interlinkages between subsectors are not always clearly defined and that some issues can fall between multiple stakeholders. Although it is likely that autonomous adaptation may occur (e.g. in the selection of different road surfacing materials), adaptation to rapid changes may be constrained by purchasing procedures and materials specifications currently in place.

A major uncertainty in this area of concern is the magnitude of the upper bound values of sea level rise. This is particularly significant considering the substantial amount of development in low lying coastal areas and on reclaimed land in Hong Kong. Any decision making to be carried out in the shorter term should be flexible enough to allow for regular reviews and adjustments to incorporate any new developments in the climate change science, as is ongoing in other parts of the world. A range of sea level rise scenarios should be considered. An understanding of the longer term risks is also crucial to prevent resources being spent on infrastructure which may have to be abandoned before the end of its useful life. It is important that the latest scientific developments are kept under regular review to ensure sufficient and timely measures to be implemented into the short, medium and long term future. Mechanisms are needed to transfer the latest findings from the scientific community to decision makers such as those designing policy and engineering guidance for Hong Kong. These mechanisms may include an interface body, placements to enable researchers to work in policy-making environments or expert meetings and debate to communicate scientific information to decision makers. Building up the resilience of this sector will benefit from cooperation between the local government, and national and international actors.

Business and Industry

The economic contribution of the business and industry sector in Hong Kong is highly significant and any negative implications here are likely to have wider consequences for Hong Kong society. It is dependent upon myriad complex interdependencies with other sectors within the territory and overseas (e.g. food resources, infrastructure and foreign investment), which must be resilient if the city is to continue to attract businesses. This sector may be affected by knock on impacts from other sectors. The city's reliance on international trade, financial markets and on imports of key products and services makes it vulnerable to climate change associated impacts beyond its boundaries. Many of the required adaptation responses must be taken by external parties and are outside of the direct control of the Hong Kong SAR Government.

Past performance is not necessarily indicative of future reliability and complacency should be avoided through continued vigilance. Hong Kong's business and industry sector is already impacted by weather events, e.g. seasonal purchasing, prices of raw materials. This vulnerability is heightened as the sector is exposed over a wide geographic area globally with

long and often complex supply chains, particularly for the logistics and international trade sub-sector. Some businesses will also be exposed over a long temporal range due to long term investment decisions and infrastructure renewal cycles. Diversification in private sector supply chains is not a given as most businesses choose suppliers on the basis of lowest cost rather than resilience to business interruption, contributing to significant vulnerability.

There is a high degree of correlation between the economic performances of Hong Kong and the PRD in the medium term. The offshoring of essential elements of the supply chain, e.g. many manufacturing activities, to the PRD region potentially reduces the adaptive capacity and resilience of this sector as climate change impacts in one region are likely to translate to losses and business continuity issues in the other, certainly for the short term. However, the present Study is confined to the assessment of the impacts and vulnerabilities within the Hong Kong SAR political boundary.

Energy Supply

The energy supply sector in Hong Kong is of primary significance and is considered highly vulnerable as it underlies virtually all local economic activities. It is interlinked with many other sectors within the territory and overseas. The energy supply sector needs to be considered alongside other sectors, namely built infrastructure, water resources, human health and food resources.

Although the system is currently able to cope with climatic variability without interruption by large, future demand is linked to the weather as is transmission capacity, adapting to rapid changes is likely to be constrained by purchasing procedures and materials specifications currently in place and supply interruptions in the future should not be dismissed. Resilience of key functional nodes such as generation plant, primary fuel import infrastructure, major substations needs to be guaranteed to ensure systemic robustness. There are some key international vulnerabilities including imports of raw materials and commodities for engineering, construction and maintenance.

Hong Kong has no significant primary energy reserves and imports all of its gas, oil and coal requirements, it is therefore highly vulnerable to climatic disruption further up the supply chain. This is particularly acute with minimal diversification within the primary fuel supply chains, i.e. Singapore for oil products and Indonesia for coal. Hong Kong has relatively low adaptive capacity should production or transportation at either of these locations be disrupted.

The energy sector is exposed over a long temporal time range with investment decisions that may have implications for 50+ years or so. The potential to design in mal-adaptation and constrain future adaptation options is significant unless climate change impacts are considered at the design stage. This highly complex process requires the incorporation of the latest science into investment decisions, e.g. future sea level rise, storm return periods etc,

and in which there is considerable uncertainty and risk of over and under engineering future infrastructure.

Building up the resilience within this sector will require cooperation between the Hong Kong SAR Government, and national and international actors. Many of the most significant actions have to be taken by private sector actors, although clear guidance from the Government will be needed.

Financial Services

The financial services sector is perceived to be highly vulnerable and of significant economic importance for Hong Kong due to its reliance upon extensive interconnected infrastructure. It contains a number of disconnected actors with a wide range of objectives; the sector invests in long international supply chains and is vulnerable to failures therein; and, it is already vulnerable to climatic extremes.

This sector is both spatially and temporally exposed to climate change due to its global coverage and the time taken for the maturation of asset values against which loans and pensions are secured. The concentration of the sector's most significant assets in a small geographic locale within Hong Kong, namely the high value harbour-side real estate, elevates the sector's collective vulnerability from future impacts including sea level rise and storm surge without adaptation. Reputationally, the financial services sector is also vulnerable due to the importance its clients place on the qualities of foresight, forward planning and risk management.

In addition, the sector is also considered vulnerable attitudinally – it has, traditionally, limited capacity to understand and “price in” environmental externalities and considerations in the absence of regulatory or market drivers. Its vulnerability is exacerbated by the lack of transparency and knowledge of climate change vulnerability in the wider business community. At present, many financial services actors view climate change to be beyond the time horizon of their investment decisions. Long-term investors are more likely to incorporate climate change in making their investment decisions, while short-term investors may not incorporate such issues. The financial services community is beginning to embark on review of the consequences of climate change on their investment and their environmental liabilities.

The insurance sector can be particularly vulnerable due to its role in protecting the assets of others from unexpected and potentially catastrophic events such as extreme weather events (e.g. in the case of Hurricane Katrina in 2005). Firms are likely to be vulnerable to both the direct and indirect impacts of climate change, and the interconnectedness of the global financial system implies that climate change may impact upon actors far from the actual impact.

Within Hong Kong, the financial sector contains relatively few large corporate actors many of which do not have the flexibility to respond to rapid events. This could be seen as potentially limiting the number of key nodal points

which, should they fail, could cause systemic repercussions. However, it should be noted that the financial services sectors have shown a rapid response to other financial variations and demonstrated responsiveness to crises in the past.

Food Resources

The food resources sector has intrinsic importance in providing Hong Kong with an essential resource in which it is not self sufficient. The sector should also be prioritised due to its importance for maintaining the population's health and complex interrelationships with other sectors, such as its vulnerability to indirect climate change impacts from international trade and logistics, energy supply, business and industry, and water resources.

Hong Kong's reliance on a broad geographic region for its food to some extent provides resilience. However, large scale climate change impacts (e.g. a widespread drought) could induce large scale system failure. Hong Kong's food resources sector may be vulnerable to long international supply chains, which may be slow to adapt to climate change and may be increasingly stressed should climatic change result in rising commodity prices, falling production and the increasing need for humanitarian food aid. The overreliance on one or two countries for the bulk of some of its most important food resources (e.g. Thailand provides 90% of Hong Kong's rice) may heighten vulnerability; diversification could be important to reduce this risk.

Temporally, this sector is primarily influenced by agricultural timescales and investment decisions are made annually. Agricultural commodities available on the international markets are usually more costly than advance purchase contracts. Many food processors, wholesalers and supermarkets only purchase on the spot markets when supply chains fail and inventories run low. The perishable nature the products suggests high stock turnover and low stockpiling.

Furthermore, the sector's reliance upon just in time (JIT) delivery mechanisms and low inventory "in-house" to reduce costs make it vulnerable to any unforeseen disruptions to international trade routes (Hong Kong port and airport, in particular), and would have only a short contingency period before stocks run low. Any interruption to one transport mode either road, rail, sea or air could lead to increased pressure on others; increased costs and decreased availability, potentially increased loss of perishable cargoes and associated financial losses may result.

The Hong Kong SAR Government has some freedom of action on this sector, and can guide adaptation with only moderate national and international collaboration. Nevertheless, it will require significant collaboration with actors from the private sector and those in the region.

Human Health

Hong Kong's health sector underlies all socio-economic activities and is essential in enabling economic growth and maintenance, although this is difficult to calculate directly.

Hong Kong can be seen to have world leading facilities and services in healthcare, public health initiatives, education, infrastructure and economic development. The excellent systems currently in place do offer significant resilience in the face of climate change. Compared to other regions of the world, Hong Kong has proven itself to be able to deal rapidly with quick-onset health incidents and emergencies, e.g. avian influenza and swine flu pandemic. The lessons learned from the SARS episode, suggest that Hong Kong has considerably enhanced its adaptive capacity in this regard. However it is important to avoid complacency. Whilst the worst health impacts of climate change are anticipated in the developing world, "*economic development is an important component of adaptation, but on its own will not insulate the world's population from disease and injury due to climate change (very high confidence)*"⁽⁴³⁾. Past excellence is not necessarily indicative of future success; some future extreme weather events could be catastrophic because of the unexpected intensity of the event and the underlying vulnerability of the affected population, including the European heatwave (2003) and Hurricane Katrina (2005) examples. Continued vigilance will be required to ensure the robustness of the healthcare sector in the light of the potentially new challenges.

Hong Kong has a highly evolved public health infrastructure and there are numerous bodies which could be used by the Government to respond to the risks to health posed by climate change. However systems with high degrees of complexity and a large number of actors could be at risk of inflexibility and delays in the decision making process in responding to emergencies. It is not clear from the information gathered for this Study whether climate change has been factored into accident and emergency or contingency planning. International best practice suggests that disaster response and emergency contingency planning should include reasonable worst case scenarios⁽⁴⁴⁾ and combinations of cumulative impacts regarding climate change. Climate change will be a paradigm shift from the historic climate; it is important that emergency and contingency plans continue to be regularly revised and that current resilience is not taken for granted.

Water Resources

The water resources sector provides a potable, reliable water supply, which enables all other economic activities in Hong Kong to operate. Any interruptions could have systemic repercussions, hence ensuring its robustness in the light of future climate change should be considered one of the highest priorities.

There are considerable uncertainties in future rainfall amount and distribution, which can have positive or negative implications on yield of raw

water both locally and regionally, as well as limitations on a meaningful assessment of vulnerability.

Many adaptive measures on both the demand and supply side within Hong Kong have already been taken under the Total Water Management Strategy. The vulnerability of imported water resources from Guangdong is likely to be considerably greater than the local supply due to a combination of climate change impacts and rising indigenous demand. Despite the existing contract with the Dongjiang water authorities, the total imported water quantity available to Hong Kong may still be limited due to physical (e.g. water stress in Dongjiang) or contractual constraints (ie the daily and annual maximums). Water shortages in Hong Kong could occur unless demand is managed to be within supply capacity.

3.1 ESSENTIAL PRINCIPLES OF CLIMATE CHANGE ADAPTATION

Scientists believe that some of the impacts of climate change impacts are inevitable, regardless of future global greenhouse gas emissions. In addition, the decisions we make today about infrastructure, health, water management, agriculture, biodiversity and housing will have lasting consequences. It is therefore important to begin planning now to adapt to impacts of climate change in the future.

The IPCC define vulnerability to climate change in AR4 as “*the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects*”⁽⁴⁵⁾. Climate change adaptation aims to reduce the potential for adverse impacts of climate change and enhance any beneficial impacts to reduce vulnerability or enhance resilience in response to observed or projected changes in climate. Adaptation can involve a variety of forms, such as better education, training and awareness of climate change, and more technical measures, such as drought-resistant seeds and better coastal protection. The exact impacts of climate change remain uncertain, so focus is also placed on building adaptive capacity, maintaining well-being, protecting property or land, maintaining economic growth, or exploiting new opportunities⁽⁴⁶⁾. However, adaptation measures generally involve financial cost and do not prevent all adverse impacts.

The IPCC notes that adaptation to climate change is already occurring around the world, in both the public and private sector through policies, investments in infrastructure and technology, and behavioural change, albeit on a limited basis⁽⁴⁷⁾.

At present, adaptation measures are to address present day climatic extremes and seldom in response to projected future climate change scenarios. Examples of consideration of future climate change scenarios include incorporating projected sea level rise into the design of infrastructure, such as the Confederation Bridge in Canada, and coastal zone management in the United States and the Netherlands⁽⁴⁸⁾. Usually, adaptation initiatives are embedded within broader sectoral initiatives, such as coastal defence, sustainable development and disaster management.

Extremes, variability, and rates of climate change are all key variables to be considered when addressing vulnerability and adaptation, not simply changes in average climate conditions.

3.1.1 Extant Adaptive Capacity and Understanding the Context for Adaptation

The ability of human systems to adapt to and cope with climate change is not universally uniform. According to the IPCC, the vulnerability of a society to climate change is influenced by its level of development, physical exposures,

resource availability, prior climatic experiences, management capabilities, and sociopolitical will ⁽⁴⁹⁾. However, it should be emphasised that high adaptive capacity does not necessarily equal successful adaptation. The IPCC notes that some future extreme events will be catastrophic regardless of a nation's preparedness because of the unexpected intensity of the event ⁽⁵⁰⁾. For example, the adaptive capacity in Western Europe is generally considered to be high, and the risks of warmer winters increasing the range of livestock diseases in the region has been well documented, yet many parts of Europe were still seriously affected by outbreaks of the Bluetongue virus in livestock in 2007. Examples of high adaptive capacity nations failing to prevent serious climate impacts include the well documented aftermath of Hurricane Katrina in the United States which led to significant loss of life, failure of flood defences, loss of essential services such as water, power and food supplies; the 2003 heatwave in Europe which caused considerable loss of life amongst vulnerable demographic groups such as the elderly; and the 2007 floods in the UK which caused serious failures in the provision of basic essential services such as food and water supplies and which caused serious disruption to many sectors including healthcare and transport. A report into the events in the UK concluded *"the experiences have highlighted a lack of contingency planning and information at strategic level as well as limited contingency and emergency arrangements at critical infrastructure level, for example water pumping stations"* ⁽⁵¹⁾ and *"it was recognised that the plans and processes in place were not adequate to meet the experience associated with this flooding event"* ⁽⁵²⁾.

The capacity to adapt is not fixed, rather it is dynamic and influenced by economic and natural resources, social networks, entitlements, institutions, governance, human resources, and technology. Existing multiple stresses (ie economic recession, land degradation, etc) reduce adaptive capacity.

For biological and geophysical systems, adaptive potential is much less than in social and market systems because impacts are more direct and therefore appear more rapidly ⁽⁵³⁾, and planned adaptation is not always possible. The majority of the predicted increase in key vulnerabilities is likely to be recorded first in biological systems. This does not mean that vulnerabilities will not occur in social and market systems; they depend on biological systems and, as ecosystems are effected by mounting stresses from climate change and concomitant factors such as habitat fractionation and the spread of plant diseases and pest infestations, the follow-on, second-order effects on human health and safety, livelihoods and prosperity, will be considerable (*ibid*).

Adaptive capacity is driven by factors operating at many different interlinked scales. Adaptive capacity at a local scale will be affected by national, regional or global scale processes. In Hong Kong, it may be that adaptation is constrained or encouraged by international processes, or the failure or success of trade partners and other international actors to adapt.

Adaptations at one scale can also create externalities at another by reducing the adaptive capacity of other actors. This is often found when broad assessments of the costs and benefits of adaptation are conducted at smaller

scales; whilst adaptation may benefit some actors, it also has a negative effect on others.

Furthermore, whilst in some cases one adaptation measure can be sufficient to reduce individual vulnerability, it is more common for collective measures to be required ⁽⁵⁴⁾, requiring wide ranging stakeholder consultation at different scales, i.e. from individuals, firms, and civil society, to local, regional, national and international governments / legislative bodies. The different scales of decision making are interrelated; for instance, individuals' decisions are likely to be constrained by national institutions, and national adaptation policies tend to be influenced by international processes such as the UNFCCC. Different adaptation actions can be influential at different spatial scales and involve actors and institutions with different spheres of influence.

Best practice recommends that policy makers strive to mainstream adaptation to climate change into national and sectoral development ⁽⁵⁵⁾ ⁽⁵⁶⁾ as development plans which do not address adaptation to climate change may result in a worsened socioeconomic situations ⁽⁵⁷⁾.

3.1.2 *Autonomous and Planned Adaptation*

A distinction is generally made in the literature between planned adaptation and autonomous (or spontaneous) adaptation. According to the IPCC, planned adaptation is defined as a “*result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state*” ⁽⁵⁸⁾, whereas autonomous adaptation does not constitute a conscious response to climatic stimuli. Adaptation can occur either in anticipation of change (anticipatory adaptation), or be a response to those changes (reactive adaptation) ⁽⁵⁹⁾.

Biological systems adapt reactively, whereas people and societies adapt both reactively and anticipatory ⁽⁶⁰⁾. Human and natural systems will to some degree adapt autonomously to climate change, although the pace of projected climate change impacts may overwhelm autonomous adaptive strategies in some instances, i.e. terrestrial species migration. Evidence of past and current autonomous adaptations to climate change or variability has been reported widely, particularly in the ecological context ⁽⁶¹⁾, but such adaptations may not be sufficient to adapt to current and expected rates of climate change in the future and cannot be relied upon to be the primary defence against climate change. Planned adaptation can supplement autonomous adaptation, although there are more options and greater possibility for offering incentives in the case of adaptation of human systems than natural systems.

Most adaptation responses being implemented at present around the world are responding to climate change are reactive, i.e. based on observed climate trends and variability, for example increased use of artificial snow-making in the European Alps, water conservation measures in Australia, etc.

Planning adaptation that goes beyond autonomous and reactive adaptation is now seen as a priority by the signatories of the UNFCCC, particularly to avoid what is known as maladaptation (and the associated waste of capital and other resources) to climate change.

3.1.3 *Avoiding Maladaptation and Adaptation which Constrains Mitigation*

Adaptation to climate change must avoid inadvertent maladaptation. Maladaptation refers to adaptation measures that increase vulnerability instead of reducing it, usually as a result of the uncertainties in climate change projections and their broad temporal exposure.

The interplay between adaptation and mitigation options also needs to be considered in order to ensure that adaptation strategies do not hamper mitigation efforts or lock-in rising carbon emissions. One example of avoiding this dilemma would be to use passive cooling systems to adapt to rising temperatures rather than air conditioning systems with associated greenhouse gas emissions. The *Stern Review* (2006) suggested that the best adaptation measures are those that are also strong mitigation measures; they avoid the worst projected impacts of climate change, and hence the need to adapt to them.

3.1.4 *Managing Scientific Uncertainty*

Conventional decision-making analysis requires an understanding of possible outcomes, their probability of occurrence and the value each holds for the decision maker and other actors, in order to decide the way forward. Classic decision analysis implicitly assumes that research reduces uncertainty. In climate science, however, as our understanding has advanced through research over time, the amount of uncertainty (as measured by our ability to make specific predictions) has remained unchanged, or has even grown as processes or complications that had not previously been understood or anticipated are revealed. Therefore, research in understanding climate science, climate impacts and the likely effectiveness of various climate management policies and technologies may not be capable of reducing uncertainty immediately; and thus, key uncertainties may not be eliminated by research activities globally within the timescales of decision making. Certainly, the IPCC's series of four assessment reports have grown more pessimistic with regard to projected climate change impacts as research has progressed.

In the face of high uncertainty, the following decision making are most appropriate ⁽⁶²⁾:

- 1) *Resilient Strategies* – Attempt to identify the range of future scenarios that one might face, and then identify approaches that will work reasonably well across that range.
- 2) *Adaptive Strategies* – Choose strategies that can be modified to achieve better performance as one learns more about the issues at hand and how

the future is unfolding. This works best when there are no large non-linearities and in which the decision time scales are well matched to the changes being observed in the world.

Some analyses have explored sequential decision strategies in combination with the avoidance of key vulnerabilities or thresholds for global temperature change. These strategies allow for the resolution of key uncertainties in the future by incorporating the findings of future research, observations and/or improved modelling. The quantitative results of these analyses only carry low confidence as most studies represent the numerous uncertain values by a small number of discrete values only and/or employ arbitrary assumptions. Furthermore there is significant uncertainty as to what temperatures and emissions concentrations will produce or preclude which climate impacts. Many studies cited in the AR4 provide global mean temperature thresholds which would lead to a specific key impact – however such thresholds are not yet known precisely. Therefore deterministic studies alone cannot provide sufficient information for a full analysis of response strategies, and probabilistic approaches should be considered to enhance the literature in Hong Kong.

The IPCC reports that, even when the impacts of climate change are not yet discernable, and despite considerable uncertainties regarding the rate and magnitude of change, scenarios of projected impacts may be of sufficient concern to justify implementing some adaptation measures now ⁽⁶³⁾. In some cases, it could be more cost effective to implement adaptation measures early, particularly for infrastructure with long economic life ⁽⁶⁴⁾, or if current activities may irreversibly constrain future adaptation to the impacts of climate change. Single scientific papers rarely prove or disprove anything - they simply add to the mass of evidence we have on a given issue. Recent reviews suggest that a “wait and see” or reactive approach is often inefficient and could be particularly unsuccessful in addressing irreversible damages such as species extinction or unrecoverable ecosystem damages ⁽⁶⁵⁾ ⁽⁶⁶⁾.

The IPCC’s conclusion that *‘all studies report the opinions of their authors’ to be that the scientific uncertainty by itself does not provide justification for doing nothing today to mitigate potential climate damages* ⁽⁶⁷⁾ could also be applied to adaptation measures.

Scientific Uncertainty – the Example of Sea Level Rise

Developing adequate and appropriate responses to potential sea level rise, an area of some of the most considerable scientific uncertainty, is one of the greatest challenges of adapting to climate change. With Hong Kong’s extensive use of reclaimed land and its high population density along the coastal strip, this is likely to be an important threat requiring attention. International best practice advises policy makers involved with infrastructure development to keep a watching brief on the latest climate science and incorporate sufficient buffer in design briefs for infrastructure and land use planning to allow for sea level rise.

Examples of good practice in adaptation to rising sea levels are appearing around the world. The design of the Confederation Bridge in Canada, which provides a navigation channel for ocean going vessels with vertical clearance of 50m ⁽⁶⁸⁾, recognised sea level rise as a principal concern by building the bridge one metre higher than required to accommodate sea level rise over its hundred year lifespan ⁽⁶⁹⁾. Deer Island sewage facility in Boston Harbour was designed to be at a higher elevation from sea level to avoid the potential future cost of constructing a protective wall around its perimeter and diverting the discharge pipe over the wall requiring extensive pumping equipment ⁽⁷⁰⁾. Other examples are the Konkan Railway in Western India ⁽⁷¹⁾; a coastal highway in Micronesia ⁽⁷²⁾, The Copenhagen Metro in Denmark ⁽⁷³⁾ and the Thames Barrier in the United Kingdom ⁽⁷⁴⁾ ⁽⁷⁵⁾.

Although the SLR projections in IPCC AR4 take into account the increased Greenland and Antarctic ice flow at the rates observed for 1993-2003, this rate could change in the future, hence the projections have not captured the full effects of changes in ice sheet flow. Due to considerable uncertainties and the need for clearer projections to assist with adaptation, modelling of sea level rise has been a particular area of focus in recent years and many studies have been published subsequent to the AR4 that have enriched understanding of the topic. Many of these studies indicate that sea levels could potentially rise by substantially more than those predicted in the AR4.

However, current “consensus” seems to be that, while multi-metre sea level rise may be unavoidable over the coming centuries, sea level rise this century is not likely to exceed 2 metres ⁽⁷⁶⁾. While a total sea level rise of about 2 metres by 2100 could occur under physically possible glaciological conditions but only if all variables are quickly accelerated to extremely high limits, more plausible but still accelerated conditions lead to total sea-level rise by 2100 of about 0.8 metres. These roughly constrained scenarios provide a “most likely” starting point for refinements in sea-level forecasts that include ice flow dynamics.

Some of the ranges of likely SLR from recent research are illustrated in the table below:

Table 3.1 *IPCC and Alternative SLR Projections*

SLR Projection Range	Reference
260mm to 590mm (2100)	IPCC Fourth Assessment Report (AR4)
800mm to 1,500mm ^(a)	Jevrejeva, S., A. Grinsted, J. C. Moore and S. Holgate (2006): Nonlinear trends and multi-year cycle in sea level records, <i>Journal of Geophysical Research</i> , 111, 2005JC003229. Presented at European Geosciences Union Annual Meeting in 2008

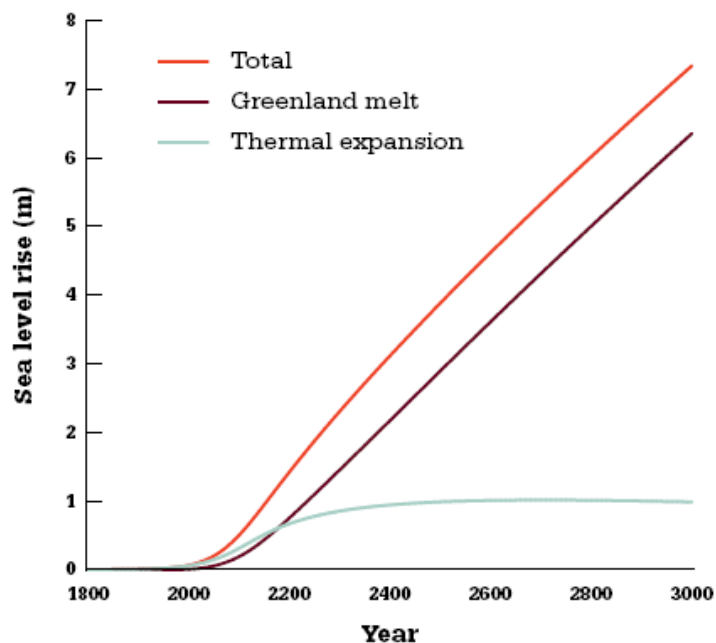
(a) This is Jevrejeva's own interpretation of her paper referenced in *Table 4.2*. Her comments to the European Geosciences Union Annual Meeting in 2008 were quoted by the BBC: *'But by the end of the century, we predict it will rise by between 0.8m and 1.5m. The rapid rise in the coming years is associated with the rapid melting of ice sheets.'* (<http://news.bbc.co.uk/1/hi/sci/tech/7349236.stm>).

SLR Projection Range	Reference
500mm to 1,400mm above 1990 levels (2100)	Rahmstorf, S., 2007, A semi-empirical approach to projecting future sea-level rise, <i>Science</i> , 315, 368–70.
500mm above 1990 levels (2100) ^(a) 1420mm (2200) 7300mm (3000)	Institution of Mechanical Engineers, <i>Climate Change Adapting to the Inevitable?</i> , IMechE, London, UK, February 2009 using GENIE-1 and HadCM3L GCMs
1400mm (22 nd Century)	Herberger, M., H. Cooley, P. Herrera, P. Gleick, E. Moore, 2009: <i>The Impacts of Sea Level Rise on the California Coast</i> , Pacific Institute, Climate Change Center, USA ^(b)
500mm to 600mm (2050), and 'multi-metre' (2100) ^(c)	Hansen, J.E. (2007): Scientific reticence and sea level rise, <i>Environmental Research Letters</i> , 2:2, 024002, doi:10.1088/1748-9326/2/2/024002. Discussed in Hansen, J.E. (2007): <i>Climate Catastrophe</i> . <i>New Scientist</i> , July 28,2007
800mm (most likely), up to 2,000mm (2100)	Pfeffer et al. (2008): Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise, <i>Science</i> , 321:5894, 1340-1343.

The UK Institution of Mechanical Engineers has recently published their professional opinion on how infrastructural development should best be tackled within a framework of uncertain science ⁽⁷⁷⁾. It points towards considering long term impacts (i.e. several hundred years) such as sea level rise, which will require revision and could lead to the construction of significant maladaptation. The likely long term changes to sea levels expected by the IMechE, and to which they recommend infrastructure is designed to, is illustrated in the figure below:

- (a) Thermal expansion of the ocean is estimated to contribute 310mm of SLR and the melting of the Greenland icesheet is estimated to contribute 190mm, and the authors of the report note that this is likely to be an underestimate because the melting of smaller inland icecaps has been excluded.
- (b) http://www.pacinst.org/reports/sea_level_rise/report.pdf
- (c) This is inferred from the lines 'let us say that ice sheet contribution is 1cm for the decade 2005-15 and that it doubles each decade until the West Antarctic ice sheet is largely depleted. That time constant yields a sea level rise of the order of 5 m this century. Of course I cannot prove that my choice of a ten-year doubling time is accurate, but I am confident that it provides a far better estimate than a linear response for the ice sheet component of sea level rise under BAU forcing.'

Figure 3.1 Sea Level Rise Projections



Source: IMechE, 2009

The IPCCAR4 (2007) “does not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise... Therefore the upper values of the ranges given are not to be considered upper bounds for sea level rise”. Therefore, in this study ERM has presented the IPCC’s figures as the lower bound for our sea level rise projections. Also, prior to the achievement of consensus among various international parties on SLR, it is recommended that the Hong Kong Government should keep a watching brief on the latest scientific research on SLR with a view to updating the most likely and upper bound figures for SLR once available, and to bear in mind the range of alternative SLR figures that have recently emerged in scientific literature. It is also suggested that long term infrastructure developments are designed according to long term, reasonable worst case scenario projections.

Any decisions to be made in the shorter term should be flexible enough to allow for regular reviews and adjustments to incorporate any new climate change research findings, as is practiced in other parts of the world. A key date for a future review is around 2013, when the fifth assessment report from the IPCC is due to be published.

3.2 BARRIERS TO ADAPTATION

In the IPCC AR4, the following five barriers to climate change adaptation are defined:

- Physical and ecological
- Technological

- Financial
- Informational and cognitive
- Social and cultural

Despite an increased focus on adaptation (rather than mitigation) to climate change, there is less understanding of the feasibility, costs, limitations, effectiveness and likely extent of implementation of adaptation measures since much of the literature on climate change adaptation is qualitative rather than quantitative, which means that understanding of the likely future costs and benefits of adaptation into numeric and particularly economic terms is limited. For many locations, sectors and impacts there is insufficient quantitative information relevant for adaptation decisions to be made.

Whilst there are serious extant barriers to implementing adaptation measures, these constraints should not be considered insurmountable or an excuse for inaction. New planning processes are attempting to overcome these barriers at local, regional and national levels in both developed and developing countries, i.e. NAPAs (National Adaptation Programmes for Action) in the developing world and national adaptation policy frameworks in some developed countries such as Australia and the UK.

These barriers are discussed in more detail in the following paragraphs.

3.2.1 *Physical and Ecological Barriers*

There is increasing evidence from ecological studies that the resilience of socio-ecological systems to climate change will depend on the magnitude and rate of change experienced. There may be critical thresholds beyond which some systems may not be able to adapt without radically altering their functional state and system integrity. Regions already experiencing environmental and climatic difficulties, and those with degraded land and denuded ecosystem services are likely to experience reduced adaptive capacity. Additionally, the loss of what are termed 'keystone' species may impact the broader socio-ecological system, eventually influencing ecosystems services that humans rely on ⁽⁷⁸⁾.

Furthermore, evidence cited in the AR4 suggests that dramatic climate changes may lead to transformations of the physical environment that limit the possibilities for adaptive capacity, for example rapid sea level rise causing significant land loss in locations where land is at a premium, i.e. small island states and coastal settlements, where adaptation options are limited to either expensive coastal defences or managed retreat resulting in migration and relocation of infrastructure and population ⁽⁷⁹⁾. Whilst it is technically feasible for some such locations to adapt to as much as five metres of sea level rise, the resources to do so are so unevenly distributed that in reality this risk may be considered outside the risk of viable adaptation ⁽⁸⁰⁾.

3.2.2 *Technological Barriers*

Technological innovation and technology transfer is often cited by policy makers as a key adaptive response to climate change. However, there are also potential limits to technological adaptation due to economically unfeasibility, or cultural inappropriateness, or unpopularity with the general public, i.e. waste water recycling as an alternative source of potable water.

Adaptations that are effective in one location may not be in others⁽⁸¹⁾, or may not be equally transferable to all groups or individuals; furthermore this may create knock-on vulnerabilities for other places or groups, and may lead to an enhancement of existing inequalities⁽⁸²⁾.

Finally, as noted by the IPCC⁽⁸³⁾, decision makers under uncertainty, may inhibit the timely adoption of technological solutions to climate change. Whilst the desire for technological solution to climate change is often cited in the media, if this desire does not translate into effective investment, research and development, such adaptation solutions cannot be developed or adopted.

3.2.3 *Financial Barriers*

Adaptation to climate change may be constrained by the lack of adequate financial resources. Even in a wealthy society, lack of resources may limit the ability of low income groups within that society to afford proposed adaptation mechanisms such as insurance coverage. Even individuals and organisations who are not financially constrained often fail to purchase insurance against low probability / high loss events, perhaps because the trade offs are not fully understood⁽⁸⁴⁾.

Uncertainty in climate change science is also likely to raise actuarial uncertainty in risk assessments, placing upward pressure on insurance premiums and potentially a reduction in risk coverage. Physical adaptations to climate change including infrastructure developments, may be subject to higher insurance costs, or lower coverage, in the future⁽⁸⁵⁾ and this should be considered during the design and development of adaptation measures.

3.2.4 *Informational and Cognitive Barriers*

Adoption of adaptation responses to climate change can be limited by human cognition⁽⁸⁶⁾, primarily because there are significant uncertainties with regard to the impacts of climate change. However, even where there is certain knowledge, this does not necessarily lead to adaptation since providing scientifically sound evidence does not necessarily result in information assimilation, action and support for policies based on this evidence⁽⁸⁷⁾. Contextual factors such as personal experiences and priorities and societal values, influence in this regard⁽⁸⁸⁾, for example, in societies where environmental issues are not traditionally considered important.

There is significant evidence that individuals can only respond to a limited number of issues at any one time⁽⁸⁹⁾ as concern about one type of risk

increases, worry about others decreases. Individuals tend to prioritise the risks they face based on which they consider to be, rightly or wrongly, the most significant at a given point in time. As an illustration of this, there was considerable concern expressed at the COP14 (Conference of the Parties to the UNFCCC) / MOP4 (Meeting of the Parties to the Kyoto Protocol) at Poznan, Poland, in December 2008, that worries about the present negative global economic situation would reduce the focus on addressing climate change, an issue generally perceived to be a more medium to long term problem. Furthermore, this example illustrates that the human brain is not well evolved to deal with medium to long term problems, but rather is best able to process immediate external threats.

A lack of previous experience of negative climatic events, or experiencing adequate societal responses to past negative events (sufficient to prevent the worst impacts of a climatic event, i.e. a typhoon) may inhibit appropriate responses beyond an individual's cognition even though more serious climatic events may be projected for the future. The issue of climate change is complicated by the fact that the threat of climate change is not entirely external, peoples' own actions and behaviour, i.e. failure to reduce their own emissions, is a part of the problem.

Concern about climate change is relatively high in developed societies, although until recently it has been commonly perceived that populations in Europe viewed climate change as a more pressing concern than those in Hong Kong. However, a 2007 study by TNS and WWF Hong Kong found that public attitudes in Hong Kong had shifted dramatically in that year, with over 82% of its residents believing Hong Kong is vulnerable to the impacts of climate change ⁽⁹⁰⁾. The study also found that Hong Kong's people were more concerned about climate change than those in Western European countries such as the UK and Germany. However, across the developed world, climate change is still not perceived to be a pressing personal priority sufficient to compel them to make serious lifestyle changes. This attitude-behaviour gap has been shown to be a significant barrier to implementing adaptation measures ⁽⁹¹⁾. Strong visceral reactions towards the risk of climate change are needed to provoke meaningful behavioural change ⁽⁹²⁾.

A divergence between perceived and actual adaptive capacity can be problematic ⁽⁹³⁾. Actors may overestimate their adaptive capacity due to their past ability to successfully meet climatic challenges; this may not accurately reflect their ability to deal with projected climate change impacts and could result in complacency and maladaptation. Conversely, actors which feel that climate change is likely to be overwhelmingly catastrophic may find attempts or the desire to adapt is paralysed by pessimism.

Studies suggest that perception of barriers to adaptation limits adaptive action, even where there are sufficient resources and capacity to adapt. Policymakers need to be aware of the barriers to adaptation and provide structural support to overcome them, and concurrently work toward fostering empowerment and action at the individual level. Research has shown that

appealing to guilt or fear does not succeed in engaging on climate change issues, and does not motivate appropriate adaptive behaviour. Rather, climate change needs be made personally relevant through messages of practical advice on individual actions and by using local imagery.

3.2.5 *Social and Cultural Barriers*

Social and cultural constraints to climate change adaptation are not well documented ⁽⁹⁴⁾. Anthropological research indicates that the scale and novelty of climate change is not likely the sole determinant of degree of impact ⁽⁹⁵⁾. Societies alter their own environments and thus their own vulnerability. Different risk tolerances, different preferences about adaptation measures, etc. exist depending on the views of different groups and societies. Conflicting and diverse knowledge and priorities of climate change adaptation across different social and cultural groups are also likely to impede adaptation.

The most successful adaptation involves marginal changes to material circumstances rather than wholesale changes in location, cultural values or development paths.

Differential power and access to decision makers may promote adaptation responses by some, but constrain them for others ⁽⁹⁶⁾. Therefore the most effective adaptation strategies will be those that maximise community participation and consultation.

4.1 INTRODUCTION

Hong Kong is sensitive to climate change due to its location in a densely populated region of the sub-tropics and due to a number of local geographic and demographic characteristics. As with all cities, Hong Kong is vulnerable because of the agglomeration of people and assets in a small area. In terms of unique locational risks, *'the physical location of Hong Kong, surrounded by water, on traditional typhoon tracks and with a dense urban setting, makes it particularly vulnerable to climate change'* ⁽⁹⁷⁾. Hong Kong's vulnerability is compounded by its dependence on imported food, water, energy and other products that are required for it to thrive.

However, Hong Kong also has comparatively high adaptive capacity due to:

- its relative wealth and access to finance and international goods;
- excellent international trade, communication and academic links;
- the Hong Kong population is by and large accepting of new ideas and willing to embrace change and best practice from around the world;
- the Hong Kong population values education and offers a world class workforce able to adapt to trends in the employment market;
- Hong Kong has world class healthcare facilities and the population is healthy, and recognizes the importance of identifying and responding to external health hazards;
- Hong Kong has high reliability of essential services i.e. electricity and water supplies;
- Highly advanced infrastructure and in situ emergency response protocols are already in existence;
- The process of approving and implementing legislation in Hong Kong is comparatively efficient and able to address long term issues.

Despite this, Hong Kong's adaptive capacity to climate change and associated resilience to climate change impacts may require improvement. The stock taking exercise undertaken by Government stakeholders illustrated that few sectors believe they are undertaking policies which build adaptive capacity for climate change as a by-product of other strategy aims and fewer still are actively considering climate change adaptation at present (only health, the built environment and water resources sectors). It may be that further policy measures either in existence, or planned for the future will assist in adapting

to climate change, however these have not been identified to the study team by the relevant stakeholders to date.

Although, Hong Kong, like many highly developed societies may today be considered to be highly adaptive to climate variability and change, it is important to recognise that vulnerability is dynamic and likely to change in response to multiple processes including economic factors ⁽⁹⁸⁾.

Whilst the impacts of climate change and the challenge of adapting to it are likely to be more problematic in developing countries due to resource constraints, it would be erroneous to assume that a highly developed city such as Hong Kong will face no barriers to adaptation. The IPCC notes evidence from Europe and other highly developed parts of the world, which suggests that high adaptive capacity many not automatically translate into successful adaptation to climate change and that complacency and overconfidence about infrastructural and systematic robustness, amongst wider society and governments in particular, in wealthy countries may itself become a barrier to adaptation ⁽⁹⁹⁾.

The IPCC highlights that *'while the overall record of adaptation to climate change and variability in the past 200 or so years has been successful overall, there is evidence of insufficient investments in adaptation opportunities especially in relation to extreme events ⁽¹⁰⁰⁾'*. With regard to extreme events the insurance and reinsurance industry has recorded that monetary losses have been rising sharply whilst mortality (in developed nations) has been falling. This situation is only partly explained by rising asset prices. Adaptation via major improvements in understanding, forecasts and warnings has been successful to a point but further progress is constrained where local concern about extreme events has declined ⁽¹⁰¹⁾ (as the memory of specific disaster events fades) eliciting a reduced propensity to adopt proactive adaptation measures. Thus Hong Kong residents' ability to respond and adapt to climate change should not be assumed on the basis of past familiarity with extreme weather events or even on the basis of regular warnings. The IPCC notes that *'related to this lack of appreciation of possible risks is that governments and communities can still be taken by surprise when extreme events occur, even though scientific evidence of their potential occurrence is widely available'*.

Furthermore, despite high adaptive capacity and significant investment, numerous studies have shown that extreme events (particularly heat waves), continue to result in high levels of mortality and morbidity, and disruption to infrastructure and electricity supplies, in highly developed countries across Europe, North America and East Asia ⁽¹⁰²⁾.

4.2

EXISTING POLICIES AND MEASURES IN HONG KONG

Within Hong Kong's legislation and contingency planning, there are numerous policies and measures which provide some degree of adaptive capacity to extreme weather events, and potentially subject in some cases to some degree of modification, to climate change. Notably, the Inter-

departmental Working Group on Climate Change (IWGCC) was established, in 2007, to co-ordinate, develop and promote actions in reducing GHG emissions and adapting to climate change. The IWGCC is currently comprised of 5 bureaux and 16 departments. ERM undertook a detailed desktop review of legislative policies and measures currently in place in the public sector which offer adaptive resilience to Hong Kong in the face of climate change. These policies and measures are illustrated thematically by climate change impacts in *Annex B*; whilst an overview of these is provided in the subsequent sections. It should also be noted that this exercise covers only public sector legislation within Hong Kong and that private sector initiatives may also be in existence which offer additional adaptive capacity. It is worth noting that the vast majority of these policies and measures were not originally designed to explicitly address climate change.

4.2.1 *Adaptive Capacity to Respond to Extreme Temperatures / Heatwaves*

In Hong Kong, high temperatures exceeding 31 °C are not unusual especially during the afternoons of the summer months. The “urban heat island” effect intensifies the effects of high temperatures. Heatwaves do not have defined geographic boundaries (unlike floodplains), and they typically affect the whole of Hong Kong. It is not possible to prevent heatwaves from occurring but it is possible to improve how we prepare for them. This section discusses the management of Hong Kong’s urban heat island and minimising the need for cooling in buildings. The policies and measures concerning human health that are associated with extreme temperatures are discussed in *Section 4.2.6*.

Urban heat island effect can be managed by increasing the area of green space cover through protecting existing green spaces and encouraging new opportunities for urban greening. The Hong Kong 2030 Strategy provides a framework for future developments in Hong Kong. The Planning Department (PlanD) has a *Hong Kong Planning Standards and Guidelines* that provides suggestions and guidelines including open space, air ventilation, landscaping and others. Micro-climate studies are carried out by the Housing Department (HD) to examine the climate characteristics of the housing estate site including wind speed, natural ventilation, solar heat gain and others. There are, however, no mandatory requirements that new and redevelopment projects need to address the urban heat island effect, such as to create breeze pathways that enhance natural ventilation, punctuate new development with green spaces, use low-albedo, permeable paving materials, and optimize the street width to allow for appropriate scale deciduous street trees.

High temperatures may cause buckling of railway lines and melting of road surfaces. The *Structures Design Manual for Highways and Railways* of the Highways Department (HyD) provides a range of suggested measures that include the use of materials and testing materials against heat stress.

Indoor temperature is dependent on the design of the building, its location and aspect. Warmer temperatures may lead to an increase in demand for energy intensive cooling such as air conditioning. Air conditioning is a common way to keep buildings cool in Hong Kong but this solution is unsustainable as it is energy intensive, contributes to greenhouse gas emissions and the waste heat generated can exacerbate the urban heat island effect. Development should be designed and constructed to avoid the need for extensive mechanical cooling as far as possible. The *Code of Practice for Overall Thermal Transfer Value in Buildings* aims to reduce heat transfer through the building envelope (in particular external walls and roofs of a commercial or hotel building), thus the electricity required for air conditioning. This does not apply to other buildings and private developments. Moreover, insulation is an important adaptation option but is not always considered during the design stage of a building in Hong Kong.

A comprehensive local review on the measures currently planned or already in operation by the Government that aim to mitigate climate change was provided under the Mitigation Assessment task of the study and these are not repeated here. The measures discussed such as energy supply, energy efficiency and conservation, renewables, are for Hong Kong's four major emission sectors, namely Energy Supply, Buildings and Appliances, Transport and Waste.

4.2.2 *Adaptive Capacity to Respond to Drought*

Hong Kong relies heavily on imported water. Periods of low rainfall has significantly impacted Hong Kong in the past. For instance, water supply was restricted to four hours every four days during the 1963 drought, and then in 1967 for a short period. For a period in 1977, the supply was limited to 10 hours a day; similar restrictions were again imposed in 1981 and early 1982.

A new agreement was signed in 2008 with the Dongjiang water authorities that allow some flexibility for variation of the quantity of water imported to Hong Kong for the period 2009-11, but does include daily and annual maximums which limit the total imported water quantity available to Hong Kong. Nevertheless, reduced availability of water resources in Hong Kong could potentially result during periods of low rainfall (1) if the quantity of imported Dongjiang water cannot be increased to compensate the reduced yield due to physical or contractual constraints; (2) the contractual obligations cannot physically be met due to water stress in Dongjiang. With regard to water use in Hong Kong, the *Total Water Management Programme* consists of a number of measures that aim to manage both water supply and water demand.

4.2.3

Adaptive Capacity to Respond to Floods

Hong Kong is prone to flooding from different sources of floodwater, including (1) from heavy rainfall overcoming the drainage system (surface water flooding); (2) from the sewers; and, (3) from the sea (tidal flooding).

Extreme Rainfall

Changes in the mean rainfall and frequency of extreme rainfall events will have an influence on Hong Kong's water supply; the latter may also give rise to flooding, landslips etc.

Flooding is not uncommon in Hong Kong especially during periods of heavy rainstorms and/or tropical cyclones. The Hong Kong Observatory (HKO) issues rainstorm warnings when heavy rain is expected. Preventive measures in Hong Kong include annual inspection of drains and watercourses especially before and during wet seasons to ensure their full operation in times of rainstorm, regular de-silting and dredging of tidal channels. The Government also has the authority to access private land to carry out maintenance works and to remove obstructions to watercourses under the Land Drainage Ordinance. There are other drainage improvement works, rural drainage rehabilitation schemes and flood protect scheme to raise flood protection level, to alleviate flooding problems and to reduce flooding hazards at various locations across the territory. The Drainage Services Department (DSD) implements flood prevention projects (including eight Stormwater Drainage Master Plan (DMP) Studies) to improve the drainage systems for the whole territory, in particular in the low-lying flood plains of the North and Northwest New Territories, to relieve flooding problems and to raise the flood protection level. All stormwater facilities in new developments have to be designed to withstand a severe flood event in accordance with the flood protection standards.

DSD has operated the Emergency and Storm Damage Organisation to ensure that floods and other emergency situations could be dealt with speedily. When Red or Black Rainstorm Warning or Typhoon Warning Signal No. 8 or above is issued, the Emergency Control Centre goes into operation immediately. Also, DSD will closely monitor the water levels of river streams and flooding conditions of flood prone areas in Hong Kong and work with HKO and Home Affairs Department (HAD) to remind the residents living at coastal and low-lying areas about the flood risks resulting from the rainstorms. Emergency situations that may threaten human lives and livelihoods along with Hong Kong's existing adaptive capacity to respond to these are described in more details in *Section 4.2.6*.

There are numerous ongoing and upcoming efforts, in particular by the DSD, to alleviate flood problems and to manage flood hazards. Design standards, thresholds, etc are reviewed regularly and updated when necessary in order to ensure that drainage facilities are capable of dealing with changes in frequency and/or intensity of rainfall and extreme rainfall events. Climate

change may also lead to new risks, such as in areas that were not prone to flooding in the past, and areas that may not have a comprehensive monitoring system. All these would require regular reviews and updates of the existing measures as well as continue monitoring.

Sewers

The whole of Hong Kong is covered by the 16 Sewerage Master Plan Studies, some of which are being reviewed to accommodate the changes in planned population.

Similar to the drainage infrastructure, design standards and hydraulic capacity for sewerage infrastructure may need regular reviews that incorporate the latest development in climate change science. There is currently limited research on the implications of climate change on sewerage infrastructure, such as on odour, the effects on hydraulic load of wastewater as stormwater enters sewerage systems in the event of heavy rainfall, the effects of hydraulic capacity of sewage treatment plant discharge systems under different sea-level rise scenarios etc.

Sea-Level Rise

Tidal information at various locations in the territory is provided by the HKO. The longest tidal records in Hong Kong is provided by North Point/Quarry Bay (NPQB) tide gauge station, which were built on reclaimed land and therefore settlement corrections would be necessary. Also, the Works Departments of the Government have developed guidelines in 1990, in which relevant government works projects should consider that the rate of mean sea level rise may increase at 10 mm per year so as to address the potential impacts from climate change.

Local / regional crustal movements are an important factor to be taken into account when considering future sea-level rise. For this reason, the Hong Kong Observatory (HKO) has started measuring vertical ground movement at tide gauge stations using satellite-based Global Positioning System techniques since 2004. This means that unfortunately, long term data does not exist for the period prior to 2004.

Projecting future sea-level rise is complex and has significant resource implications. The amount of future sea-level rise may also be influenced by regional ocean currents, as well as processes that may be unknown at present. There is also potential for synergetic impacts of storm surge coupling with sea level rises. Currently there is limited research that focuses on the issue of local sea-level rise, such as downscaling from global projections, research in factors that may contribute to or exacerbate the effects of sea-level rise, modelling / sensitivity studies on the potential impacts resulted from different scenarios of sea-level rise etc.

Development on reclaimed land may be particularly susceptible to flooding associated with sea-level rise and storm surges. Guidance and

recommendations on reclamation design, covering design considerations, stability analysis, settlement assessment and monitoring are provided in *Port Works Design Manual: Part 3*. In line with drainage and sewerage infrastructure described above, the implications of climate change will need to be incorporated into the development and reviewing of design standards, thresholds, return periods etc. Victoria Harbour is protected from any new reclamation projects under the *Protection of the Harbour Ordinance*. However, this *Ordinance* only applies to Victoria Harbour, and reclamation can still take place in other parts of Hong Kong which will potentially raise the area at risk of flooding associated with sea-level rise.

4.2.4 *Adaptive Capacity to Respond to High Winds and Gusts associated with Tropical Cyclones, Intense Monsoon and Severe Thunderstorms*

Hong Kong typically experiences a few tropical cyclones every year, and they commonly occur during the months of May to November. Tropical cyclones activities in recent decades have not resulted in significant deaths, casualties and damages due to the high level of preparedness within the community.

In view of the climate change impacts and potential increase of extreme events in the coming years, HKO periodically review the Typhoon, Rainstorm and Very Hot Weather Warning systems so as to fulfil the needs of the society and citizens. Warnings will be issued for shipping when a tropical cyclone is within Hong Kong's area of responsibility. Whenever a threatening tropical cyclone comes within 800 km of Hong Kong, the HKO issues local warnings and advisory bulletins. This provides information on the warning signal, the latest position and expected movement of the centre of the tropical cyclone, wind strength, rainfall and sea level in the territory, as well as advice on precautionary measures so that the public can prepare for the tropical cyclone. The Labour Department (LD) has a *Code of Practice* that seeks to provide advice and practical guidelines on work arrangements in times of typhoons and rainstorms, in particular when Typhoon Warning Signal No. 8 or above or Black Rainstorm Warning is in force. There are also arrangements for Kindergartens, Day Schools and Evening Schools in periods of tropical cyclones and heavy persistent rain by the Education Bureau (EDB). Apart from tropical cyclones, the Strong Monsoon Signal is issued during episodes of strong or gale force gusty winds associated with surges of intense southwest (summer) or northeast (winter) monsoon. The Hong Kong Observatory may also issue thunderstorm warnings with information on violent gusts generated by intense squall lines.

The *Code of Practice on Wind Effects* of the Buildings Department (BD) provides general equations on calculating wind information that can be incorporated into building designs. Nevertheless, this does not apply to buildings of unusual shapes or where wind conditions are influenced by topography. The existing warning systems and the associated arrangements imply that Hong Kong is already in a position to cope with climate change influence on tropical cyclone activities and storms. In spite of these measures, intense tropical cyclones, i.e. those equivalent to Category 4 and 5 hurricanes, are

rarely experienced in Hong Kong. Should tropical cyclones intensify as a result of climate change, relevant policies or measures may need to be reinforced to minimise the impacts.

4.2.5 *Adaptive Capacity to Respond to Landslips / Landslides*

Hong Kong has a hilly to mountainous terrain with steep slopes, and landslips in Hong Kong have impacted human lives and livelihoods in the past. For instance, the rainstorm of late July 1994 triggered a severe landslide at Kwun Lung Lau which led to 5 deaths and 3 serious injuries. The June 2008 extreme rainfall event causing 2,500 landslides on both man-made slopes and natural terrain in Hong Kong, and the extensive damage and loss of life resulting from landslide disasters triggered by typhoon Morakot on Taiwan in August 2009 are vivid reminders that adverse impacts of climate change on slope safety should not be underestimated, as the current adaptive capacity to respond to landslips/landslides may not be sufficient.

The GEO, in consultation with HKO, issue Landslip Warnings when numerous landslips are expected to alert the public as well as relevant parties so that they can take necessary precautions to ensure safety.

The GEO recently launched the Landslip Prevention and Mitigation Programme (LPMitP) to dovetail with the Landslip Preventive Measures (LPM) Programme which was completed in April 2010. The LPMitP is implemented on a rolling basis with the following annual output: (a) upgrade 150 government man-made slopes; (b) conduct safety-screening studies for 100 private man-made slopes; and (c) implement studies and necessary risk mitigation works for 30 natural hillside catchments.

In conjunction with LPMitP, the GEO controls the standard of new slopes by checking their design and construction, promotes regular maintenance of slopes by maintenance parties to prevent deterioration and provides public education to maintain public awareness of landslide risk.

The GEO promotes slope engineering practice by promulgating technical guidance documents. For example, the *Highway Slope Manual* provides a standard of good practice on slope engineering for project planning, design, construction and maintenance on highway slopes. Other key publications include *Geotechnical Manual for Slopes*, *Guide to Soil Nail Design and Construction* (Geoguide 7), etc.

4.2.6 *Adaptive Capacity to Respond to Health Impacts and Safety Concerns*

There are organisations and systems in place to safeguard the health of the population in Hong Kong; many of these may contribute to, or are synergistic to, adaptation to climate change. For instance, the Hong Kong Observatory (HKO) monitors the changing weather patterns and issues forecasts and warnings that allow the general public to prepare for severe weather conditions; the Department of Health (DH) of the Hong Kong SAR Government is an agency to execute health care policies and statutory

functions, under which a Centre for Health Protection (CHP) has been established to strengthen the public health system in prevention and control of communicable diseases and other public health hazards; the Home Affairs Department (HAD), Security Bureau (SB) and Civil Aid Service (CAS) are some of the authorities involved as emergency situations or incidents arise; the Centre for Food Safety (CFS) and the Food and Environmental Hygiene Department (FEHD) address food safety while the Water Supplies Department (WSD) has measures to ensure the quality of water supply. The following sections provide an overview of the existing policies and measures in Hong Kong that may facilitate climate change adaptation of relevance to human health impacts and safety.

Heat Stress and Cold Stress

Heat stress and cold stress may result from periods of extreme temperatures, and the elderly population is particularly vulnerable. The relationship between cold and hot weather on the health of senior citizens in Hong Kong was recently studied jointly by the Hong Kong Observatory and the Senior Citizen Home Safety Association (SCHSA). The Observatory and SCHSA will continue their collaboration to ensure the safety of senior citizens in hot and cold weather conditions. When periods of cold or very hot weather are anticipated, health warnings are issued and communicated to the general public via the media so that they can take necessary precautions. The announcement of such warnings also activates the relevant government departments and voluntary agencies to provide emergency relief such as temporary shelters and distribution of blankets. A leaflet has been produced to promote heatstroke prevention at work place by the Occupational Safety and Health Branch of Labour Department (LD), which provides generic information for employers and employees. Employers are responsible for the occupational health and safety of all employees, including assessing the risk of heat stroke for those working in a hot environment. There are also guidelines that identify a range of potential health hazards and provide recommendations on preventive measures. Under the Elderly Health Service by the Department of Health (DH), elderly health centres were established to provide primary health care to the population aged over 65, as well as health visiting teams. Regarding weather extreme and the relevant health information/services for elderly, the Central Health Education Unit of the Department of Health (DH) has a pamphlet which includes health advice to the elderly in extreme weather (heat/cold stress). More specific guidance is also available from Elderly Health Service (EHS) of DH. Elderly Health Service has been using various channels to deliver relevant health messages and advice, targeting at both the elderly and their carers. This includes face-to-face health education by the Visiting Health Teams at various community settings, pamphlets, contributed articles to publications targeting at elderly readers, radio interviews, internet webpages, etc. To assist carers and volunteers, two Do-It-Yourself health education kits, comprising reading materials, presentation files and speaking notes, have been produced and made available for download from the internet.

In addition to the hot and cold weather warnings, the Hong Kong Observatory also provides information on ultraviolet (UV) radiation and issues advisory messages when the UV Index reaches 11 or above. Further, there is a fire danger warning system in place to warn against the risks of hill fires during episodes of low relative humidity in the dry season.

Air Pollution Related Morbidity and Mortality

Climate change will have an influence on both the sources and dispersion of air pollutants. Air pollution episodes will have the greatest impact on the elderly population and those with pre-existing cardio and/or respiratory conditions. In Hong Kong, the Air Pollution Index (API) provides information to the general public via the media so that necessary precautions can be taken. Warnings are issued to schools when API of a certain level has been detected or forecasted. To improve the air quality in Hong Kong, the Air Quality Objective (AQO) is currently under review and a long-term air quality management strategy is being developed.

Weather Disasters

The frequency and/or intensity of extreme weather events have been projected to increase as climate changes, which may raise the risk of weather-related disasters such as storms and floods.

Hong Kong has excellent warning systems for bad weather conditions as the Hong Kong Observatory (HKO) maintains a close watch on the weather. Early warnings (e.g. warnings for tropical cyclones, rainstorm, thunderstorm and landslip etc) are issued when severe weather conditions are predicted to affect Hong Kong so that general public can take precautionary measures.

Should there be an emergency situation or in the event of natural disasters, the Emergency Monitoring and Support Centre (EMSC) activates. The actions to be taken under an emergency situation are outlined in the *Emergency Response System: the policy, principles and operation of the Government's emergency response system*, which covers the rescue, recovery and restoration phase, as well as communication with the public. There is a *Contingency Plan for Natural Disasters* by the Security Bureau (SB), which lists out the roles and responsibilities of controlling authorities. The plan is updated annually and is tested regularly. The Civil Aid Service (CAS) also provides support to the emergency services and government departments. There is also guidance on the action to be taken by government departments, agencies and relevant organisations when emergency situation involving Hong Kong Residents arises outside of Hong Kong SAR. Buildings Department (BD) will activate the Emergency Control Centre when Tropical Cyclone Warning Signal No. 8 is issued or in times of heavy rainfall and other disasters. It co-ordinates professional services to deal with dangerous buildings, landslides, dangerous scaffolding and advertising signs. Transport Department (TD) has established the Emergency Transport Co-ordination Centre to closely monitor the traffic and public transport services throughout the year. The centre also

has developed emergency response plans for the traffic and public transport service disruption due to extreme weather events such as typhoons, rainstorms, flooding and landslides, etc. and coordinates with various Government departments such as Hong Kong Police (HKP), Highways Department (HyD) and public transport service providers to implement the response measures and provides the real time traffic conditions to the public through mass media. The power companies have developed emergency response plans to handle the issues on power systems (e.g. power outage) due to bad weather. These plans are subject to periodic review by the power companies and the Government is monitoring it through legislative means. In the event of a Typhoon signal No. 8 or above, a landslip warning or a Red or Black rainstorm warning, Home Affairs Department (HAD) and the Department Emergency Co-ordination Centre (DECC) will be activated for the provision of emergency support services. An emergency hotline manned round the clock for the provision of weather reports, information and assistance to the public will also be available. Temporary shelters to people in need in event of cold or prolonged hot weather are also provided. Meals, blankets and mattresses are provided to shelter-seekers at a number of widely-publicized locations.

Diseases

The Department of Health (DH) coordinates the public health information and disease surveillance system in order to monitor the communicable diseases and collate the epidemiological data. There are a number of policies and measures in place that aim to prevent and control both infectious and non-communicable diseases. In the prevention and preparedness stage, there are programmes for on-going disease surveillance and monitoring, public education, awareness raising and information sharing among health professionals, as well as a Childhood Immunisation Programme. In the respond stage, there is a mechanism for emergency response to deal with outbreaks of infectious diseases (including in public hospitals) which involves centres for coordination and communications to both authorities and the general public. Further, there is an advisory group that provides advice to the Centre for Health Protection (CHP) on risk communication strategies and development of action plans. The group also reviews the CHP's existing risk communication measures. Also, DH maintains close contact with the Food and Environmental Hygiene Department (FEHD) so as to obtain climate related vector-based data (e.g. Ovitrap Index) and food safety monitoring information and take appropriate remedial measures accordingly.

The public sector has shown awareness in the potential changes in disease patterns associated with climate change as the Hong Kong Observatory (HKO) has analysed health surveillance data (such as mortality and Japan encephalitis) against weather information.

The water supplied in Hong Kong complies with the World Health Organisation (WHO) guidelines. The Water Supplies Department (WSD) has a number of measures including a multi-barrier approach to ensure the

quality of drinking water is maintained in Hong Kong. These include hazard identification, risk assessment, monitoring and operational requirements, control measures and corrective actions covering events of flooding, power failure and water contamination that may be caused by adverse weather conditions. WSD not only ensures the quality of the supply of water, but also has a scheme to encourage proper maintenance of the fresh water plumbing system within premises. Notwithstanding these measures, water supply may be contaminated at source (i.e. in the Dongjiang water catchment area) which WSD may not have direct control over.

The Centre for Food Safety (CFS) of FEHD carries out risk assessment, risk management and risk communication to ensure food safety in Hong Kong, including research on food safety topics that are important to public health, food surveillance and sampling at the import, wholesale and retail levels, import control on high risk food items, monitor the food safety incidents in and outside Hong Kong through the Food Incidents Monitoring Mechanism and communicate with the trade and public about the food safety issues.

Apart from food safety, the Government also has regulations in place to maintain the stable supply of food into Hong Kong. Under the Reserved Commodities Ordinance and its subsidiary Regulations (Cap. 296), rice is classified as a reserved commodity under the regulation. The Government operates the Rice Control Scheme to ensure a stable supply of rice and the stockholders have to keep a reserve stock sufficient for consumption by the population for a reasonable period (at present 15 days) to cater for emergencies or any short term shortage of supply. About 70% of wheat flour is imported from Mainland China. The Trade and Industry Department (T&ID) monitors the import quantity of wheat flour periodically and will liaise with relevant authorities in Mainland China to increase the supply quantity if necessary.

4.2.7

Adaptive Capacity of Hong Kong's Economy

Climate change will result in differing risks and opportunities in different segments of the financial services sector although analysis of how climate change will affect the sector is still at an early stage. For example, the value of the assets that are vulnerable to climate change (such as those located at the waterfront or on reclaimed land) may depreciate. On the other hand, climate change may bring about new service areas and business opportunities.

The financial services sector is one of the Four Key Industries in the Hong Kong economy. While short-term investors may not take into account long-term climate change in their investment decision-making process, financial institutions may benefit from incorporating future climatic conditions into their decision making. The sector also has a role to aid identification of threats and opportunities to Hong Kong's economy such as in the advice they offer, the assets they invest in, the business continuity plan they develop etc, yet they are not required to do so.

Businesses, particularly the insurance industry, have a key role in climate risk management. In addition to the mandatory *Third Party Risks Insurance*, building owners and owners' corporations are advised to purchase *Property-All-Risks Insurance* (property insurance), which covers losses or damages to the common properties of the building due to fire or other risks e.g. flooding. This type of insurance has the potential to minimise the losses property owners may face, especially the waterfront properties alongside of Victoria Harbour (that are also amongst those with some of the highest asset values in Hong Kong), but it is not currently a mandatory requirement.

The Hong Kong Monetary Authority (HKMA) has established emergency response plan to handle the issues that will affect banking stability in Hong Kong. HKMA anticipates that the emergency response plan will also be developed by the banking institutions in order to ensure their normal operation. Such a response plan will normally form part of the organisation's continuity plan and it will include the arrangement for backup services and methodology for service reactivation.

The Hong Kong Exchanges and Clearing Limited (HKEx) has developed procedures and guidance for emergencies, including the exchanges and clearing arrangement under Typhoon and Black rainstorm as well as the exchanges and clearing rules and process for various HKEx departments.

The Office of the Telecommunications Authority (OFTA) has an emergency response team that operates throughout the year and maintains close contacts with the telecommunications operators, relevant governments and overseas bodies so as to obtain the latest information about the emergencies (including the incidents resulting from the extreme weather events).

4.2.8

Adaptive Capacity of Hong Kong's Environment

Hong Kong's Biodiversity

In addition to being a highly developed world city, Hong Kong is rich in biodiversity and has a variety of endemic and near endemic species. The territory also supports globally significant proportions of the population of a number of more widespread far-ranging species.

There are a number of policies and measures, mainly implemented by the Agriculture, Fisheries and Conservation Department (AFCD), to protect and conserve biodiversity. There are measures that aim to protect endangered species of animals and plants by regulating all activities involving the listed species, to protect wild animals from human disturbances as well as conservation programmes for species that are of ecological importance, such as the Chinese White Dolphin.

There is legislation to protect ecologically important areas from adverse development impact, and prevent development or incompatible land uses on ecologically sensitive sites. Country Parks, marine parks and marine reserves are some of the sites being regulated. The wetland in the Mai Po

and Inner Deep Bay region is a significant Ramsar Site in Hong Kong. Through the Baseline Ecological Monitoring Programme and Waterbirds Survey at Mai Po Inner Deep Bay Ramsar Site, AFCD monitors and conserves the ecological value of the important wetlands.

The Agriculture, Fisheries and Conservation Department (AFCD) also works with NGOs, private sectors, communities, the academia and etc in research, surveys and awareness raising. In addition, the Environment and Conservation Fund (ECF) also supports educational activities, research, technology demonstration and other environmental and conservation related projects and activities.

Education and Public Awareness

Until relatively recently, environmental issues (e.g. biodiversity) were not a major concern for the majority of stakeholders in Hong Kong. Attitudes are changing and the population in Hong Kong is becoming increasingly aware of and values the unique biodiversity of the territory.

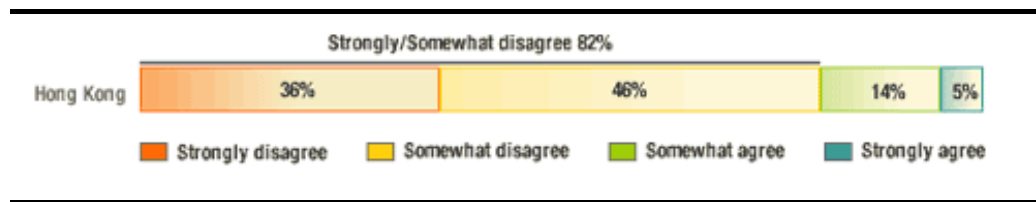
It is important to incorporate the subject of climate change into education curriculum as, in Hong Kong, there is often a misconception that climate change is equivalent to an air quality issue. The Education Bureau (EDB) has held workshops aimed at improving teachers' understanding of climate change, and climate change is included in the curriculum. The Hong Kong Observatory (HKO) has provided an educational package for distribution in schools that aims to raise awareness and understanding of climate change and the associated impacts. The Hong Kong Observatory is also actively engaged in activities that aim to promote public awareness. AFCD has carried out a series of education programmes at Hong Kong Wetland Park, including seminars and bird watching competition, to encourage public participation in wetland conservation.

4.3 PUBLIC PERCEPTION OF CLIMATE CHANGE AND ADAPTIVE CAPACITY IN HONG KONG

As noted in *Section 3.2.4* of this report, cognitive and socio-cultural attitudes to climate change are an important part of adaptive capacity. A recent survey conducted by the WWF and TNS in Hong Kong found that over 80% of people still feel threatened by climate change.

The results of this survey are illustrated below:

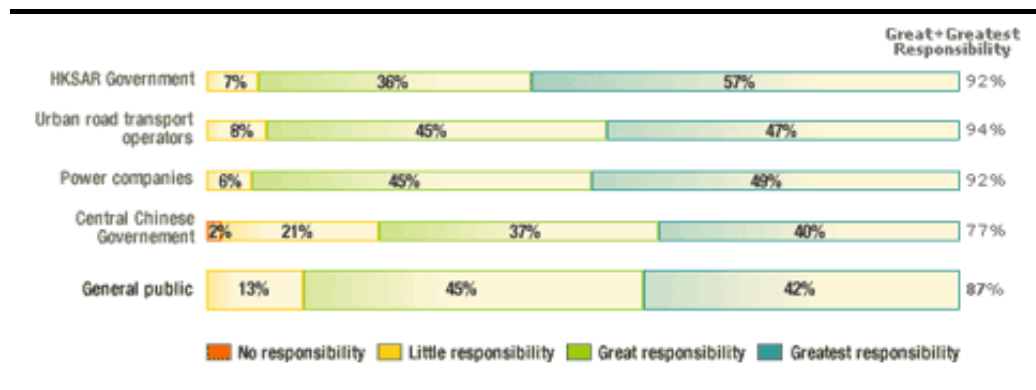
Figure 4.1 *What Extent do you agree With the Statement: 'Hong Kong is safe from the impacts of Climate Change'?*



Source: TNS and WWF, 2007 ⁽¹⁰³⁾

In terms of assigning who should be responsible for adapting to, and mitigating the worst impacts of climate change, whilst over 90% of Hong Kong residents are willing to make some lifestyle changes themselves, the majority feel that the Hong Kong SAR Government has the most responsibility for addressing the issue.

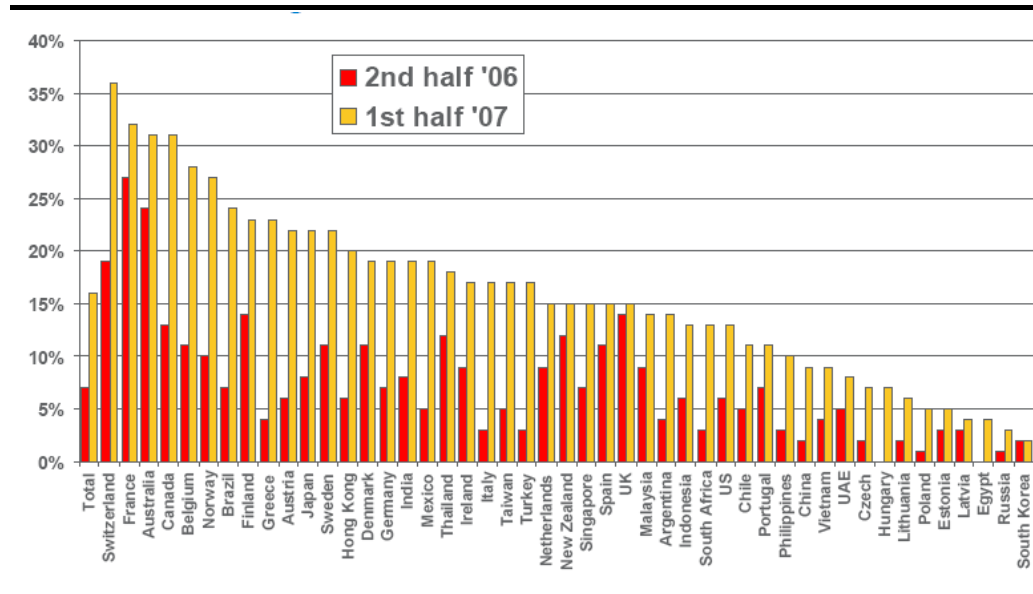
Figure 4.2 *If Hong Kong was to take Action on Climate Change, What Responsibilities should each of the Following Have?*



Source: TNS and WWF, 2007 ⁽¹⁰⁴⁾

It is important to put Hong Kong’s residents’ opinions within an international context. It appears from international surveys that climate change has rapidly become an important concern for Hong Kong residents. The following figures obtained from an international survey conducted across 47 countries in 2007 ⁽¹⁰⁵⁾, reveal that the population in Hong Kong are in the top 30% of those surveyed in terms of the degree to which they are concerned about climate change, representing a 14% increase in the percentage of those Hong Kong residents concerned about the issue over the previous six months.

Figure 4.3 International Concern about Climate Change



(Percentage of Respondents who felt Climate Change was their First or Second most Pressing Concern over the Next 6 Months). Source: Nielsen, 2007

Another international survey: the 2007 Synovate Global Omnibus survey on climate change which interviewed 14,220 respondents across 21 countries (USA, China, France, Germany, Hong Kong, Singapore, South Korea, Australia, India, Japan, Poland, Dubai, UK, Brazil, Italy, South Africa, Norway, Spain, Denmark, Russia and Canada), revealed that 76% of Hong Kong residents surveyed were concerned about climate change, which was considerably higher than the global average of 68% (106).

4.3.1 Conclusions

Hong Kong’s residents are concerned about the impacts of climate change on the SAR, and this concern is increasing. Hong Kong however possesses significant adaptive capacity and has many systems in place which could be used to adapt to the physical impacts of climate change. It is however likely that some such policies may need to be up-scaled, or that the climatic thresholds which trigger other policies may need to be made more conservative. Furthermore the resources allocated to the implementation of policies and measures to protect and respond to climatic events may need to be increased as a result of climate change.

5 **METHODOLOGY USED TO DEVELOP RECOMMENDATIONS FOR HONG KONG**

5.1 **ESSENTIAL PRINCIPLES FOR HONG KONG'S ADAPTIVE RESPONSE**

The IPCC notes that '*it is clear, that there is no simple comprehensive response to the adaptation question, and that the answers are often very place specific and very nuanced and are likely to become more so as research advances.*'⁽¹⁰⁷⁾ Despite this, there are some best practice principles which need to be considered by Hong Kong in the development of its response to the impacts of climate change.

Based upon international best practice, it is recommended that the central tenets of Hong Kong's climate change adaptation strategy should be five-fold:

1. Sustainable
2. Inclusive
3. Flexible and regularly revised
4. Pro-active
5. Based upon the precautionary principle

These principles are described in more detail in the paragraphs below.

5.1.1 ***Sustainable***

Firstly, all adaptive responses to climate change should be sustainable and should not compound the problem of climate change by exacerbating GHG emissions. Preference should be given to measures that yield complimentary benefits such as mitigating further GHG emissions, biodiversity protection, cost savings, cleaner air, increased human health etc. Synergistic measures that offer both mitigatory and adaptive benefits should be prioritised, as should measures which offer no-regrets and win-win solutions. Furthermore in the light of IPCC conclusions⁽¹⁰⁸⁾ that locations already suffering from environmental degradation will be more vulnerable to the impacts of climate change, it is vital that Hong Kong acts to secure the ecosystem services of its natural environment and seeks to redress and remedy extant environmental degradation.

5.1.2 ***Inclusive***

Adaptation must be inclusive and informed. A well adapted society requires individuals and businesses to take action to increase their adaptive capacity and reduce their vulnerability, alongside government effort. Education of the public including publication of reasonable worst case scenarios for climate change is essential to illicit lasting behaviour change. An effective adaptation

strategy requires a consultative, multi-stakeholder approach able to incorporate and respond to the views of all sections of society.

Any official body tasked with driving adaptation to climate change in Hong Kong will require input and/or representation from the public, private and NGO sectors and should be directed by independent scientific advice. Consultation and education are essential components of the multi-sectoral competency building needed to address climate change in Hong Kong.

5.1.3 *Flexible*

Incorporating flexibility and making use of the latest available science is vital. Hong Kong's adaptation strategy needs to be based upon and regularly updated via the latest climate change science. Relying upon superseded data and climate change projections could result in maladaptation. Because of the considerable uncertainties within climate change science, and because some of the science used in any vulnerability assessment conducted at present is incomplete i.e. sea level rise projections, it is recommended that Hong Kong's adaptation strategy is viewed as a 'roadmap' that will be continually updated to reflect developments in technology, actions already undertaken and, perhaps most significantly; changes in climate change science and observed climate change impacts.

5.1.4 *Proactive*

Adaptation should start as soon as practicable and as the literature review has shown it has been underway for several years in some other world cities around the world. Hong Kong needs to build on its existing adaptive policies and measures to ensure climate change is being appropriately addressed in a timely manner. The *Stern Review* has shown that early action will bring clear economic benefits by anticipating potential damages and minimizing threats to ecosystems, human health, economic development, property and infrastructure. The C40 Cities Climate Leadership group has acknowledged that most previous measures to deal with global warming have consisted of efforts to reduce the emission of carbon dioxide and other greenhouse gases, but with the various impacts of global warming now emerging there is a growing understanding that *urgent* adaptation measures are also required to minimize damages⁽¹⁰⁹⁾.

It is acknowledged that sufficient knowledge on the likely timing of climate change impacts is important when setting adaptation priorities. However, the exact level of change to any climatic variable is uncertain due to unknowns in the science, and due to the fact that climate change is not a 'fixed' entity - future emissions will depend on global mitigation action taken over the next few decades and hence a range of possible 'futures' exists. This is particularly the case for the longer time frames for which uncertainties are larger. A solutions orientated scenario based approach (similar to that used in London's TE2100 project) is recommended to deal with the inevitable

uncertainties and to ensure that scientific uncertainties do not result in a lack of action.

5.1.5 *Precautionary Principle*

The precautionary principle needs to be central to Hong Kong's climate change adaptation strategy. International best practice dictates that it is vital to consider worst-case scenario measures, even if uncertainties are high (cases where the costs or the magnitude of the impacts in such scenarios would be unacceptable). To ensure that the latest science is used to shape Hong Kong's adaptation at all stages, close relationships with independent academic experts from the climate science, insurance, medical and engineering communities will need to be developed and used to inform policy and decision makers.

5.2 *CHECKLIST FOR POLICY MAKERS*

The policy recommendations have been developed in accordance with general principles of international best practice observed in the literature and policy review, which have been summarized into the following road map / flow chart ⁽¹¹⁰⁾ recommended for policy makers to use in assessing responses to the impacts of climate change:

- **Economic Efficiency:** Will the initiative yield benefits substantially greater than if the resources were applied elsewhere?
- **Flexibility:** Is the strategy reasonable for the entire range of possible changes in temperatures, precipitation, and sea level?
- **Urgency:** Would the strategy be successful if implementation were delayed ten or twenty years?
- **Low Cost:** Does the strategy require minimal resources?
- **Equity:** Does the strategy unfairly benefit some at the expense of other regions, generations, or economic classes?
- **Institutional feasibility:** Is the strategy acceptable to the public? Can it be implemented with existing institutions under existing laws?
- **Unique or Critical Resources:** Would the strategy decrease the risk of losing unique environmental or cultural resources?
- **Health and Safety:** Would the proposed strategy increase or decrease the risk of disease or injury?
- **Consistency:** Does the policy support other national state, community, or private goals?

- Private v. Public Sector: Does the strategy minimize governmental interference with decisions best made by the private sector?

5.3

PACE AND TIMESCALES FOR ADAPTATION ACTION

Both temporal and spatial scales are very important in thinking about adaptation. Much adaptation takes place in relation to short-term climate variability; however this may cause maladaptation to longer-term climatic trends.

The IPCC notes that it might be expected that the slower the rate of climate change the more likely it is that adaptation will be successful. For example, even a major rise in sea level may be accommodated and adjusted to by human societies if it happens very slowly over many centuries ⁽¹¹¹⁾.

However, slow incremental change can still involve considerable costs and people are likely to be less motivated to take precautionary action against gradual change and are thus likely face additional costs without some more dramatic stimulus. *'Paradoxically, therefore the full array of human adaptation potential is not likely to be brought to bear when all the market, social, psychological, market and institutional barriers to adaptation (to gradual change) are taken into account* ⁽¹¹²⁾.

One of the most fundamental issues facing decision makers is whether to implement responses today or defer preparation until the impacts are better understood and more close at hand. The fact that global warming might eventually necessitate a particular action does not necessarily imply that the action should be taken today. On the other hand, the likelihood of global warming is sufficiently well-established, and the time it takes to develop a response sufficiently long, that deferring all preparation could lead us to overlook opportunities to inexpensively prepare today and which may have other benefits in the interim ⁽¹¹³⁾. The view that it would be unwise to prepare for climate change until its eventuality and consequences are firmly established has been largely discredited in the international literature.

If policy responses are delayed, Hong Kong may be forced into reactive ad hoc adaptation as a response to increasingly frequent crises and disasters, which will prove much more costly and damaging to Hong Kong's society and economy.

For impacts where there is enough confidence in the forecasts, or where alternative benefits 'win-wins' can be postulated i.e. improved public health; it is recommended that adaptation must therefore start now. Furthermore competitive advantages could be gained for local companies if they choose to lead in adaptation strategies and technologies.

The IPCC notes ⁽¹¹⁴⁾ that *'a harmful impact is more likely to be considered 'key' by policy makers if it is expected to happen soon rather than in the distant future'*. In the international literature the disintegration of the Greenland and West Antarctic ice sheets are often cited as examples of key impacts and delayed

irreversibility. It has been proposed that melting of ice shelves in the next 100 to 200 years may lead to gradual but irreversible deglaciation and a large sea level rise over a much longer time scale (in the order of 7 metres ⁽¹¹⁵⁾), which is a timescale usually beyond that considered by policy makers, however adapting to lower, more short term estimates of sea level rise is likely to require significant reinvestment in the future as the ice shelves continue to melt. Debates over an appropriate rate of time preference for such events i.e. discounting, are widespread in the integrated assessment literature (*ibid*). The IPCC notes that '*major geophysical changes (such as multi-metre sea level rise) leave little room for human-managed adaptation. Fortunately these changes are likely to unfold relatively slowly, thus allowing more time for adaptation to their eventual impacts.*' ⁽¹¹⁶⁾ The UK Institution of Mechanical Engineers has recently published their professional opinion how infrastructural development should best be tackled within a framework of uncertain science ⁽¹¹⁷⁾ which points toward considering long term impacts (i.e. several hundred years) for impacts such as sea level rise rather than short term perspectives which will require revision and which could lead to the construction of significant maladaptation. It is therefore recommended that an adaptation strategy is adopted early with regular revisions as the science develops.

5.3.1 *Classifying Adaptive Responses by Temporal Scales*

Knowing when to respond to climate change is as important and problematic as knowing the scale of the response needed. There are no definitive answers onto the 'timing' of specific climate change impacts and this means that flexible solutions will be needed to cope with this inherent uncertainty. Recommendations on the temporal scale of potential responses also consider the four-fold categorization identified by Titus ⁽¹¹⁸⁾: i.e.:

1. No action today solutions – where least-cost quick-implementation solutions can be implemented as the problem emerges with existing technology and institutions;
2. Anticipatory actions – where it would be wise to take concrete measures today despite the scientific uncertainty;
3. Planning – where decision makers do not need to physically change what they are doing immediately, but where we need to change the legislative, fiscal, institutional or policy framework now so that people can respond to new information and priorities in a way that furthers social goals;
4. Research and education – actions which should begin now i.e. where it could potentially take decades to develop solutions and train people to carry them out, or where the need to take action has not been assessed sufficiently in the international or local literature.

Further information on the types of responses and actions which could be implemented under each of these categories are given in the following paragraphs below:

No Action Today

The urgency of responding to the impacts of climate change depends not only on the severity of a potential impact, but also the extent to which taking action today would diminish the ultimate cost of adaptation or allow us to avoid problems which will be unavoidable if policymakers wait before taking action. If the solution to a particular impact is well defined, based upon readily available extant technology and can be implemented quickly, there is little reason to take action decades in advance of the solution being needed. Examples of such a strategy would be changing the schedule for lowering reservoir water levels during flood periods to reflect future rainfall trends, farmers changing crops to other crops or varieties (already in existence) that reflect new climatic norms – both of which could be done relatively quickly but there is no need to do them today in advance of these impacts occurring. However before assigning any actions to this category it is important that all consequences of the impact on the system are understood, and that broader consequences and thresholds are appreciated. Therefore assigning potential adaptation responses to the ‘no action today’ category should be considered only after all eventualities have been considered, and any actions assigned to this category need to be reviewed regularly.

Anticipatory Action

There are a number of studies in the literature which identify adaptive responses that are appropriate to be undertaken today by either incorporating climate change projections into long term projects that are already underway, or by taking actions today that without climate change might not be necessary until later, if at all ⁽¹¹⁹⁾.

Incorporating climate change projections into projects with long time horizons or asset lifespans is one area of pressing concern for engineers and designers around the world. The rationale for designing according to the projections is that the outcome of projects initiated today may be altered by climate change, and that designing for the current climate and climatic extremes is not appropriate for assets which have long lifespans and will have to function in the future climate. Modifying plans to consider climate change is viewed by many experts to be an ‘easy win’ solution despite the considerable uncertainty regarding climate change projections as the cost of factoring climate change will often be a small percentage of total project costs, and by doing so would mean that the project would be better able to cope with present day extreme conditions, even if the projected warming does not materialise as expected. It is recommended that where there are major infrastructure projects currently at the planning stages in Hong Kong, that reasonable worst case scenario climate change impact projections are considered for the late stages of the projects useful life, and that these should be used to inform the design standards, as once the project is under construction or completed, it is usually more difficult and expensive to retrofit adaptive capacity.

For example, Titus *et al* (1987) examined the replacement of drainage systems in Charleston, South Carolina, and found that if they designed for the current 5-year storm, such a system might be insufficient to cope with sea level rise of one foot (0.30m) or if the severity of such a storm were to increase by 10%, necessitating a completely new system long before the end of the project's useful life. It was found that installing slightly larger pipes sufficient to accommodate climate change projections would only add an additional 5% to the original build costs. In such a case, designing for increases in precipitation might prove to be worthwhile if these changes occur and even if they do not, there would be some benefits because the system would provide protection during 10-year storm events. Similar situations are acknowledged by the study authors to exist around the world, and it is logical that many examples may exist in Hong Kong. It is our recommendation that when costing future projects with a lifespan of over 20-30 years that design specifications are drawn up both with and without adaptation to climate change projections, and that it is inherent on the project team to build to the adaptive design unless it is proven via conservative analysis that it is cheaper to adapt such designs in the future to climate change, than to build in adaptive capacity now. There needs to be a culture shift in planning and engineering toward the implicit assumption that climate adaptation is an essential part of business as usual design, as recommended by the UK's Institution of Mechanical Engineers and other professional bodies around the world.

Additionally, where the Government may be contemplating public works for which the economic justification is marginal, the prospect of sea level rise or climate change may convince decision makers to proceed. Constructing a project because of climate change will rarely be an 'easy' process as it requires a greater level of certainty than incorporating climate change into a project that would be undertaken anyway. Until recently the consensus has been that even if future impacts are certain, action on climate change is unnecessary unless the time it will take for the impacts to occur is no greater than the time it will take to design, approve and build the project. Thus only near term impacts and those whose solutions may take several decades to implement were deemed necessary of requiring remedial action today. However recent additions to the scientific literature raising the risk of non-linear warming and 'tipping points' suggest that our ability to project 'when' impacts may occur is less robust than previously assumed and that as a result where the decision has been only marginally toward the opinion that it is 'safe' to delay adaptive action, then it may instead be wise to err on the side of caution and include climate change adaptation. For example, in parts of the United States where it is projected that the climate may become drier, but where regional forecasts contain significant uncertainties and water resource managers are not yet sure that they will need more dams and reservoirs, in many instances the view has been taken that it would be wisest to purchase the necessary land today, otherwise the most suitable sites may be developed, making future construction more expensive and perhaps infeasible. Examples of this situation include Tocks Island National Park on the Delaware River.

Planning

Because of the future focussed nature of the profession, planners have to deal with significant uncertainty. Thus defining the legislative and policy framework i.e. how to respond to particular events should they occur – is often as important as taking concrete action. Although taking concrete action today in response to the impacts of climate change is necessary today for only a few types of problems – defining the rules of the game is needed to provide solutions for a much wider class of problems. Doing so increases flexibility, if the climate changes, Hong Kong will be better prepared, if it does not or changes in a manner different to the current projections, then preparation has not cost any significant capital outlay. Political feasibility for designing the framework for new future policy responses may be enhanced because it is easier to reach consensus when no one is immediately threatened. Moreover such planning reduces the risk to investors for although they continue to face uncertainty due to the uncertainty surrounding the degree of future climate change, planning can prevent that uncertainty from being compounded with additional uncertainty regarding how the Government may respond.

Research and Education

The fact that a particular problem may not require solutions for a few decades does not necessarily mean that society should not begin preparing today. For climate change, whilst the necessary solutions for some issues are available now, the need to implement others is decades away, for many others, very little work has been undertaken to systematically examine the costs and benefits. Investment in research and education is an essential element of adaptation which can commence today even if expenditure on immediate physical measures cannot be financially justified, or undertaken due to a lack of knowledge. The value of research into climate change adaptation is potentially the savings that it could make. Education is another critical component of adaptation for the medium and long term which can commence now without risk of maladaptation. Education is important for a number of reasons; there will be an increased need for personnel in some professions (i.e. hydrologists, coastal engineers etc), people in other professions will need to routinely consider the implications of climate change and it will take time to develop this familiarity, and an informed citizenry will be needed for the public expenditures and institutional changes that may be required.

5.3.2

Classifying Adaptive Responses by Function

Because the temporal scales of adapting to climate change contain significant uncertainties adaptation options will be prioritized under criteria which are based upon the methodology used by the draft adaptation strategy for London ⁽¹²⁰⁾ and which is itself based upon the UK climate impact programme's range of methodological tools.

1. Prevention: actions which can reduce the probability of an impact occurring;

2. Preparation: actions taken to better understand the risk and develop an effective response;
3. Response: damage limitation actions taken in response to an event to reduce the consequences
4. Recovery: actions taken after an event to enable a return to normal, or a state of greater resilience than before the event

It is recommended that Category 1 'Prevention' actions should be the focus of a resilient adaptation response. However actions under all 4 headings will be needed in Hong Kong, as in any location seeking to increase their adaptive capacity. Category 4 'Recovery' actions should be considered ideally, after all other actions have been exhausted as it would be hoped that having to recover could be avoided by preventing an impact in the first place. However, not all impacts will be preventable, and not all impacts can be adapted to. Responses under each of the adaptation headings need to be developed in a synchronised manner, so that worst case scenarios can be averted where possible in the first instance, and responded to adequately should they occur. Additionally some events cannot be prevented and for these instances, effective response and recovery plans are the only adequate form of adaptation.

It can be seen that these criteria cover all three of the adaptation cornerstones identified by the IPCC by firstly reducing exposure, secondly reducing sensitivity and thirdly building intrinsic adaptive capacity by raising population wellbeing and education or designing insurance schemes.

5.3.3 *Classifying Adaptive Responses by Location*

Some geographical locations are more vulnerable than others to particular climate change hazards. It is recommended that adaptation is focussed initially at these locations ⁽¹²¹⁾.

Table 5.1 *Most Vulnerable Locations by Impact*

Impact	Particularly Vulnerable Locations
Rise in average temperatures (and increased risk of heatwaves)	Regions where average temperatures are already high Urban Centres where the UHI effect will exacerbate high temperatures Dwellings without access to, or unable to afford artificial cooling
Sea level rise, coastal flooding, storm surge	Coastal zones and islands Offshore locations
Drought, wildfire, subsidence	Locations where current demand for water almost matches / outstrips supply Locations where water quality is poor Regions prone to wildfire Subsidence prone soils
Increased seasonal precipitation and flooding	Regions with high rainfall Deltas, river floodplains, estuaries, low lying areas Mountainous and hilly areas Locations prone to landslips Urban areas where drainage is already challenged Contaminated environments (land or water)

Impact	Particularly Vulnerable Locations
Possible increased storm intensity or frequency	Densely populated areas
	Areas at risk of tropical and extra tropical storms
Human health	Densely populated areas
	Areas where construction standards are poor
	Areas with endemic / borderline endemic diseases that are influenced by climatic conditions
	Populations with reduced access to healthcare (due to financial, language, cultural constraints)

Source: London Accord, 2009

6.1 INTRODUCTION

A review of overseas approaches and existing institutions in Hong Kong suggests the need for the following government framework for adapting to climatic change:

- Sectoral-level actions in specific areas where Hong Kong is most vulnerable.
- Cross-sectoral activities such as research activities to inform government decision making and activities to raise awareness of Hong Kong's vulnerabilities to climatic change as well as possible adaptation actions to address them.
- Cross-departmental bodies to monitor and co-ordinate government action to ensure consistency across government decision-making.

The following sections highlights adaptation options that the Hong Kong SAR Government could take to address the identified "key" vulnerabilities, as well as to improve understandings of the science of the climate system, the impacts of climate change on society and possible responses to climate change. It should be noted that the options presented in this Report are based upon current understanding of climate change and will need to be periodically reviewed and updated as the science evolves. IPCC is preparing its AR5 due for publication in 2015. More detailed analysis on the possible impacts of climate change on different sectors would then be available and hence new or updated adaptation strategies should be developed based on the updated findings.

Implementation of proposed adaptation options is likely to lead to additional compliance costs on both the Government and the trades concerned. Hence, it is recommended that the Government should duly evaluate the implications, feasibility and costs and benefits of various measures before taking the matter forward. The methodology in assessing the economic aspects of the proposed adaptation options and its limitations are discussed in *Section 10*.

6.2 SECTORAL CLIMATE CHANGE ADAPTATION OPTIONS

This section presents some of the climate change adaptation options that aim to address key sectoral vulnerabilities in Hong Kong, as identified in the vulnerability assessment in *Section 2.6*, for the Hong Kong SAR Government to consider.

Table 6.1 Climate Change Adaptation Options for Biodiversity and Nature Conservation

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
BIO-R1	Establish priorities	Species / habitats / ecosystems most at risk	Due to resource limitations, priority species and habitats need to be established for more immediate actions. Priorities may include, but are not limited to: <ul style="list-style-type: none"> • Currently rare / threatened / endangered species • Species and ecological communities with narrow climatic ranges • Systems most sensitive to changes in climate or climate-driven processes • Habitats that have known concentrations of high biodiversity • Species that are endemic and of ecological significance; and, • Potential species extirpation and extinction under future climate. 	<ul style="list-style-type: none"> • Develop methods and ecological criteria for identifying and mapping species and ecosystems at greatest risk from climate change. • Identify key indicator (climate-sensitive) species (including non-native / invasive species), populations and communities, and ecosystems (e.g. those in Montane habitats) that are particularly sensitive to changes in climate and the associated effects to track climate impacts in terrestrial, freshwater and marine ecosystems (e.g. changes in occurrence, distribution and health of these indicators). • Identify and determine actions to address most important gaps in the local knowledge and data (e.g. for the marine environment and on seasonality) that limit the ability of decision making. 	Prepare	<ul style="list-style-type: none"> • AFCD • Academia • NGOs 	Short Term ¹
BIO-R2	Research effects on non-native / invasive species	Non-native / invasive species	Non-native / invasive species could change in distribution and abundance as climate changes. Consequently, their risk on Hong Kong's biodiversity may also be altered.	<ul style="list-style-type: none"> • Research the effects (e.g. changes in distribution and abundance) of key invasive species / non-native species (<i>Option BIO-R1 - Establish priorities</i>) that may become invasive as climate changes, and pathways in which these species may affect local biodiversity. 	Prepare	<ul style="list-style-type: none"> • AFCD • Academia 	Short Term
Monitoring							
BIO-M1	Periodically review and revise monitoring	Incomplete knowledge of Hong Kong's	The establishment and maintenance of long term data sets (ie robust baseline and historical data sets) are essential for accurate monitoring, preventing loss of services, mitigating climate	<ul style="list-style-type: none"> • Review, and as necessary update, current biodiversity monitoring approaches to ensure they are adequate to track changes related to climatic changes. 	Prepare	<ul style="list-style-type: none"> • AFCD • NGOs 	Short Term

¹ Short term is generally now and/or within the next few years

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
	programmes	biodiversity	change impacts, as well as to underpin modelling and scenario work. Baseline assessments may include the extent of ecological services currently provided by natural ecosystems (eg, carbon sequestration, flood control, physical buffer, etc), existing threats and opportunities.	<ul style="list-style-type: none"> As necessary, develop monitoring programmes for other areas of ecological importance or priorities (Option BIO-R1 – Establish priorities), such as SSSIs, conservation areas and montane habitats. 	Prepare	<ul style="list-style-type: none"> AFCD NGOs 	Medium / Long Term
BIO-M2	Surveillance for non-native species	Non-native / invasive species	<p>Invasive species have gradual but persistent impacts upon biodiversity and ecosystems. There is evidence that climate change is already increasing the impact of alien invasive species on biodiversity overseas.</p> <p>Hong Kong's biodiversity is considered to be highly vulnerable to climate change. Invasive species may pose an increased threat to the local terrestrial, marine and freshwater biodiversity under future climate.</p>	<ul style="list-style-type: none"> Establish and/or adapt existing surveillance programs for the arrival of non-native species that may threaten to become invasive as climate changes by methods such as early identification, prevention and protection of areas. As necessary, control any alien species that threaten to become invasive as a result of climate change at an early stage in their establishment or spread by methods such as direct removal or containment.. As necessary, monitor the success of control programs for selected widespread invasive species. 	Prepare Respond Prepare	<ul style="list-style-type: none"> AFCD AFCD AFCD 	Short Term Medium / Long Term Medium / Long Term
Institutional Strengthening & Capacity Building							
BIO-I1	Incorporate climate change into existing management framework	Future climate and variability	Climate change may exacerbate many other stresses already affecting Hong Kong's natural systems. Maximising the resilience of local ecosystems to adapt by protecting them from other pressures is likely to protect valuable ecosystem services.	<ul style="list-style-type: none"> Review all existing biodiversity strategies, policies, measures, programmes, plans, legislations and regulations to identify those that may be climate-sensitive. Where applicable, integrate climate change considerations into existing nature conservation programmes, policies and measure. For example, include priority species (<i>Option BIO-R1 - Establish priorities</i>) in existing protection ordinance(s). 	Prevent, Prepare Prevent, Prepare	<ul style="list-style-type: none"> AFCD AFCD 	Short Term Medium / Long Term
BIO-I2	Gather existing knowledge	Incomplete knowledge of Hong Kong's biodiversity	As the IPCC notes, climate change is likely to be observed first in natural systems. Hong Kong is disproportionately rich in biodiversity. However, there is an incomplete knowledge of the full extent of Hong Kong's biodiversity.	<ul style="list-style-type: none"> Share, formalize and centralize data, information and knowledge of various institutions and groups across the SAR, and identify gaps and research needs. 	Prepare	<ul style="list-style-type: none"> AFCD Academia NGOs 	Short Term

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			Natural resource and conservation planning, and other informed decisions, require an improved understanding of the potential climate impacts on local biodiversity. Various research groups have already carried, or are carrying, out impact studies on the local biodiversity.				

Table 6.2 Climate Change Adaptation Options for Built Environment and Infrastructure

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
BUE-R1	Identify at-risk infrastructure	Future climate and variability	Structures, assets, infrastructure that suffer from today's climate variability and extremes are likely to be more vulnerable to future climate impacts. Repairing or upgrading critical infrastructure that is already at risk (including roads, water systems and other infrastructure that are already worn or overcapacity) should be a priority. <i>Some Available Guidance and Tools:</i> <ul style="list-style-type: none"> UKCIP tools (NB. These tools have been designed for UK organizations (eg the use of UKCP09 scenarios); they may be adjusted to the local situation, by using the Hong Kong climate change scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>), for instance.): (i) UKCIP Adaptation Wizard: a good starting point for those who do not have a good understanding of climate change and their climate risks. (ii) UKCIP Risk, Uncertainty and Decision- 	This option could be implemented in the following stages: <i>Stage 1: Identify critical infrastructure at risk.</i> <ul style="list-style-type: none"> Identify critical infrastructure previously affected by weather events, e.g. damages, service interruption, performance loss etc. Infrastructure may include transport (e.g. the airport, MTR), communications (e.g. telecommunications), drainage systems, sewer and wastewater treatment systems, slopes, coastal defence, energy (e.g. power plants, transmission infrastructure), water supply (e.g. reservoirs, water treatment works, water mains), human health (eg hospitals). Identify causes and the pathway of damages, services interruptions, performance loss etc. <i>Stage 2: Assess current tolerances.</i> <ul style="list-style-type: none"> Assess these infrastructure's current tolerances through sensitivity analysis to: <ul style="list-style-type: none"> Identify and/or quantify critical thresholds and failure points of critical infrastructure Examine the implications of a range of climate change scenarios (<i>Option R1- Produce and Update Climate Change</i> 	Prepare	<ul style="list-style-type: none"> Public sector Private developers Property managers Public transport providers Power companies 	Short Term

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			<p>Making Framework: those who have some knowledge of their climate risks but want to fully understand them and get a good understanding of the adaptation options.</p> <p>(iii) UKCIP guidance on Identifying adaptation options: used in parallel to the other UKCIP tools.</p> <ul style="list-style-type: none"> • NYC Climate Change Task Force’s forthcoming report on existing at-risk infrastructure: it may detail the methodology adopted for NYC, which could be tailored to the local situation for adoption by relevant stakeholders. 	<p><i>Scenarios</i>) and reasonable worst case scenarios (<i>Option R1e</i>).</p> <p><i>Stage 3: Compile information into a central risk register.</i></p> <ul style="list-style-type: none"> • Prioritise assets / infrastructure that have suffered from past weather events for upgrading, replacement or adaptation. <p><i>Stage 4: Identify adaptation options.</i></p> <ul style="list-style-type: none"> • Upon prioritisation of the components of each system: <ul style="list-style-type: none"> (i) Develop a range of potential adaptation options attempted or contemplated worldwide in consultation with a team of experts and stakeholders. (ii) Evaluate potential engineering solutions and technological applications in terms of their relative contribution towards achieving the desired outcome, the relative nature of associated risks, economic costs and benefits, technical feasibility, and their potential conflicts and synergies with other objectives (social, economic, legal, and related policies and regulations), as well as consideration of the implications of non-climatic factors, to determine their applicability to the possible impacted areas. (iii) Examine the cost-benefits-risks under a range of climate change scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>) and extreme weather scenarios (<i>Option R1e - Reasonable Worst Case Scenarios</i>). • It may be necessary to engage a wide range of stakeholders from both the public and private sector that operate, maintain or regulate the critical infrastructure, as well as professional bodies such as engineers and architects. • Similar to NYC’s approach, a Task force could be formed to coordinate this task and leverage resources from various areas. • Based on <i>Option R1 (Produce and Update Climate Change Scenarios)</i>, produce and regularly update flood risk / warning maps that cover flood risk from different sources e.g. rivers, sea, surface water, coastal erosion etc. • Identify appropriate means of making such 			
BUE-R2	Update flood risk maps	Flooding (from rivers, sea, surface water, and coastal	DSD’s current flooding blackspots list and location maps are produced based on historic flooding records and complaints received. At present, they do not provide any information on potentially new and		Prepare	• DSD	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
		erosion etc)	changes in flood risks arising from climate change. Implications of making of such maps publicly available need to be considered.	information publicly available - implications of this option may include that some properties or areas at-risk could become potentially uninsurable or experience a significant drop in asset value, which would need to be further discussed and examined with the industry and stakeholders.			
Institutional Strengthening & Capacity Building							
BUE-I1	Develop climate risk screening tool	Future climate and variability	<p>The World Bank has developed ADAPT (Assessment and Design for Adaptation to Climate Change: a Prototype Tool), a computer-based tool to screen proposed development projects for potential risks posed by climate change and variability. The tool is meant for use by development practitioners, including bank staff, bilateral agencies, the NGO community and client governments. This tool involves: (1) identification of project activities and location; (2) consultation of a climate database; and (3) a climate risk assessment based on expert assessment.</p> <p>It may be cheaper to cost in adaptation options at the design stage than to attempt to retrofit it in the future. Such a tool could be used for screening new plans for developments (in particular, coastal developments) currently in the design stage to avoid mal-adaptation.</p>	<p>• Similar to the World Bank's ADAPT tool, develop a screening process to mainstream climate due diligence into developments in a manner that is easy to use for non-technical staff. Such a tool could be integrated with existing planning procedures, e.g. sustainability assessments or EIAO.</p> <p>(i) In its simplest form, the tool needs not be quantitative but rather an iterative screening tool to flag up issues of concern where a project's future viability may be in doubt or where adaptive action needs to be considered.</p> <p>(ii) A transparent decision making process is needed.</p> <p>(iii) Formal guidance on decisions as to whether to "over-engineer" if relying on worst case scenario projections or "under-engineer and rely upon retrofitting" if relying on current international consensus science, depending on the appetite for risk.</p> <p>• Resilience to particular climatic hazard(s) (eg future sea levels) could be a required criterion for Government support or funding of local and private coastal projects.</p>	Prevent, Prepare	Development of this screening tool is a new area and the parties responsible for it will be determined by the Government.	Short Term
BUE-I2	Periodically review construction-related codes / guidelines / design standards against climate	Future climate and variability, extreme weather conditions	As buildings and infrastructure typically have long asset lives, longer term conditions (ie those in mid and latter half of this century) should not be disregarded in strategic planning. Existing construction-related codes and design standards for buildings and infrastructure (in particular, drainage and sewerage systems, transport infrastructure, flood protection standards)	<p>Using information from <i>Option BUE-R1 (Identify at-risk infrastructure)</i>, this option could be implemented in the following stages:</p> <p><i>Stage 1: High level overview</i></p> <p>• Evaluate the effectiveness of existing codes and design standards in past weather, in particular extreme events; identify any causes of failure.</p> <p>• Identify those technical areas and particular standards</p>	Prepare	<ul style="list-style-type: none"> • ArcSD • BD • CEDD • DSD • HD • HyD • LandsD • PlanD • TD 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
	change scenarios		<p>may have been designed based on historical trends, which may no longer represent future conditions. Hence, adjustments may be needed to ensure their effectiveness under future climate.</p> <p>Elements to be examined may include, but are not limited to, the elevation of buildings, building envelope performance, foundation design, long-duration flood impacts, effluent discharge standards, debris impact, design of transport infrastructure under high / extreme temperatures (e.g. distortion of soldered rails and track buckling for rails), design of future public projects, impacts on abandoned facilities and contaminated land.</p> <p>To deal with scientific uncertainties, the planning stage of any development at risk from future climate change could consider (1) resilient strategies (i.e. one that seeks to identify approaches that will work reasonably well across a range of future circumstances that have been identified); and, (2) adaptive strategies (i.e. those that can be adjusted as new information becomes available).</p>	<p>where a revision of the codes / standards / guidelines may be necessary.</p> <p><i>Stage 2: Identify possible changes to design standards in particular areas</i></p> <ul style="list-style-type: none"> • Conduct sensitivity analysis on the capability of existing systems (e.g. hydraulic capacity of effluent discharge systems, stormwater drainage, wastewater flow rates and wastewater treatment facilities) for a range of climate change scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>), identify critical threshold values and failure points of existing infrastructure triggering the need for management action. • Assess the cost-benefits-risks of these possible changes, including under reasonable worst case scenarios (<i>Option R1e - Reasonable Worst Case Scenarios</i>) that account for future climate. • A number of assignments could be carried out on different subject areas covered under different standards / guidelines (e.g. DSD Storm Drainage Manual, Port Works Manual). <p><i>Stage 3: Provide recommendations for updating of specific standards / codes / guidelines</i></p> <ul style="list-style-type: none"> • Obtain independent review and carry out industry consultation. • There would be scope for some packaging together of a number of standards / codes / guidelines that cover similar or overlapping subject areas. 			
BUE-13	Regularly update the Hong Kong Urban Climatic Map	Urban heat island (UHI) effect	<p>The UHI effect is found in Hong Kong. In 2006, PlanD commissioned a feasibility study on <i>Urban Climatic Map and Standards for Wind Environment</i>, which included the production of an Urban Climatic Map. This Urban Climatic Map can serve as a baseline and maps Hong Kong's UHI effect under present day conditions. This map could be used to monitor the changes in Hong Kong's UHI effect in the coming decades.</p>	<ul style="list-style-type: none"> • Review / update this Urban Climatic Map regularly, say every four to five years. • Using the information provided by the Urban Climatic Map and other environmental monitoring data, review the <i>Hong Kong Planning Standards and Guidelines</i> regularly and update as necessary. • Using the Urban Climatic Map to identify "hotspots", and hence priority action areas. New developments within these areas could be encouraged to contribute to offsetting the UHI effect. 	Prepare	<ul style="list-style-type: none"> • PlanD • EPD • HKO 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
BUE-I4	Develop flood risk strategies	Flooding	<p>Heavy rain events are not uncommon in Hong Kong especially in the summer months; sea level rise could pose additional flooding threat. Hong Kong has substantial developments in low lying areas, at or near the coastline. Future sea levels should not be omitted in any sustainable development and coastal flood risk should be considered alongside other spatial planning issues. The frequency, patterns and severity of flooding (from the sea and other sources) may change and become more damaging as climate changes. In order to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk, flood risk should therefore be accounted for at all stages in the planning process.</p> <p><i>Some Available Guidance:</i></p> <ul style="list-style-type: none"> • England's Planning Policy Statement 25: Development and Flood Risk (PPS25) (2006): sets out Government policy on development and flood risk. • Defra's Appraisal of flood and coastal erosion risk management: A Defra policy statement (June 2009): guidance for operating authorities and others in England on decision making on the sustainable management of flood and coastal erosion risk. • Defra's SD3: Risk Management Guidance (forthcoming): this project aims to develop broader risk management tools and, after wide consultation, publish a new set of policy statements covering all levels of appraisal. 	<ul style="list-style-type: none"> • Develop strategies to address flood risk from sea, rivers and land (i.e. surface run-off), overwhelmed sewers and drainage systems associated with climate change, which could include the following elements: <ul style="list-style-type: none"> (i) Appraise risk - identify land at risk (e.g. coastal zones, low-lying areas) and the degree of risk of flooding from different sources in their areas; prepare flood risk appraisals / assessments; (ii) Manage risk – frame policies to avoid development in areas of flood risk and identify parties to manage any residual risk; and, (iii) Reduce risk - reduce the causes and impacts of flooding. (iv) Adopt a partnership approach – to ensure that plans are effective and decisions on planning applications can be delivered expeditiously. 	Prepare	<ul style="list-style-type: none"> • PlanD • DSD 	Short Term
BUE-I5	Develop a strategy to	Slope stability	The GEO's studies indicate that the effects of climate change will have significant	(i) Understand the impacts of climate change and identify relevant major geohazards	Prepare	GEO, CEDD, HKO	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
	manage challenges of climate change and major geohazards		implications on slope safety. However, the current understanding in the relevant technical issues (e.g. relevant climate change scenarios, scale and extent of relevant geohazards and their potential impacts, etc.) is limited. There is a need to develop a plan to improve understanding of the impacts of climate change on slope safety and develop strategies/measures to manage the risk arising from major geohazards identified.	(ii) Develop strategies and measures for managing the risk arising from the major geohazards (iii) Promote sustainable construction practices in geotechnical works.			
Education & Public Awareness							
BUE-E1	Promote green roofs	Urban heat island (UHI) effect	Green roofs and green walls can reduce summer overheating and reduce the need for artificial cooling and heating in the summer and winter, respectively. The technology of green roofs is relatively well established. ArchSD commissioned a study to examine the application of green roof in Hong Kong, which was completed in 2007. In addition to economic benefits, green roofs have environmental, and amenity and aesthetic benefits as outlined in the study. The recommendations of this study could be actively taken forward and need not be repeated here.	<ul style="list-style-type: none"> Actively promote, and encourage the adoption of, green roofs to the private sector such as private developers and property managers: (i) Emphasise the longer term benefits (e.g. the environmental and economic benefits). (ii) Educate developers and property managers on maintenance issues to ensure that green roofs continue to be effective. (iii) Consider the associated safety risks during high winds, tropical cyclones, other extreme weather conditions etc. Maximise green roofs opportunities in newer urban areas, and also in urban renewal projects. Provide incentives for retro-fitting green roofs on existing roofs, and/or consider statutory mandate for green roofs on new buildings or renewal projects, including residential and commercial buildings, and both public and private developments. Examine the application and effectiveness of green walls (e.g. the use of climbers on walls), covering issues such as structural issues and horticultural research on the viability of different species. 	Prevent	<ul style="list-style-type: none"> ArchSD BD EMSD HD PlanD 	Ongoing
BUE-E2	Promote cool roofs	Urban heat island (UHI) effect	“Cool roofs” have a coating of light coloured water sealant to limit the absorption of solar energy and damage from daily temperature fluctuations. Similar to green roofs (<i>Option BUE-4</i>), cool roofs can also facilitate	<ul style="list-style-type: none"> Promote cool roofs where green roofs are not suitable. Adopt cool roofs for government buildings where green roofs are technically not feasible. Collate data for assessing the effectiveness of cool roofs and analysing the costs and benefits, eg regular 	Prevent	<ul style="list-style-type: none"> ArchSD BD EMSD HD PlanD 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			<p>mitigation whilst enhancing adaptive capacity at relatively little cost to stakeholders.</p> <p>It should be noted that:</p> <ul style="list-style-type: none"> • If appropriate to the location, green roofs should be the preferred option because of the multiple benefits they provide, such as improving air quality, alleviating urban flooding. • Cool roofs require less capital investment and could be considered for lower rise, older premises which may not, for structural or financial reasons, be able to consider a green roof. • It has been found that the disadvantages of a cool roof in winter may offset the advantages in the summer in very cold climates (eg Minneapolis) and climates in which the summers are cloudy and cool (eg Seattle). However, the benefits in summer generally outweigh the winter penalty in sunbelt cities like LA and Phoenix. In the sub-tropical climate of Hong Kong, cool roofs would certainly be advantageous. 	<p>monitoring cool roofs to track the progress and their effectiveness.</p> <ul style="list-style-type: none"> • Consider adopting London TFL (Transport for London)'s approach to minimise cooling needs in public transport by requiring all new vehicles entering service to have heat reflective white painted roof panels, and vehicles that are in service to be refurbished (which include painting roof panels white). 		<ul style="list-style-type: none"> • TD 	

Table 6.3 Climate Change Adaptation Options for Business and Industry

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Institutional Strengthening & Capacity Building							
BUS-I1	Develop Hong Kong business assessment tool on climate change impacts	Business risks and/or opportunities	The Business Areas Climate Impacts Assessment Tool (BACLIAT), developed by UKCIP, is used to assess the potential impacts of climate change (both risks and opportunities), either on business or on an entire business sector. BACLIAT encourages a comprehensive assessment, by inviting consideration of the opportunities as well as the threats from a changing climate, under the headings: Markets; Finance; Logistics; Premises; People; and, Process.	<ul style="list-style-type: none"> Consider developing a Hong Kong business assessment tool on climate change impacts. Reference could be made to a similar tool, BACLIAT, developed in the UK for their business climate impacts assessment 	Prepare	<ul style="list-style-type: none"> EPD HKO 	Short Term
Disaster Management & Emergency Planning							
BUS-E1	Mandate business continuity planning for essential operations	Business / operation disruptions	It is essential to ensure continuity of critical functions in the event of a disruption, and effective recovery afterwards.	<ul style="list-style-type: none"> If future scenarios are severe, then consider the possibility to mandate BCM for certain essential operations, such as frontline responders, emergency services, etc. 	Prepare	<ul style="list-style-type: none"> FSB 	Medium / Long Term
Education & Public Awareness							
BUS-P1	Promote business climate impact assessment	Business risks and/or opportunities	To assist the private sector and other organizations recognize the potential threats and opportunities presented by climate change.	<ul style="list-style-type: none"> Engage with stakeholders to raise awareness and initiate discussion about climate change adaptation risks to business and markets. Actively promote the Hong Kong business assessment tool on climate change impacts to organisations that operate in Hong Kong and encourage the use of the Hong Kong business assessment tool on climate change impacts checklist (Ref <i>Option BUS-I1</i>) 	Prepare	<ul style="list-style-type: none"> EPD HKO 	Short Term
BUS-P2	Encourage business continuity planning	Business / operation disruptions	Organisations needs to recover and restore operations quickly in the event of a disaster or extended disruption. It is therefore important to identify in advance the risks and actions to be taken after an event to enable a rapid return to normal.	<ul style="list-style-type: none"> Actively promote BCM to commercial and voluntary organizations in Hong Kong, and encourage businesses to improve their Business Continuity Management in respect of climate risks (<i>Option R1- Produce and Update Climate Change</i>) 	Prepare	<ul style="list-style-type: none"> EABFU FSB 	Short Term

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			In order to be successful, Business Continuity Management (BCM) must be regarded as an integral part of an organisation's normal ongoing management processes.	<i>Scenarios).</i>			

Table 6.4 Climate Change Adaptation Options for Energy Supply

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Monitoring							
EGY- M1	Monitor for changes in energy demand and supply patterns	Changing energy demand and supply patterns	The production, and use, of energy are sensitive to changes in the climate, although the effects of climate change on energy supply and demand will also depend on patterns of economic growth, land use, population growth and distribution, technological change and social and cultural trends that shape individual and institutional actions.	<ul style="list-style-type: none"> • Monitor for any changes in energy demand/supply patterns (in particular for those associated with climatic events), including peak energy demand/supply, gradual and seasonality changes etc, and identify the causes for these changes. 	Prepare	<ul style="list-style-type: none"> • EMSD • ENB • Power Companies 	Ongoing
Institutional Strengthening & Capacity Building							
EGY- I1	Periodically review likely changes in energy demand and supply patterns	Changing energy demand and supply patterns	As mentioned in <i>EGY-M1 (Monitor for changes in energy demand and supply patterns)</i> , climate change will have an influence on the production, and use, of energy.	<ul style="list-style-type: none"> • Consider the latest available climate change scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>) and the associated impacts during its regular review and forecasts of energy demand and supply. 	Prepare	<ul style="list-style-type: none"> • EMSD • ENB • Power Companies 	Ongoing
EGY- I2	Diversify fuel sources and fuel suppliers	Energy security	Hong Kong has no indigenous fuel sources and imports all its main sources of fuel, thus it may be impacted by climatic disruption further up the supply chain and beyond the host country's control. Any interruption to the supply of power due to a shortage of fuel supplies, or impacts along the transportation route or on the supplier, could have significant implications.	<ul style="list-style-type: none"> • Encourage a diverse mix of different energy fuels and fuel suppliers. 	Prevent	<ul style="list-style-type: none"> • ENB 	Medium / Long Term
EGY- I3	Assess impacts along the energy supply chain	Impacts along the energy supply chain	As mentioned in <i>Option EGY-2 (Diversify fuel sources and fuel suppliers)</i> , Hong Kong is vulnerable to impacts and climatic disruptions further up its energy supply chain. It is necessary to improve our understanding on the risks and challenges along the supply chain, which would facilitate the identification of effective actions to minimise the occurrence of an impact.	<ul style="list-style-type: none"> • Encourage (or, at a later stage, mandate) power companies to report on how they assess and act on the climate risks and opportunities along the energy supply chain, including those at fuel sources and the route of importation. 	Prepare	<ul style="list-style-type: none"> • EMSD • ENB • Power Companies 	Short Term

Disaster Management & Emergency Planning

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
EGY- E1	Energy supply contingency planning	Energy supply interruptions	Hongkong Electric and CLP emphasize their ability to prevent energy supply interruptions and quick response towards any interruptions. As any energy supply interruptions could have significant implications for the whole city, contingency planning that accounts for potential future climatic disruptions may be required.	<ul style="list-style-type: none"> Encourage power companies to incorporate climate change related risks and challenges (eg future extreme weather scenarios, sea-level rise), both in Hong Kong (such as power generation, transmission and distribution) and along the supply chain (such as primary fuel imports and supply), in their risk assessments. This may involve: <ol style="list-style-type: none"> Enhancing existing and identify new preventive measures to reduce the probability of an impact associated with climate change. Assess the effectiveness of existing respond / recover actions under future climate scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>); update and revise as necessary. 	Prepare	<ul style="list-style-type: none"> EMSD ENB Power Companies SB 	Ongoing

Table 6.5 Climate Change Adaptation Options for Financial Services

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
FIN- R1	Examine the potential for expanding the role of insurers in climate risk management	Climate risk management	<p>There are uncertainties in climate change and the associated impacts, hence risks. Insurance exists to manage risk, and hence the insurance sector has a key role in climate risk assessment and loss control.</p> <p>Residential property insurers in California are required (under California Insurance Code (CIC) Section 10081) to offer earthquake coverage subject to the minimum dwelling and personal property requirements for the peril of earthquake and the offer must be accepted. This spreads the losses that could otherwise be faced by the property owners and/or occupants. In Hong Kong, building owners and owners' corporations are advised to purchase Property All-Risk Insurance in addition to the mandatory Third Party Risk Insurance; however all-risk insurance is not mandatory ⁽¹⁾.</p>	<ul style="list-style-type: none"> If in the future, climate scenarios are especially severe, then explore the possibility of mandating infrastructure and assets located in hazard-prone areas and vulnerable assets. 	Prevent	Examining the insurance coverage on climate risks located in hazard-prone areas is a new area and the parties responsible for it will be determined by the Government.	Medium / Long Term
				<ul style="list-style-type: none"> Examine the legal implications of the insurance industry in dealing with climate risks and opportunities. In addition to some of the key questions in <i>Option FIN-1 – Examine the impacts on the insurance industry</i>, other questions may include: <ul style="list-style-type: none"> - How should the insurance industry, as major shareholders, use its influence to 	Prevent, Prepare	<ul style="list-style-type: none"> FSB 	Ongoing

(1) California Department of Insurance (<http://www.insurance.ca.gov/0100-consumers/0060-information-guides/0040-residential/earthquake-insurance.cfm>) [Date accessed: 18 February 2009].

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
FIN- R2	Examine legal roles of insurance industry and regulators	Business risks and/or opportunities	Insurers are acknowledged as a major source of advice on risk. As mentioned in the Business and Industry sector (<i>Table 9.3</i>), decisions made by insurers that do not consider climate change may be open to future legal challenge (<i>BUS-2 – Examine legal roles of professional advisers and regulators</i>).	<p>help adapt to climate change?</p> <ul style="list-style-type: none"> - How can the insurance industry encourage and reward good practices by policyholders and developers? - Should the insurance industry invest in communicating the impacts of climate change and the role of insurance to the public? - Should the insurance industry be advising policyholders now of potential uninsurable zones in the future? - Should the insurance industry be working with mortgage lenders to identify potential high-risk areas? - Should the insurance industry pay for climate research and have closer contact with academics in relevant fields? <p>• Examine the legal responsibilities of the insurance industry and regulators that consider and advise on the relative climate risks and opportunities. Some key questions to consider in consultation with the insurance industry may include:</p> <ul style="list-style-type: none"> - Should the industry invest in communicating the impacts of climate change and the role of insurance to the public? - Should the insurance industry be advising policyholders now of potential uninsurable zones in the future? - Should the insurance industry be working with mortgage lenders to identify potential high-risk areas? 	Prepare	Examining the legal responsibilities of the insurance industry is a new area and the parties responsible for it will be determined by the Government.	Short Term

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Institutional Strengthening & Capacity Building							
FIN- I1	Climate Risk Disclosure (Insurance Industry)	Business risks and/or opportunities	Regulators would be concerned about how the financial health of the insurance sector, the availability and affordability of insurance for consumers would be impacted. Standardised disclosure of climate risk would provide regulators the information they need to better understand the risks the industry faces.	<ul style="list-style-type: none"> Encourage companies to disclose to regulators/investors the financial risks from climate change, and actions being taken to respond to those risks. 	Prepare	<ul style="list-style-type: none"> FSB 	Medium / Long Term
<p><i>Some Available Guidance:</i></p> <ul style="list-style-type: none"> Ceres's <i>Global Framework for Climate Risk Disclosure: A statement of investor expectations for comprehensive corporate disclosure</i> (2006): a new statement on disclosure that investors expect from companies. 							
Education & Public Awareness							
FIN- P1	Examine the implications on the insurance industry	Impacts on the insurance industry	Climate change can affect every aspect of insurance, including both sides of the insurance industry's balance sheets. While the insurance industry can develop new risk transfer mechanisms and loss-prevention products and services, US insurers, for instance, have experienced growth in weather-related catastrophe losses from around US\$1 billion (1970s) to US\$17 billion per year (past decade).	<ul style="list-style-type: none"> Engage with, and encourage, the local insurance industry to consider risks and opportunities associated with climate change through awareness raising. 	Prepare	<ul style="list-style-type: none"> FSB 	Short Term
FIN- P2	Examine the implications on the banking industry	Impacts on the banking industry	The banking industry has substantial economic significance in Hong Kong and provides the hub between all other financial sectors. It provides a wide range of financial services (eg lending, structured finance, leasing, asset management, equity investments and savings), which could be directly or indirectly impacted by climate change.	<ul style="list-style-type: none"> Engage with, and encourage, the local banking industry to consider risks and opportunities associated with climate change through awareness raising. Implications and issues arising from climate change may need to be discussed in consultation with the banking industry. Some key questions may include: 	Prepare	<ul style="list-style-type: none"> FSB 	Short Term
The market value of some properties of certain							

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			<p>designs or in certain locations may decline significantly should they become uninsurable in future climate (eg increased flooding risk may lead to potential buyers unable to raise a mortgage). Climate change impacts may negatively affect the future revenue stream of businesses, and hence their ability to secure or repay a loan. Opportunities may arise as alternative risk transfer products (eg catastrophe bonds) become more popular. It is therefore important that banks and their shareholders are aware of the climate risks and opportunities and the associated implications on their core lending and saving books.</p>	<p>- To what extent are future scenarios related to climate change considered in credit assessment and lending portfolio planning by the banking industry?</p> <p>- To what extent are climate change impacts relative to different geographical areas considered by the banking industry when determining lending and equity portfolio policies?</p> <p>- To what extent do banks require borrowers to demonstrate that they have identified and incorporated climate change impacts on their business model, including value chains?</p>			
BUS- P1	Promote business climate impact assessment	Business risks and/or opportunities	Similar to the Business and Industry sector (<i>Table 9.3</i>), financial organizations may be encouraged to use Hong Kong business assessment tool on climate change impacts to assess the potential impacts (both risks and opportunities) of climate change.				
BUS- P2	Encourage business continuity planning	Business / operation disruptions	As mentioned in the Business and Industry sector (<i>Table 9.3</i>), BCM could be used to help financial organizations to recover or restore partially or completely from interruptions.				

Table 6.6 Climate Change Adaptation Options for Food Resources

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
FOD-R1	Examine the effects on local live poultry production and live pig husbandry	Impacts on local live poultry production and live pig husbandry	Local agricultural production has a potential role in reducing Hong Kong's reliance on food imports and the associated vulnerabilities along the food supply chain. Local live poultry production and live pig husbandry satisfies almost 40% and 10% of local demands, respectively.	<ul style="list-style-type: none"> Examine the direct (e.g. extreme weather events) and indirect (e.g. costs and availability of livestock feed grains) impacts on local live poultry production and live pig husbandry. 	Prepare	<ul style="list-style-type: none"> AFCD Academia Local agricultural sector 	Short Term
FOD-R2	Examine the impacts on food supply chain and food hazards	Resilience of local food supply chain	Hong Kong's food supply is dependent on a sophisticated and complex chain and infrastructure, in particular energy in its various forms. The food system may be prone to interruptions in energy supplies used for agriculture, food processing and refrigeration, food transport and in food retailing. Also, food hazards, including those from biological, chemical and physical agents, will have impacts to the human health and food supply in Hong Kong.	<ul style="list-style-type: none"> Identify and examine the risks and challenges along the food supply chain, including those arising from: <ol style="list-style-type: none"> Just-in-time operations across the industry. Energy supply and reliability. Capability of switching ports / entry points in the event of disruptions. reduction of food supply and varieties due to food hazards. 	Prepare	To be identified	Short Term
FOD-R3	Research effects on vulnerable groups	Distributional impacts	Similar to the Human Health sector (<i>Option HEA-R3 – Research effects on vulnerable groups</i>), climate change and its impacts (eg food price rises) are likely to disproportionately affect the low-income population and other vulnerable households, and their ability to eat well.	<ul style="list-style-type: none"> Investigate the potential risks and challenges of food security facing the vulnerable population and households. This could be a collaborative effort with community-level organisations and/or other NGOs. 	Prepare	To be identified	Short Term
Monitoring							
FOD-M1	Monitor food prices	Household food security	Everyone should have the opportunity to access and afford a healthy diet. Some of the challenges in this area of Hong Kong's food security may include the effects of rising food prices on affordability, impacts of major shocks to food supply chains affecting the production, distribution and/or retailing of food.	<ul style="list-style-type: none"> Monitor movements in prices of major food stuff (eg rice), and factors that could lead to fluctuations in prices. 	Prepare	To be identified	Ongoing
At present, only the daily fresh food supply and							

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
FOD-Monitor M2	overseas agricultural impact studies	Impacts on Hong Kong's food trade partners	<p>wholesale prices of major fresh food are monitored by AFCD.</p> <p>In 2008, major sources of food and beverages imports were China (19.0%; for poultry and pork, prepared or preserved meat), Brazil (11.4%; for poultry and pork, dried / salted / smoked fish), United States (12.8%; for poultry and pork, mollusks, nuts), Thailand (5.7%; for rice) and Australia (5.0%; for crustaceans, molluscs, milk and cream) ⁽¹⁾.</p> <p>Climate change impact studies are available for some of the key food trade partners (as follows). These studies and others provide an indication on the vulnerability of agricultural production at these regions, which may have implications on the food exported to Hong Kong.</p> <ul style="list-style-type: none"> • China: e.g. the joint UK-China project on Impacts of Climate Change on Chinese Agriculture (ICCCA) • Brazil: yet to complete an impact study • US: e.g. US Climate Change Science Program ⁽²⁾, US Global Change Research Program ⁽³⁾ • Thailand: e.g. a study by Climate Institute, the Mekong Programme ⁽⁴⁾ (a Regional Cooperation Programme for the Sustainable Development of Water and Related Resources in the Mekong Basin owned by its member countries) 	<ul style="list-style-type: none"> • Monitor climate change agricultural impact studies for Hong Kong's key food importers (such as their production capability in future climate) for new and updated data and information as they become available. 	Prepare	To be identified	Ongoing

(1) Market Profile of Hong Kong's food and beverage industry by the New Zealand Trade and Enterprise (<http://www.nzte.govt.nz/explore-export-markets/market-research-by-industry/Food-and-beverage/Documents/Market-Profile-Hong-Kong-Food-and-Beverage-April-2009.pdf>)

(2) Synthesis and Assessment Product 4.3 (SAP 4.3): The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States (http://www.usda.gov/oce/global_change/sap_2007_FinalReport.htm)

(3) Global Climate Change Impacts in the United States (<http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts>)

(4) Climate Change in Thailand: Impacts and Adaptation Strategies (<http://www.climate.org/topics/international-action/thailand.htm>)

(5) Australia's Agriculture - Impacts of Climate Change (<http://www.climatechange.gov.au/impacts/agriculture.html#research>)

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
				<ul style="list-style-type: none"> Australia: e.g. Australia's Farming Future ⁽⁵⁾ 			
Institutional Strengthening & Capacity Building							
FOD- I1	Allocate responsibility for security of food supply	Security of food supply	At present, a number of bodies are responsible for different issues related to food supply, security and safety; there is no one single agency responsible for food security in Hong Kong.	<ul style="list-style-type: none"> Allocate the responsibility for security of food supply to an agency, such as the Food Control Committee. 	Prevent Prepare Respond Recover	To be identified	Short Term
FOD- I2	Develop food security indicators	Food supply, security and safety	<p>Food security has many dimensions and may be assessed in relation to six themes: availability, access, affordability, nutrition, quality, safety and resilience.</p> <p>Vulnerable groups (e.g. the poor) in Hong Kong could be most affected by climate change impacts.</p> <p>Due to the complex and cross-cutting nature of Hong Kong's food supply chain, themes / indicators could be developed (similar to the UK example) to provide insights into the range of issues underlying our food security and how they fit together. These also allow the short, medium and long term risks and challenges, and "what-if" scenarios to be examined. These themes and indicators should be kept under regular review, and should be revised or developed as necessary.</p>	<ul style="list-style-type: none"> Similar to the recent <i>UK Food Security Assessment</i> (2009) ⁽¹⁾, develop indicators in the Hong Kong context for the following themes: <ul style="list-style-type: none"> (i) Hong Kong availability and access (ii) Hong Kong food chain resilience (iii) Household food security (iv) Safety and confidence Monitor overseas findings (e.g. the UK Food Security Assessment (2009)) on food security in relation to: <ul style="list-style-type: none"> (i) Global availability (ii) Global resource sustainability 	Prepare	To be identified	Ongoing
FOD- I3	Encourage / increase domestic agricultural production	Impacts on food imports	<p>Hong Kong is not self-sufficient in food and relies heavily on imports. Climate change impacts on Hong Kong's key food trade partners may have knock-on implications on commodity prices and their ability to export food to Hong Kong. For instance, Hong Kong was shown to be sensitive to the rice crisis in April 2008, which occurred as a result of an influx in prices and export restrictions.</p> <p>There is a need for Hong Kong to reduce its exposure to</p>	<ul style="list-style-type: none"> Encourage / increase domestic agricultural production to reduce reliance on food imports: <ul style="list-style-type: none"> - There are, however, voluntary surrender schemes for poultry farmers and pig farming licences due to public health concerns. How to achieve the balance of these may deserve further investigation. - In addition to AFCD's current agricultural policies, alternative crops may be identified. The local food production can't support the whole 	Prevent	To be identified	Medium / Long Term

(1) Defra, UK food security assessment (<http://www.defra.gov.uk/foodfarm/food/security/assessment.htm>)

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
			the vulnerabilities associated with food imports.	population of Hong Kong and therefore Hong Kong may not be able to reduce overall reliance on food imports from various jurisdictions including Mainland China. However, the impact of any food supply disruptions (including price fluctuations) could be mitigated to some extent by encouraging/ increasing domestic agricultural production. Given the share of Hong Kong's food imported from Mainland China, coordination with and support from the CPG is likely to be required in the event of significant disruptions to the food supply.			
Disaster Management & Emergency Planning							
FOD- E1	Food supply contingency planning	Food supply shortage	<p>Under the <i>HKSAR Emergency Response System</i>, SWD is responsible for providing essential relief items, including food, to the victims following an emergency or disaster. According to the <i>Daya Bay Contingency Plan</i>, the Food Control Committee is triggered by an emergency situation. This measure, however, is currently restricted to the safety of foodstuff in relation to a nuclear incident. The <i>East Asia Emergency Rice Reserve (EAERR)</i> programme, which serves as food aid, may provide some buffer and strengthen food security in encountering food shortage due to temporary natural disaster or man made calamity. These responsive actions are taken in response to an incident.</p> <p>Our openness to trade should, theoretically, make Hong Kong resilient in terms of disruptions from one or a few sources of supply. However, a contingency plan is currently lacking to deal with any disruptions along the food supply chain that could impact on the local food security.</p>	<ul style="list-style-type: none"> • Develop an emergency response management plan to deal with unforeseen food shortages resulted from unexpected breakdowns in domestic or international sources of supply or other emergency situations that could affect Hong Kong's food supply and security: <ul style="list-style-type: none"> (i) Set up an emergency structure to handle the situation, which could include: assess the impact of disruption to the local food supply, provide strategic leadership over preparation of the proposed emergency response management plan, coordinate response, as well as to keep close contact with the industry. (ii) Identify the roles of relevant government units and personnel, and other stakeholders in the food chain business. (iii) Examine how food retailers could switch sources of supply rapidly in case of disruption. The associated communication, transport and energy networks could be incorporated. (iv) Identify critical thresholds for food supplies / reserves for essential food items (e.g. rice) for activating the plan. 	To be identified		Short Term

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
				(v) Assess the plan against future climate scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>) and “what-if” scenarios (e.g. if rice exports from Thailand dropped to a significantly low level).			
Education & Public Awareness							
BUS- P2	Encourage business continuity planning	Business / operation disruptions	Although the food chain has generally proved to be remarkably robust, business continuity planning is becoming more important and to help individual business and organisation recover and restore from interruptions.	<ul style="list-style-type: none"> • Work with key food chain businesses to ensure sufficient continuity planning occurs in respect of climate risks, particularly in light of the risks arising from just-in-time operations across the industry. • Actively promote Business Continuity Management (BCM) (<i>Option BUS-E1</i>) to stakeholders in the Food Resources sector. 	Prepare	To be identified	Short Term

Table 6.7 Climate Change Adaptation Options for Human Health

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
HEA- R1	Research effects on vulnerable groups	Distributional impacts	Climate change is having, and will have, strongly differential effects on people within Hong Kong and between regions, on this generation and future generations. The impacts of climate change are likely to disproportionately affect the poor, sick, poorly housed and other vulnerable groups such as the elderly whose own adaptive capacity may be limited. For example, Hong Kong's heavy reliance on mechanical cooling (and heating) may raise some equity issues on certain demographics and socio-economic groups as they may not have access to or cannot afford air-conditioning. These issues may be exacerbated by the aging population in the territory.	<ul style="list-style-type: none"> Investigate the potential impacts and challenges facing the vulnerable groups, in collaboration with the medical community and organisations that provide primary health care, support and social welfare. 	Prepare	<ul style="list-style-type: none"> Academics DH FHB HA Health practitioners HKO SWD 	Ongoing
Monitoring							
HEA- M1	Observe the effects of extreme temperatures	Health concerns associated with extreme temperatures	The excessive mortality and morbidity related to extreme weather conditions are not specifically monitored. Filling this gap may be needed.	<ul style="list-style-type: none"> Set up monitoring programmes to observe the health implications of extreme temperatures on the local population and the associated distributional impacts in collaboration with Hong Kong Observatory, Department of Health, and Hospital Authority. 	Prepare	<ul style="list-style-type: none"> DH FHB HA Health practitioners HKO SWD 	Short Term
Institutional Strengthening & Capacity Building							
HEA- I1	Communicate information on extreme temperatures to health practitioners and the public	Extreme temperatures	Heat stroke has attracted much attention in Hong Kong especially in recent years. While the awareness of heat stress / heat stroke has generally increased, hot weather may also induce other illnesses such as cardio-respiratory diseases. In addition to heat stroke / heat stress, these illnesses could have resource implications on health and	<ul style="list-style-type: none"> When an extended period of hot spell is expected, alert the emergency departments and other medical staff or health practitioners for potential increased levels of patients and/or hospital admissions (including those for hot weather related illnesses). As a preventive measure, Enhanced Risk Communication for Prevention of Heatstroke has 	Prepare	<ul style="list-style-type: none"> DH HA FSD Health practitioners 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
HEA-I2	Periodically review emergency relief services – temporary accommodation	Extreme temperatures	<p>medical services.</p> <ul style="list-style-type: none"> • More shelters may be needed to cater for the potential increase in demand associated with future climate variability or the changing demographics. • Elderly and people with disabilities may find temporary shelters that are located within walking distance from their homes more welcoming, and hence the service could be utilised. 	<p>been established between HK Observatory and DH</p> <ul style="list-style-type: none"> • Based on <i>Option R1 (Produce and Update Climate Change Scenarios)</i>, periodically review the adequacy and effectiveness of temporary cold and night heat shelters, such as their geographic location and distribution, their provision and opening hours etc. 	Respond	<ul style="list-style-type: none"> • HAD 	Medium / Long Term
HEA-I3	Periodically review welfare policies	Distributional impacts	<p>An effective, well-funded adaptation safety net may be needed for the segment of the population least capable of coping with climate change impacts (e.g. the elderly, poor and sick); a common but differentiated mitigation strategy may be needed to protect the most vulnerable.</p>	<ul style="list-style-type: none"> • Reviews should consider whether additional measures are needed when considered against future climate scenarios (<i>Option R1- Produce and Update Climate Change Scenarios</i>). 	Prevent	<ul style="list-style-type: none"> • SWD 	Medium / Long Term
HEA-I4	Review existing surveillance systems for detecting non-endemic diseases	New / non-endemic diseases, in particular vector-borne diseases	<p>Global aviation, in particular, has facilitated the spread of diseases worldwide. The existing measures by the Port Health Office, CHP and others, may not eliminate the risk of new or non-endemic diseases from being introduced into, and possibly become established in, Hong Kong (e.g. incubation period of some diseases imply that they may not be picked up at port control points). A well-known example is the West Nile Virus: this flavivirus (commonly found in Africa, West Asia, and the Middle East) was first found in the US in 1999 but is now permanently established in the Western Hemisphere.</p> <p>Vector-borne diseases may deserve particular attention under a changing climate.</p>	<ul style="list-style-type: none"> • Review existing vector surveillance and control measures (such as those for Dengue fever). 	Prepare	<ul style="list-style-type: none"> • DH • FEHD • HA • Health practitioners • Medical community 	Ongoing
HEA-I5	List changing disease patterns and impacts on vulnerable population	<ul style="list-style-type: none"> • Vector-borne diseases • Non-endemic diseases 	<p>No local research was identified on the effects of climate change on the changing patterns of endemic and non-endemic diseases, as well as other illnesses such as chronic or cardio-respiratory diseases. For infectious diseases, the Scientific Committees of the</p>	<ul style="list-style-type: none"> • List the changing disease patterns (including non-endemic diseases that could pose a threat to Hong Kong) and health distributional impacts associated with climate change, as research priorities under the <i>Health and Health Services Research Fund (HHSRF)</i> and 	Prepare	<ul style="list-style-type: none"> • Academic/Medical community 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
	associated with climate change as research priorities and provide funding		Centre of Health Protection (CHP) currently focus on major communicable diseases and research on their patterns of change. The <i>Research Fund for the Control of Infectious Diseases (RFCID)</i> aims to encourage, facilitate and support research on the prevention, treatment and control of infectious diseases, in particular, emerging infectious diseases such as SARS. This or another fund could be extended to cover the implications of climate change on these and other diseases.	the <i>RFCID</i> , or as special consultancy studies by academics and professionals in environmental health. • More local research on impact of climate change on infectious diseases should be encouraged.			
Disaster Management & Emergency Planning							
HEA-E1	Periodically review warning, alert / monitoring systems	Accidents and emergency situations	Weather extremes (e.g. heavy rains, floods, and hurricanes) have severe impacts on human health. Hong Kong is familiar with extreme weather events such as tropical cyclones, and has some of the best disaster preparedness systems of any world city.	• Based on <i>Option R1 (Produce and Update Climate Change Scenarios)</i> , regularly evaluate the effectiveness of warning and monitoring systems based upon actual climate events.	Prepare	• DSD • HKO • GEO	Ongoing
HEA-E2	Periodically review emergency services / contingency plans	Accidents and emergency situations	Nevertheless, wealthy and well-prepared nations could still be highly vulnerable to more extreme weather events, as demonstrated in the European heatwave (2003), Hurricane Katrina (2005) and UK floods (2007) examples. It is therefore important that our familiarity with extreme weather and extant adaptive capacity do not induce complacency, particularly under future climate scenarios.	• Re-examine the goals and strategies of emergency preparedness, response and recovery (including the Hong Kong Contingency Plan for Natural Disasters) as the climate changes. • Examine the implications of extreme weather scenarios (<i>Option R1e – Reasonable Worst Case Scenarios</i>) on resources, such as emergency response staff, ambulances, helicopters, equipments, public weather shelters, as well as post-disaster actions.	Prepare	• FSD • HA • HAD • HKPF • SB	Ongoing
HEA-E3	Plan and prepare for reasonable worst case situations	Accidents and emergency situations		• Incorporate reasonable worst case scenarios (<i>Option R1e – Reasonable Worst Case Scenarios</i>) that account for future climate into the contingency plans and other emergency management planning process.	Prepare	• HKO • SB	Ongoing
Education & Public Awareness							
HEA-Educate		New / non-	Local medical community and healthcare	• Provide additional education and/or training on	Prepare	• Academic/	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
P1	medical community on related diseases	endemic diseases, in particular vector-borne diseases	professionals may not be familiar with non-endemic diseases and may therefore lead to a delayed response in disease control.	non-endemic diseases to the general medical community and healthcare professionals to help them identify any potential cases or outbreaks of non-endemic diseases, which in turn, would enable an effective response.		Medical community	

Table 6.8 Climate Change Adaptation Options for Water Resources

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
Research & Investigation							
WAT-R1	Assess impacts along the water supply chain	Impacts along the water supply chain	<p>The WSD has been implementing a Total Water Management (TWM) strategy since 2008. It aims to manage the demand and supply in an integrated, multi-sectoral and sustainable manner. It is also aimed to better prepare Hong Kong for uncertainties such as acute climate changes and low rainfall and to enhance Hong Kong's role as a good partner to other municipalities in the Pearl River Delta in promoting sustainable use of water in the light of rapid growth of water demand in the region.</p> <p>Since a majority of Hong Kong's raw water supply is imported from Dongjiang, information on water resources for the Dongjiang basin would be useful in assessing the vulnerability of the imported water resources from Guangdong.</p> <p>Some studies, such as Guo (1995)⁽¹²²⁾, Ying (2000)⁽¹²³⁾ and Jiang <i>et al.</i> (2007)⁽¹²⁴⁾, have examined the hydrological impacts of climate change and the associated implications on water resource systems for the Dongjiang Basin. However, substantial uncertainties are inherent in the rainfall projections and the sign of change can be unclear, which would have significant implications on water resources.</p>	<p>Building on the existing climate change impact studies on regional water resources, a continuation and expansion of the TWM to address the vulnerabilities and to assess the relative significance of the risks of the various elements along Hong Kong's water supplies chain. This may include:</p> <p>(1) The effects of the potential changes in rainfall amount and patterns on:</p> <ul style="list-style-type: none"> • Dongjiang river flows • Dongjiang water quality <p>(2) The effects of climate change (eg warmer temperatures, drier conditions, more frequent / intense extreme weather events etc) on:</p> <ul style="list-style-type: none"> • Resilience of assets and infrastructure both within Hong Kong and the Mainland • Water demand / supply under the anticipated socio-economic changes in parts of the Guangdong province which rely on the supplies from Dongjiang <p>(3) Stress-test the water supply agreement with Dongjiang and the associated implications for Hong Kong. "What-if" scenarios, including a reasonable worst case scenario, could be used to assess the effects on the water supply available to Hong Kong.</p>	Prepare	<ul style="list-style-type: none"> • WSD • In collaboration with Dongjiang water authorities and supported by the HKO, Guangdong Meteorological Bureau (GMB) and academia 	Ongoing
Institutional Strengthening & Capacity Building							
WAT-I1	Periodically review Total Water Management (TWM) Strategy	Changes in water supply and demand	<p>Water demand and supply in Hong Kong are managed through the Total Water Management (TWM) Strategy. The measures and initiatives in the current TWM Strategy may be inadequate to deal with future climate.</p>	<ul style="list-style-type: none"> • Review the current TWM Strategy regularly, say every 5 years, to: <ul style="list-style-type: none"> - Incorporate the latest available science based on <i>Option R1- Produce and Update Climate Change Scenarios</i>. - Examine the effectiveness of the measures on both the demand and supply side management. 	Prevent, Prepare	<ul style="list-style-type: none"> • WSD 	Ongoing

Code	Option	Vulnerability / Hazard Addressed	Rationale	Framework	Type of Instrument	Possible Responsible Parties	Timescale
				<ul style="list-style-type: none"> - Enhance existing adaptation options as necessary, e.g. mandate the “Water Efficiency Labelling Scheme” (WELS) based on feedback from relevant stakeholders. - Explore and adopt new adaptation options as necessary, e.g. provide rebates for installing rainwater collection tanks for schools, commercial and industrial customers etc; tax incentives for water technologies. 			
Disaster Management & Emergency Planning							
WAT-E1	Contingency planning for droughts	Water supply shortage	Despite the water supply agreement with the Guangdong authorities, it is possible that contractual obligations cannot physically be met, for instance during periods of low rainfall or water stress in Dongjiang. Hong Kong needs to be prepared for such a situation.	<ul style="list-style-type: none"> • Review drought contingency plans as desirable from time to time– 	Prepare	<ul style="list-style-type: none"> • DevB • HKO • WSD 	Ongoing

6.3 *CROSS-SECTORAL CLIMATE CHANGE ADAPTATION OPTIONS: RESEARCH ACTIVITIES*

This section highlights some general climate change research activities that would help to improve our understanding in the potential impacts associated with climate change in the local context, and thus facilitate adaptation actions across the different sectors.

6.3.1 *Option R1 – Produce Climate Change Scenarios*

Projections of future climate presented in the IPCC Assessment Reports are of global (ie global averages) or continental scale in nature. However, climate change will not be uniform across the globe; rather it will occur at different rates and magnitudes at different locations. Local climate change scenarios (ie projections for Hong Kong) are therefore necessary. A single set of scenarios of future climate that contain the same assumptions about the future state of the economy would allow the results for different assessments and analysis (e.g. for the various sector components) to be comparable and compatible ⁽¹²⁵⁾.

The Hong Kong Observatory has a comprehensive database for a range of meteorological, atmospheric and oceanographic variables, some since record began in 1885. The Observatory and various local research institutes have conducted research on a number of climate change related topics. It would seem sensible for the Observatory to lead and coordinate strategic research programmes on climate change to enhance our understanding on the local future climate and to fill data and information gaps.

The Observatory could hold primary responsibility for investigating the priority research areas (as presented below in *Section 6.3.2*) to produce the necessary scenarios, although local, regional or international collaboration may be necessary. While the Observatory is concerned with pure (and some applied) research into natural and anthropogenic climate change and the production of climate change scenarios, it may be in a good position to create a platform for centralising the existing efforts and knowledge in climate change research to produce the necessary scenarios for government planning.

It is also important to develop a mechanism to effectively communicate any scientific findings to decision makers and resource planners. For example, it is vital that users of climate change scenarios (e.g. decision makers and planners, both technical and non-technical staff) are aware of their limitations and sources of uncertainties.

All these could have resource implications on the existing institution. Although the Observatory may conduct some research in collaboration with local research institutes, the establishment of a “climate change team” may be necessary to develop and coordinate strategic research programmes on climate change for Hong Kong. Further, additional resource, including financial and staff with the relevant technical expertise, is likely to be required.

Based upon the IPCC AR4 projections, the Hong Kong Observatory has produced updated local temperature and rainfall scenarios for the 21st century; studies on extreme temperature and rainfall projections that use higher temporal resolution model data (daily) are forthcoming. Despite these, a more complete set of climate change scenarios for Hong Kong is desirable. Given the uncertainties in climate projections, a range of climate change scenarios would enable decision makers and resource planners to make informed judgements about the potential impacts of climate change. They could also explore the effects and implications of different planning decisions under a range of plausible futures in Hong Kong.

While some research needs are unique to certain sector, this section highlights some generic areas where high uncertainties and/or low confidence are inherent in their projections, and further research and investigation in these areas are considered beneficial in climate change adaptation based on our current knowledge and understanding, and they should not be considered exhaustive.

Option R1a – Sea Level Rise Scenarios

A significant proportion of Hong Kong's development concentrates in low lying coastal zones and on reclaimed land, in particular on either side of Victoria Harbour. This implies that many buildings and infrastructure are at risk of coastal flooding. Hong Kong is ranked in the 9th place in terms of assets exposed to coastal flooding in the 2070s, with exposed assets estimated at US\$1,164 billion (over HK\$9,000 billion) ⁽¹²⁶⁾.

Buildings and infrastructure tend to have long asset life and investment decisions made at present day could have implications for many decades. However, the rate and magnitude of change in future sea levels remain one of the major sources of uncertainties at the international level. To facilitate sufficient and timely adaptive response, scientific developments across the globe in sea level change research should continue be monitored. Sea level rise during this century is projected to have substantial geographical variability. Therefore, where sufficient information is available, the implications of the global projections on the regional perspective (e.g. changes in ocean currents) could be examined. This may require considerable efforts and collaboration from the research community and significant technological advancement. As our understanding in climate change impacts on sea level changes improves, localized and location-specific effects such as storm surges could be investigated. These may need to be a collaborative effort with regional and/or international scientists.

In addition to eustatic changes (ie changes in global sea level independent of local factors), local mean sea level may also be influenced by vertical land movements associated with isostatic adjustment. Measurement of the vertical ground movement at tide gauge stations which started in 2004 will support long term sea level change studies in future. The effects of vertical

ground movement on the sea level change could be examined for Hong Kong, and this would contribute to our understanding in sea level changes determined based on tide gauge data. Its effects on the wider region of Southern China could also be investigated as a collaborative effort to enhance our understanding in regional sea levels.

Option R1b – Seasonal Climate Change Scenarios

The local temperature and rainfall projections produced by HKO provide little information on the seasonal climate change. Compared to the human system, the seasonal behaviours of many species and ecological communities such as breeding, flowering, emergence and migration are linked to either climatic conditions or food availability, seed dispersers and pollinators, and are therefore very sensitive to seasonal changes in climate. Information on changes in seasonality may also be useful for energy resource planners in reviewing energy demand patterns.

Changes in seasonality, for temperature and rainfall in particular, would be useful in assessing the impacts and vulnerabilities on ecology and biodiversity. This information could also supplement the existing temperature and rainfall projections for Hong Kong.

Option R1c – Changes in Marine Environment Scenarios

Relatively little is known about climate change impacts on the marine environment, such as sea surface temperatures, ocean acidity, dissolved oxygen and ocean currents especially on the regional or local scale. This enhances the difficulties and challenges in impact and vulnerability assessments for Hong Kong's marine ecosystems and biodiversity. Further, changes in the marine environment may also have an influence on the goods and services it provides, e.g. impacts on local and regional aquaculture and fishing activities.

Specific overseas research programmes that aim to understand the effects of climate change on the marine environment and marine ecosystems are important sources of knowledge that could be transferred to Hong Kong. These should be monitored for updates and new developments as they become available. Where necessary, local monitoring and research could be carried out at certain sites such as those of ecological significance such as marine parks and reserves (e.g. Hoi Ha Wan, Sha Chau and Lung Kwu Chau Marine Park) to supplement the knowledge gained from international experience. These information would assist in the formulation of effective policies and measures in marine nature conservation and protection.

Option R1d – Extreme Weather Events

Weather extremes such as tropical cyclone have the potential to cause significant damage. The scientific community has yet to produce conclusive findings on the connections between tropical cyclones and climate change.

While more intense tropical cyclones may result in a warmer climate, changes in tracks or areas of impact remain unknown.

Continual monitoring on the scientific developments in climate change and tropical cyclones research is necessary. When sufficient information is available, international findings could be incorporated into local climate change projections.

Hong Kong's weather is also influenced by the Asian summer monsoon, which is in itself related to the El Niño Southern Oscillation (ENSO). As consistency is still lacking in model projected discernible changes in ENSO amplitude or frequency, international findings on this area should be monitored for updates and new development.

Option R1e – Reasonable Worst Case Scenarios

Despite the uncertainties in climate change projections, reasonable worst case scenarios for Hong Kong could allow planners and decision-makers to ask “what-if” questions, consider their impacts on climate-sensitive natural and human systems, plan for reasonable worst case situations and examine their implications on resources etc.

For instance, storms with intensities equivalent to Category 4 or 5 are historically uncommon in Hong Kong. Hence, tropical cyclones with these intensities may be included as a reasonable worst case scenario. Sea level rise may also be included as a variable.

Option R1f – Probabilistic Projections

Planners and decision-makers need as much information as possible on how climate will evolve in order to adapt effectively. As uncertainties (namely modelling uncertainty, and that due to natural variability and in future emissions) continue to remain in climate change projections, the move away from single projections and towards probabilistic ones has become increasingly desirable. The probabilities attached to different levels of future climate change represent the relative degree to which each climate outcome is supported by the evidence currently available, taking into account the latest understanding of climate science and observations, and using expert judgement.

Probabilistic projections for the UK Climate Projections (UKCP09) reflect major known uncertainties in relevant climate system processes. A comprehensive review of the methodology used to convert the ensembles of climate model simulations into probabilistic estimates of future climate is provided in UKCP09.

Hong Kong could consider developing probabilistic scenarios based on the UKCP09, as these would provide better science for climate change impacts and vulnerability assessment, and in turn, the development of effective

adaptive response. This could be a collaborative effort for the region that may also involve inputs from overseas experts.

6.3.3 *Option R2 – Undertake Further Sectoral Research on Impacts and Vulnerabilities*

To increase the adaptive capacity of communities, infrastructure, and economic activities, important vulnerabilities and priorities need to be identified and established through detailed regional or even local assessments⁽¹²⁷⁾. It should be stressed that the climate change impacts and vulnerability assessment in this Study serves as a preliminary assessment for Hong Kong that aims to provide an indication of the key vulnerabilities and where more immediate actions are warranted. More detailed semi-quantitative and quantitative risk-based assessments are therefore needed for some sectors or areas to identify the influence, the specific receptors at risk, the pathways linking climate hazard to receptors, help identify or refine and appraise climate adaptation and climate change risk management options.

While this study has made a start at identifying vulnerabilities in Hong Kong, considerable amounts of additional data and information are needed prior to the formulation of effective climate change adaptation measures and policies. More information on the potential climate change impacts would highlight specific areas for adaptation, which often involves a better understanding of the baseline conditions in Hong Kong. Although some research activities may be designed to have a distinct sectoral and local focus, some studies may require coordination between different sectors and actors, for example in information and knowledge sharing.

Specific areas of research required are highlighted in the sectoral tables in *Section 6.2* above.

6.3.4 *Option R3 – Establish Fund for Adaptation Research*

A sound research base is needed for decision-makers and planners in all areas and in both the public and private sector to understand the risks / opportunities arising from climate change, and potential adaptation options. A research budget would be needed to support research and monitoring activities that aim to improve our understanding of the climate system, impacts of climate change on society and adaptive responses. Funding schemes would also be needed to facilitate the implementation of climate change adaptation measures.

6.4 *CROSS-SECTORAL CLIMATE CHANGE ADAPTATION OPTIONS: EDUCATION AND PUBLIC AWARENESS*

This section presents options for education and raising the level of public awareness and understanding of climate change issues across all sectors.

6.4.1 *Option P1 – Raise Public Awareness*

Public awareness and understanding are paramount in the discussion about how to adapt to climate change. There is a relatively low level of understanding of vulnerabilities and adaptation options amongst the general population of Hong Kong. Communication of climate change, in particular, the causes and potential impacts on ecosystems, promotion of water conservation, climate variability and concepts such as risk and uncertainty, along with the need for adaptation activities could be implemented. Appropriate policy responses and management goals are more likely to be widely supported when there is informed public discussion of the potential impacts of climate change.

6.5 *CO-ORDINATION AND REVIEW*

6.5.1 *Option A1 – Periodically Review Institutional Arrangements*

Since climate change is multi-disciplinary by nature; the formulation and implementation of adaptation measures would be more efficient and effective through cross-sectoral and international efforts from the private sector as well as those from the Government. To ensure that institutional arrangements and Government departments are coordinating climate change response and adaptation efforts, institutional arrangements need to be periodically reviewed and aligned as necessary to ensure co-ordination between different departments and that the Government is making decisions that is informed by the latest science.

6.6 *DECISION-MAKING IN THE FACE OF UNCERTAINTY*

Adaptation planning should incorporate a range of different approaches as each of them would have its own strengths and weaknesses and there is no single “preferred” methodology. When adaptation strategies are being developed, a procedure for periodic review and assessment of progress should be created; adaptation planners should be prepared to make “course corrections” when updated and new information on climate change and methodology becomes available.

Many decisions in business (such as investment decisions) and politics are regularly made in the face of uncertainty. In spite of the uncertainties associated with the projected future climate and the potential climate risks, “uncertainty” should not be used as an excuse for not taking appropriate action. While overinvestment in adaptation may be worse from a welfare perspective than underinvestment, overinvestment has been considered to be *far preferable* to inaction⁽¹²⁸⁾. For this reason, uncertainty about the exact optimal amount of adaptation should not prevent investment in adaptation, although caution is needed.

A flexible or adaptive management that involve implementing the required adaptation measure(s) in a phased manner could be an effective solution

when both the risks associated with inaction and the uncertainty and the risk associated with introducing mal-adaptive measures are high. This approach involves introducing incremental adaptation options in a timed or sequential manner, based on the evaluation of risks, costs, feasibility and contribution to desired outcomes. It addresses the obvious risks now, but also allows for incremental or directional change in future, as vulnerability, knowledge, experience and technology evolve.

Continual review of the performance of introduced measures is needed for identifying the need for, and nature of, next steps. A decision to “delay” introducing adaptation measure(s) may be necessary where the risk of mal-adaptation (i.e. under or over-adapting) is particularly high, when the climate risks are below defined thresholds or when the required adaptive capacity (e.g. regulatory or institutional circumstances) is insufficient to support taking the specified measure. Delaying is only effective when there is continual adaptive capacity building, and also time monitoring and evaluating evolving risks and adaptation options.

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Annex A

Potential Climate Change Consequences in Hong Kong by Sector

Please note the following potential consequences should not be considered exhaustive or definitive. The consequences projected are *possible* outcomes as a result of climate change and assume no adaptation measures other than those currently in place. The consequences identified are essentially putative; whilst they are based on the current scientific understanding of climate change, the academic evidence base for climate change impacts contains considerable uncertainties and is rapidly evolving.

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<i>A1</i>	<i>POTENTIAL FUTURE CONSEQUENCES OF CLIMATE CHANGE IN HONG KONG IDENTIFIED THROUGH A REVIEW OF INTERNATIONAL AND LOCAL LITERATURE</i>	<i>1</i>
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A1 POTENTIAL FUTURE CONSEQUENCES OF CLIMATE CHANGE IN HONG KONG IDENTIFIED THROUGH A REVIEW OF INTERNATIONAL AND LOCAL LITERATURE

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
Agriculture						
<i>Poultry Production</i>						
<ul style="list-style-type: none"> • Exceedence of thermal tolerance of poultry species. • Changes in poultry pest and disease regime, leading to increased mortality in flocks, rising veterinary costs and possible health impacts to consumers and farm workers. • Increased proliferation of bacteria and microorganisms leading to greater risk of conditions such as salmonella poisoning. Risk of public health incident and transmission to humans and reputational damage for the industry. Products will have a shorter shelf life. Higher refrigeration costs are likely for processing plants and abattoirs. 	<ul style="list-style-type: none"> • Changes in poultry pest and disease regime, leading to increased mortality in flocks, rising veterinary costs and possible health impacts to consumers and farm workers. • Risk of flooding, power cuts, asset damage and business interruption. 	<ul style="list-style-type: none"> • Risks to feedstock and water supplies from the mainland and overseas – reducing availability and increasing costs. Reduced availability of water locally. Increased costs likely for purchasing additional water. 	<ul style="list-style-type: none"> • Rising costs of grain and other feed due to climate change impacts overseas. • Risk to assets, infrastructure, energy supplies, livestock and farm workers and business interruption. 	<ul style="list-style-type: none"> • Significant potential for influx of climate change refugees from neighbouring flooded regions increasing demand and raising prices. Also risk of contamination to water supplies which could impact production. Risk of loss of coastal and low lying farms. 	<ul style="list-style-type: none"> • Depletion of marine mollusc populations globally due to increasing acidity will increase costs of oyster shell and cockle grit – vital components of chicken feed. 	
<i>Pig Husbandry</i>						
<ul style="list-style-type: none"> • Exceedence of thermal tolerance of pig breeds. • Changes in pig pest and disease regime, leading to increased mortality in herds, rising veterinary costs and possible health impacts to consumers and farm workers. • Increased proliferation of bacteria and microorganisms leading to greater risk of food poisoning agents. 	<ul style="list-style-type: none"> • Changes in pig pest and disease regime, leading to increased mortality in herds, rising veterinary costs and possible health impacts to consumers and farm workers. • Risk of flooding, 	<ul style="list-style-type: none"> • Risks to feedstock and water supplies from the mainland and overseas – reducing availability and increasing costs. Reduced availability of water locally. Increased costs likely for purchasing 	<ul style="list-style-type: none"> • Rising costs of grain, silage and other feed due to climate change impacts overseas. • Risk to assets, infrastructure, energy supplies, livestock and farm workers and 	<ul style="list-style-type: none"> • Significant potential for influx of climate change refugees from neighbouring flooded regions increasing demand and raising prices. Also risk of contamination to water supplies 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<ul style="list-style-type: none"> Risk of public health incident and transmission to humans and reputational damage for the industry. Products will have a shorter shelf life. Higher refrigeration costs are likely for processing plants and abattoirs. 	<p>power cuts, asset damage and business interruption.</p>	<p>additional water.</p>	<p>business interruption.</p>	<p>which could impact production. Risk of loss of coastal and low lying farms.</p>		
<i>Dairy Farming and Cattle Husbandry</i>						
<ul style="list-style-type: none"> Exceedence of thermal tolerance of dairy and beef cattle species. Changes in bovine pest and disease regime, leading to increased mortality in herds, rising veterinary costs and possible health impacts to consumers and farm workers. Increased proliferation of bacteria and microorganisms leading to greater risk of conditions such as salmonella poisoning in dairy products. Risk of public health incident and transmission to humans and reputational damage for the industry. Temperature changes are also likely to affect consumer demand for dairy products i.e. increased demand for ice cream. Products will have a shorter shelf life. Higher refrigeration costs are likely for dairies. 	<ul style="list-style-type: none"> Changes in bovine pest and disease regime, leading to increased mortality in herds, rising veterinary costs and possible health impacts to consumers and farm workers. Risk of flooding, power cuts, asset damage and business interruption. 	<ul style="list-style-type: none"> Risks to feedstock and water supplies from the mainland and overseas – reducing availability and increasing costs. Reduced availability of water locally. Increased costs likely for purchasing additional water. 	<ul style="list-style-type: none"> Rising costs of grain, silage and other feed due to climate change impacts overseas. Risk to assets, infrastructure, energy supplies, livestock and farm workers and business interruption. 	<ul style="list-style-type: none"> Significant potential for influx of climate change refugees from neighbouring flooded regions increasing demand and raising prices. Also risk of contamination to water supplies which could impact production. Risk of loss of coastal and low lying farms. 		
<i>Fruit, Flower and Vegetable Production</i>						
<ul style="list-style-type: none"> Temperature changes are also likely to affect consumer demand with increasing demand for salad vegetables. Products will have a shorter shelf life. Higher refrigeration 	<ul style="list-style-type: none"> Changes in plant pest and disease regime, leading to decreased yield and increased costs i.e. 	<ul style="list-style-type: none"> Reduced availability of water locally. Increased costs likely for purchasing additional water. 	<ul style="list-style-type: none"> Risk to assets, infrastructure, energy supplies, loss of crops, risks to farmer workers and 	<ul style="list-style-type: none"> Significant potential for influx of climate change refugees from neighbouring flooded regions 		<ul style="list-style-type: none"> Increase in atmospheric CO₂ concentrations - Providing sufficient water

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<p>costs are likely for processing plants and wholesalers.</p> <ul style="list-style-type: none"> • Change in distribution of pollinator species, may lead to pollination problems for crops that require external pollinators, ie most fruits. • Exceedence of thermal tolerance of cultivar species, may lead to greater use of greenhouses with climate control increasing costs for growers. Also the risk that as cultivars with tolerance of higher temperatures are likely to be selected, extreme cold snap events could devastate yields and blossom formation of fruit trees. • Changes in plant pest and disease regime, leading to decreased yield and increased costs i.e. pesticides, and their potential impacts on workers and local water courses. 	<p>pesticides, and their potential impacts on workers and local water courses.</p> <ul style="list-style-type: none"> • Risk of flooding, power cuts, asset damage, loss of crop and business interruption. 	<p>Reduction in soil moisture levels and production as a result.</p>	<p>business interruption.</p>	<p>increasing demand and raising prices. Also risk of contamination to water supplies which could impact production. Risk of loss of coastal and low lying farms.</p>		<p>supplies and soil moisture is available, this could lead to an increase in yield of some crops.</p> <ul style="list-style-type: none"> • Decrease in global solar radiation levels - This may negatively impact the yield of some crops which require high levels of solar irradiance.
Aquaculture and Fisheries						
<i>Marine Capture Fishery</i>						
<ul style="list-style-type: none"> • Warmer sea surface temperatures may result – May have an influence in marine productivity; changes in marine species distribution / occurrence. Increased potential for hypoxia events. 	<ul style="list-style-type: none"> • Increased potential for hypoxia events. • Possible decreases in salinity and the associated implications for the fisheries sector. 		<ul style="list-style-type: none"> • Storm interference with fishing operations. 		<ul style="list-style-type: none"> • Implications for fish reproduction and stock replenishment as fish eggs are more sensitive to pH change than juveniles and adults. • Depletion of fish stocks due to loss of food chain (i.e. calcareous 	<ul style="list-style-type: none"> • Potential change in ocean currents - Change in commercial fisheries species distribution / occurrence.

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						invertebrates and plankton).
<i>Marine Culture Fishery</i>						
<ul style="list-style-type: none"> Warmer sea surface temperatures may result - Exceedence of thermal tolerance of fish in surface waters. Increased potential for hypoxia events. 	<ul style="list-style-type: none"> Increased potential for hypoxia events. Possible decreases in salinity and the associated implications for the fisheries sector. 		<ul style="list-style-type: none"> Cage damage, loss of stock, interference with access and operations. 		<ul style="list-style-type: none"> Implications for fish reproduction and stock replenishment as fish eggs are more sensitive to pH change than juveniles and adults. 	
<i>Inland Pond Fishery</i>						
<ul style="list-style-type: none"> Warmer pond water temperatures may result - Exceedence of thermal tolerance of fish; reduce dissolved oxygen levels. 	<ul style="list-style-type: none"> Flooding may result - Flooding, loss of stock, increased construction costs. 	<ul style="list-style-type: none"> Increased operation costs as additional water supplies are sought. 			<ul style="list-style-type: none"> Flooding, loss of pond sites and stock, relocation costs. 	
<i>Oyster Culture Fishery</i>						
	<ul style="list-style-type: none"> Exceedence of salinity tolerance of oysters 	<ul style="list-style-type: none"> Exceedence of salinity tolerance of oysters 			<ul style="list-style-type: none"> Decreased area of mudflat for clutches. 	
Biodiversity and Nature Conservation						
<i>Terrestrial and Aquatic Ecology</i>						
<ul style="list-style-type: none"> Change in species distributions/occurrence/ migration patterns. Loss of montane species. Increase in stream water temperature will affect both life and breeding cycle of aquatic species. Exceedence of thermal tolerance of terrestrial organisms (especially herpetofauna and insects) and heat stress. Impacts to organisms' seasonal behaviours/ adaptations. Greater risk of heat stroke and heat stress for 	<ul style="list-style-type: none"> Increased risk of stream wash outs – putting eggs and young of numerous aquatic species at risk. This will also disrupt food chains. Impacts to organisms' seasonal behaviours/ adaptations. Increased storm 	<ul style="list-style-type: none"> Increased risk of wildfires and loss of forest ecosystem components. Health of conservation workers put at risk. Low stream flows will concentrate pollutants putting aquatic wildlife under stress. 	<ul style="list-style-type: none"> Risk to conservation assets, infrastructure, energy supplies, and conservation workers. Damage to woodlands. Higher stream flows and incidence of stream wash out, landslides etc. 			

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conservation workers.	damage to woodlands. Increased risk of landslides will impact terrestrial species. Health of conservation workers also put at greater risk as extreme conditions increase. Risk of damage to assets from extreme weather at conservation sites.	Impacts to organisms' seasonal behaviours/ adaptations. Shallower streams likely to experience higher water temperatures putting some organisms beyond their thermal tolerance.				
<i>Marine Ecology</i>						
<ul style="list-style-type: none"> Warmer sea surface temperatures may result - Change in species distributions/occurrence/ migration patterns. Exceedence of thermal tolerance of marine organisms. Increased potential for hypoxia events. Bleaching /mortality of hermatypic corals due to increased seawater temperature. 	<ul style="list-style-type: none"> Increased flows of debris from terrestrial water courses increasing marine pollution. Increased potential for hyposaline events and impacts to corals. Potential flooding of conservation assets. 		<ul style="list-style-type: none"> Risk to conservation assets, infrastructure, energy supplies, and conservation workers. Damage to coral communities. Increased wave scouring will affect beach and intertidal ecosystems. Increased flows of debris from terrestrial water courses, increasing marine pollution. 	<ul style="list-style-type: none"> Loss of intertidal habitats. Loss of low lying conservation assets. Increased risks of marine pollution as formerly terrestrial areas become submerged, releasing any pollution present at industrial sites into the marine environment. 	<ul style="list-style-type: none"> Reduction in growth/ strength of skeletons/shells of calcifying organisms (e.g. hard corals). Serious negative impacts on marine food chain and particularly those species that use reef areas as nurseries for their young. 	

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Built Environment and Infrastructure						
<i>Building Stock</i>						
<ul style="list-style-type: none"> • Risk of subsidence and foundation damage. Also risk of damage to utilities cabling and pipes. • Loss of thermal comfort and increased use of artificial cooling. • Possible health risks should power supply be interrupted. • Power interruptions more likely due to demand /supply mismatch. 	<ul style="list-style-type: none"> • Asset damage from flooding, landslides etc. • Increased risk of rain penetration of building fabric, lightning strike etc. • Health risks to building occupants. • Possible business interruption and reputational damage. • Increased insurance costs. 	<ul style="list-style-type: none"> • Risk of subsidence and foundation damage. Also risk of damage to utilities cabling and pipes. • Possible business interruption and reputational damage. • Increased insurance and maintenance costs. 	<ul style="list-style-type: none"> • Asset damage from flooding, storm surge, landslides, wind damage etc. • Increased risk of rain penetration of building fabric, loss of structural integrity, lightning strike etc. • Health risks to building occupants. • Possible business interruption and reputational damage. • Increased insurance and repair costs. 	<ul style="list-style-type: none"> • Loss of low lying assets and damage to foundations from changes to hydraulic pressure. • Health risks to building occupants. • Possible business interruption and reputational damage. • Increased insurance and relocation costs. 		
<i>Transport Infrastructure</i>						
<ul style="list-style-type: none"> • Risk of subsidence and foundation damage. Damage to tracks and road surface. Also risk of damage to utilities cabling and pipes leading to greater excavation of roads for repairs. • Loss of thermal comfort and increased use of artificial cooling needed on transport vehicles. • Possible health risks should power supply be interrupted. • Power interruptions more likely due to demand /supply mismatch. 	<ul style="list-style-type: none"> • Asset damage from flooding, landslides lightning strike etc. • Health risks to travellers and staff. • Possible business interruption and reputational damage. • Increased insurance and repair costs. • Power and 		<ul style="list-style-type: none"> • Asset damage from wind damage, storm surge, flooding, landslides, lightning strike etc. • Health risks to travellers and staff. • Possible business interruption and reputational damage. • Increased insurance 	<ul style="list-style-type: none"> • Loss of low lying assets from inundation and storm surge and damage to foundations from changes to hydraulic pressure. • Health risks to travellers and staff. • Possible business interruption and 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
	<p>communications system interruption likely.</p> <ul style="list-style-type: none"> • Tunnel flooding and electrical damage possible. 		<p>and repair costs.</p> <ul style="list-style-type: none"> • Power and communications system interruption likely. • Tunnel flooding and electrical damage possible. 			<p>reputational damage.</p> <ul style="list-style-type: none"> • Increased insurance and relocation costs. • Tunnel flooding and electrical damage possible.

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<i>Communications Infrastructure</i>						
<ul style="list-style-type: none"> Risk of power interruption due to supply / demand mismatch. 	<ul style="list-style-type: none"> Asset damage from flooding, landslides lightning strikes to transmitters etc. Health risks to staff. Possible business interruption and reputational damage. Increased insurance and repair costs. Power interruption likely. 		<ul style="list-style-type: none"> Asset damage (transmitters, cabling) from wind damage, storm surge, flooding, landslides, lightning strike etc. Health risks to staff. Possible business interruption and reputational damage. Increased insurance and repair costs. Power interruption likely. 		<ul style="list-style-type: none"> Loss of low lying assets from inundation and storm surge and damage to foundations from changes to hydraulic pressure. Health risks to staff. Possible business interruption and reputational damage. Increased insurance and relocation costs. 	
<i>Drainage Infrastructure (including stormwater drainage, sewerage systems and wastewater treatment facilities)</i>						
<ul style="list-style-type: none"> Increase odour problems emanating from sewers. Greater rates of evaporation, risk of reduced dilution of pollutants. Possible damage to some concrete structures. Risk of power interruption. Possible formation of algae blooms in the receiving waters of wastewater treatment facilities. 	<ul style="list-style-type: none"> Asset damage from flooding, landslides to culverts and pumping plant etc. Health risks to staff. Possible business interruption and reputational damage. Increased insurance and repair costs. Power and communication 	<ul style="list-style-type: none"> Due to reductions in soil moisture levels, increased subsidence may affect underground pipes and cables, and also building foundations. 	<ul style="list-style-type: none"> Asset damage from flooding, backing up of both stormwater and sewerage systems, landslides to culverts and pumping plant etc. Health risks to staff. Possible business interruption and reputational damage. Increased insurance 		<ul style="list-style-type: none"> The hydraulic capacity of sewage treatment plant discharge systems may be reduced. Discharge problems at sewerage and stormwater outflows – risking backing up. Flooding of system beyond designed capacity. Loss of low lying 	

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	<p>interruption likely.</p> <ul style="list-style-type: none"> • Discharge problems at sewerage and stormwater outflows –risking backing up. Flooding of system beyond designed capacity. • Increase in hydraulic load of wastewater treatment facilities. • The effective dilution of wastewater flow due to stormwater infiltration may impact the effectiveness of the existing wastewater treatment processes. 		<p>and repair costs.</p> <ul style="list-style-type: none"> • Power and communication interruption likely. • The hydraulic capacity of effluent discharge systems may be severely reduced if storm surges coincide with high tides. • Impacts on wastewater flow rates due to an increase in stormwater entering sewerage systems. This may increase the hydraulic load of waste water treatment facilities throughout Hong Kong. • The effective dilution of wastewater flow due to stormwater infiltration may impact the effectiveness of the existing wastewater treatment processes. 		<p>assets from inundation and storm surge and damage to foundations from changes to hydraulic pressure.</p> <ul style="list-style-type: none"> • Health risks to staff. • Possible business interruption and reputational damage. • Increased insurance and relocation costs. 	
Business and Industry						

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<i>Trade and Logistics</i>						
<ul style="list-style-type: none"> • Increased costs from additional air conditioning usage. Increased risk of power cuts. • Health risks to staff from working outside in elevated temperatures. Raised temperatures in transportation units such as containers and HGVs – possible negative impacts on staff and transported goods. • Increase in very hot days may result - Damage to transport infrastructure i.e. rail bucking, tarmac melt, risks to delivery times. 	<ul style="list-style-type: none"> • Risk of flooding, power cuts, asset damage and business interruption up and down the supply chain and across key logistics routes. Failure to deliver on time. 	<ul style="list-style-type: none"> • Increased risk of water supply restrictions and increased costs for purchasing additional water. May lead to reduction in production output for manufacturing processes which are water intensive. May also impact operation of water-cooled AC systems. 	<ul style="list-style-type: none"> • Damage to assets and infrastructure including communications. Risk of loss of life and limb. Business continuity issues due to power cuts and transportation problems i.e. cancelled flights, lost berths etc. Failure of supply chains and JIT. Power cuts. Increased siltation of harbour and navigation channels. 	<ul style="list-style-type: none"> • Significant disruption likely to PRDEZ manufacturing leading to reduced export and re-export trade. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets including wharfs and warehousing. 		
<i>Manufacturing</i>						
<ul style="list-style-type: none"> • Increased costs from additional air conditioning usage. Increased risk of power cuts, production interruption and failure to fulfil orders on time. • Health risks to staff from working outside in elevated temperatures. Raised temperatures in transportation units such as containers and HGVs – possible negative impacts on staff and transported goods – failure to fulfil orders due to damage and spoiling of perishable goods in transit. 	<ul style="list-style-type: none"> • Risk of flooding, power cuts, asset damage and business interruption up and down the supply chain and across key logistics routes. Failure to fulfil orders on time due to delays in receiving raw materials and part finished components. 	<ul style="list-style-type: none"> • Increased risk of water supply restrictions and increased costs for purchasing additional water. May lead to reduction in production output for manufacturing processes which are water intensive. Leading to failure to fulfil orders on time and associated 	<ul style="list-style-type: none"> • Damage to assets and infrastructure including communications. Risk of loss of life and limb. Crop damage could lead to increased raw materials costs for manufacturers. Business continuity issues due to power cuts and transportation problems i.e. failure 	<ul style="list-style-type: none"> • Significant disruption likely to PRDEZ manufacturing leading to reduced export and re-export trade. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets including warehousing. 		

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		reputational damage. Increased raw material costs for food and beverage manufacturers. May also impact operation of water-cooled AC systems.	of mass transit meaning workers cannot get to work, failures in supply chains and JIT leading to inability to fulfil orders. Power cuts.			
<i>Professional and Producer Services</i>						
<ul style="list-style-type: none"> Increased costs from additional air conditioning usage. Increased risk of power cuts. Health risks to staff from working outside in elevated temperatures. 	<ul style="list-style-type: none"> Risk of flooding, power cuts, asset damage and business interruption up and down the supply chain and along public transportation routes. 	<ul style="list-style-type: none"> Increased risk of water supply restrictions and increased costs for purchasing additional water. May lead to reduction in production output for manufacturing processes which are water intensive. May also impact operation of water-cooled AC systems. 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life and limb. Business continuity issues due to power cuts and transportation problems i.e. staff unable to get to work. Failure of supply chains and JIT. Power cuts. Reputational damage. 	<ul style="list-style-type: none"> Significant disruption likely to PRDEZ manufacturing leading to reduced producer services demand. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets particularly waterside property alongside Victoria Harbour. 		
Energy Supply						
<i>Electricity Generation</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration. May lead to supply interruptions, power spikes and load shedding. Health risks to staff from working 	<ul style="list-style-type: none"> Demand from pumping out floodwaters is likely to increase. May lead to supply 	<ul style="list-style-type: none"> May lead to reduced generating capacity at the Guangzhou pumped storage 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life 	<ul style="list-style-type: none"> Significant disruption likely to international trade risks primary fuel supply. Business 		

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<p>outside in elevated temperatures. Increase in very hot days / hot nights - Generators may encounter problems in acquiring sufficiently cold cooling water to operate their plant safely. May lead to supply interruptions, power spikes and load shedding.</p> <ul style="list-style-type: none"> • Increase in very hot days - Damage to transport infrastructure i.e. rail bucking, tarmac melt, risks to delivery of primary fuels. May lead to supply interruptions, power spikes and load shedding • Decreased number of cold days - Reduction in demand for electric heating. 	<p>interruptions, power spikes and load shedding.</p>	<p>power station. Reduction in peak capacity. May lead to supply interruptions, power spikes and load shedding.</p>	<p>and limb. Staff unable to get to work. May lead to supply interruptions, power spikes and load shedding.</p>	<p>continuity issues. Raised insurance costs. Risk of loss of low lying assets including coal unloaders and some power plant depending on elevation. May lead to supply interruptions, power spikes and load shedding.</p>		
<i>Electricity Transmission and Distribution</i>						
<ul style="list-style-type: none"> • Increased transmission system losses as lines sag, requiring increased generation to meet demand. May lead to supply interruptions, power spikes and load shedding. • Health risks to staff from working outside in elevated temperatures. 	<ul style="list-style-type: none"> • Risk of flooding, lightning strike, landslides, leading to damage to power lines and other assets. May lead to supply interruptions, power spikes and load shedding. 		<ul style="list-style-type: none"> • Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. May lead to supply interruptions, power spikes and load shedding. 	<ul style="list-style-type: none"> • Raised insurance costs. Risk of loss of low lying assets including pylons and substations. May lead to supply interruptions, power spikes and load shedding. 		
<i>Primary Fuel Imports and Supply</i>						
<ul style="list-style-type: none"> • Health risks to staff from working outside in elevated temperatures. Increase in very hot days - Damage to 	<ul style="list-style-type: none"> • Risk of flooding, lightning strike, landslides, leading 		<ul style="list-style-type: none"> • Damage to assets and infrastructure including 	<ul style="list-style-type: none"> • Significant disruption likely to international trade. 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<p>transport infrastructure i.e. rail bucking, tarmac melt, risks to delivery times.</p> <ul style="list-style-type: none"> Decreased number of cold days - Reduction in demand for energy for heating. 	<p>to disruption of transport routes and to deliveries of primary fuels risking fuel shortages and electricity blackouts, brownouts and load-shedding.</p>		<p>communications. Risk of loss of life and limb. Staff unable to get to work. Fuel supply vessels may be affected. A serious impact on Hong Kong could involve a reduction in port capacity which would delay vital deliveries. May lead to supply interruptions, power spikes and load shedding.</p>	<p>Business continuity issues. Raised insurance costs. Risk of loss of low lying assets including wharfs and warehousing. May lead to supply interruptions, power spikes and load shedding.</p>		

Financial Services

<i>Banking</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration. May lead to blackouts, brownouts and load shedding. Business interruption. Health risks to staff should power fail. Increase in very hot days - Damage to transport infrastructure i.e. rail bucking, tarmac melt, risks to supply chain, productivity and business interruption for investments. Decreased number of cold days - Reduction in demand for cold weather products, negative impacts on investments in these sectors. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Poor performance of investments affected by flooding and secondary impacts i.e. power cuts, supply chain failures. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Poor performance of investments affected by reduced rainfall and secondary impacts i.e. power cuts, supply chain failures. 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business interruption, depreciation of asset values, poor performance of investments, 	<ul style="list-style-type: none"> Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets. Power cuts, business interruption, depreciation of asset values, poor performance of 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
			reputational damage.	investments, reputational damage.		
<i>Insurance</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration. May lead to blackouts, brownouts and load shedding. Business interruption and costs of insured losses. Health risks to staff should power fail. Increase in very hot days - Damage to transport infrastructure i.e. rail bucking, tarmac melt, risks to supply chain, productivity and business interruption for investments. Costs of insured losses. Decreased number of cold days - Reduction in demand for cold weather products, negative impacts on investments in these sectors. Cost of insured losses. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Poor performance of investments affected by flooding and secondary impacts i.e. power cuts, supply chain failures. Cost of insured losses. 	<ul style="list-style-type: none"> Power cuts, business interruption. Poor performance of investments affected by reduced rainfall and secondary impacts i.e. power cuts, supply chain failures. Cost of insured losses. 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business interruption, depreciation of asset values, poor performance of investments, reputational damage. Cost of insured losses. 	<ul style="list-style-type: none"> Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets. Power cuts, business interruption, depreciation of asset values, poor performance of investments, reputational damage. Cost of insured losses. 		
<i>Other Financial Services</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration. May lead to blackouts, brownouts and load shedding. Business interruption. Health risks to staff should power fail. Increase in very hot days - Damage to transport infrastructure i.e. rail bucking, tarmac melt, risks to supply chain, productivity and business interruption for investments. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Poor performance of investments affected by flooding and secondary impacts i.e. power cuts, supply chain failures. 	<ul style="list-style-type: none"> Power cuts, business interruption. Poor performance of investments affected by reduced rainfall and secondary impacts i.e. power cuts, supply chain 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business interruption, 	<ul style="list-style-type: none"> Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss of low lying assets. Power cuts, business 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<ul style="list-style-type: none"> Decreased number of cold days - Reduction in demand for cold weather products, negative impacts on investments in these sectors. 		failures.	depreciation of asset values, poor performance of investments, reputational damage.	interruption, depreciation of asset values, poor performance of investments, reputational damage.		

Food Resources

Food Imports

<ul style="list-style-type: none"> Exceedence of thermal tolerance of poultry and livestock species resulting in more expensive and lower availability of imports. Reduced agricultural output due to increased incidence of pests and diseases as warmer temperatures mean pathogens can survive the winter. Increased cost and lower availability of imports. Reduced agricultural output from areas affected by drought and those that are already marginal or where crops are at their thermal comfort thresholds. Rising costs, reduced import availability, alternative sources may have to be found. Increased risk of sterility in Thai rice crops leading to harvest failure. 	<ul style="list-style-type: none"> Damage to agricultural assets, risk to workers, loss of crops and livestock. Transportation disruption. Reduced agricultural output in affected regions, raising the cost and decreasing the availability for imports. 	<ul style="list-style-type: none"> Risks to feedstock and water supplies reducing availability and increasing costs. Increased desertification in some parts of northern China. Reduced agricultural outputs in affected regions, raising the cost and decreasing the availability for imports. Reduced rainfall would lead to a reduction in Thai rice harvest, leading to higher rice prices. Increased requirement for food aid. 	<ul style="list-style-type: none"> Business interruption, power cuts, transport delays, loss of assets and infrastructure, damage to crops and loss of livestock. Rising costs of grain and other feed due to climate change impacts resulting in more expensive poultry and grain fed meat imports (beef). Greater requirement for food aid globally raising commodity prices and reducing supply raising commodity prices and reducing supply. 	<ul style="list-style-type: none"> Loss of low lying land, particularly rice production areas in southern China and Thailand. Disruption to transportation. Increased costs and decreased availability of imports. 	<ul style="list-style-type: none"> Depletion of marine mollusc populations globally due to increasing acidity will increase costs of oyster shell and cockle grit – vital components of chicken feed. Increasing cost of poultry. Will also dramatically reduce availability of shellfish, and increase the costs for importing. Reduced fishing yields will also increase costs.
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Food wholesale and retail

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<ul style="list-style-type: none"> Increased proliferation of bacteria and microorganisms leading to greater risk of conditions such as salmonella poisoning. Risk of public health incident and transmission to humans and reputational damage for the industry. Products will have a shorter shelf life. Higher refrigeration costs are likely for processing plants and abattoirs. 	<ul style="list-style-type: none"> Risk of flooding, power cuts, asset damage and business interruption. 	<ul style="list-style-type: none"> Raised operating costs for water intensive industries such as food processing. Possible supply interruption leading to business interruption and increased prices. 	<ul style="list-style-type: none"> Risk to assets, infrastructure, energy supplies, employees, transport and business interruption leading to failures of JIT delivery and increased risk of spoilage in transported goods. Potential loss of shipping vessels. Increased costs and decreased availability of imports. 	<ul style="list-style-type: none"> Significant potential for influx of climate change refugees from neighbouring flooded regions increasing demand and raising prices. Also risk of contamination to water supplies which could impact production. Risk of loss of low lying assets i.e. warehouses. 		

Human Health

<i>Accidents / external health stresses</i>	<ul style="list-style-type: none"> Increased number of accidents, particularly RTAs, and risks of injury from flooding (injury and drownings) Increased risk of injury from lightning strike, wildfire; damage to buildings causing injury 	<ul style="list-style-type: none"> Increased risk of injury from debris, gusting, drowning, RTAs 	<ul style="list-style-type: none"> Decrease in visibility - increased number of RTAs
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Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<i>Respiratory Diseases</i>						
<ul style="list-style-type: none"> • Changes in the survival of some pathogens • Potentially greater incidence of some respiratory diseases caused by pathogens influenced by temperature change 	<ul style="list-style-type: none"> • Changes in the survival of some pathogens and changes in the incidence of some respiratory diseases 					
<i>Vector Borne Diseases</i>						
<ul style="list-style-type: none"> • Increased potential for some vectors and potentially a greater incidence of some vector borne diseases 	<ul style="list-style-type: none"> • Increased potential for some vectors and potentially a greater incidence of some vector borne diseases 					
<i>Water Borne Diseases</i>						
<ul style="list-style-type: none"> • Increased proliferation of bacteria and microorganisms leading to greater risk of food poisoning and diarrheal illnesses 	<ul style="list-style-type: none"> • Flooding, increased proliferation of bacteria and microorganisms leading to greater risk of diarrheal diseases 		<ul style="list-style-type: none"> • Increased incidence of flooding and waterborne diseases (particularly diarrheal diseases) as a result 			
<i>Chronic Health Conditions</i>						
<ul style="list-style-type: none"> • Higher average temperatures may have a negative impact on air quality, which could result in increased mortality and morbidity associated with respiratory and cardiovascular conditions • Decrease in cold days – reduction in cold weather harvesting of vulnerable populations • Increase in very hot days and hot 						

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
nights – increase in hot weather harvesting of vulnerable populations						
<i>Health Infrastructure</i>						
	<ul style="list-style-type: none"> • Increased number of RTAs lengthening ambulance response times and putting paramedic crews at greater risk of themselves being involved in RTAs • Risk of flooding of buildings and assets and disruption to services • Increased risk of damage to hospital buildings and communication masts and loss of electricity 	<ul style="list-style-type: none"> • Increased operation costs as additional water supplies are sought, or in a worst case scenario situation - water supply interruptions which could potentially limit ward availability and surgery schedules although hospitals are priority users so disruption is highly unlikely 	<ul style="list-style-type: none"> • Increased risk of damage to hospital buildings and communication masts and loss of electricity • Potential delays to deliveries of food and medical supplies due to interruptions of maritime and road freight 	<ul style="list-style-type: none"> • Flooding, loss of healthcare facilities and relocation costs 		<ul style="list-style-type: none"> • Decrease in visibility – increased number of RTAs, lengthening ambulance response times and putting paramedic crews at greater risk of themselves being involved in RTAs
<i>External Infrastructure</i>						
<ul style="list-style-type: none"> • Risks to food, energy and water supplies from the mainland and overseas – reducing availability and increasing costs 	<ul style="list-style-type: none"> • Risks to food, energy and water supplies from the mainland and overseas – reducing availability and increasing costs 		<ul style="list-style-type: none"> • Risks to food, energy and water supplies from the mainland and overseas – reducing availability and increasing costs • Delays and interruptions to shipping and land 	<ul style="list-style-type: none"> • Potential population displacement from flooded areas which may stretch health infrastructure and sanitary conditions • Forced migration of environmental refugees could 		<ul style="list-style-type: none"> • Risks to food and water supplies from the mainland and overseas – reducing availability and increasing costs. • Reduced availability of

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
			transportation of food and other products	<p>enhance transmission of disease due to intermingling of populations with introduction of novel diseases into non-immune populations</p> <ul style="list-style-type: none"> • Risk of flooding to water treatment facilities potentially causing industrial contamination of drinking water 		<p>food may lead to greater domestic raising of food ie poultry which could increase the risks from Avian Influenza. Conversely changes to wild bird migration routes due to temperature changes in northern Eurasia may affect the incidence of bird flu in Hong Kong by affecting the size and seasonal distribution of the host population of visiting migrant birds</p>

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
Leisure and Tourism						
<i>Hotels</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration in hotels, tourist attractions and transport hubs. Increased demand combined with supply constraints may lead to power cuts and business interruption / reputational damage. Health risks to staff and visitors should power fail. Reduced thermal comfort for overseas visitors. Increase in very hot days - Negative health impacts on elderly guests – compounded in the event of power cuts. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption, risk to visitor health and safety during flood events. Secondary impacts i.e. power cuts, supply chain failures. Poor visitor perception of Hong Kong, adverse publicity. 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Risk to visitor health and safety during flood events. Secondary impacts i.e. power cuts, supply chain failures. Reduction in water quality. Poor visitor perception of Hong Kong, adverse publicity. 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business interruption, reputational damage – Hong Kong perceived to be a ‘dangerous’ destination. 	<ul style="list-style-type: none"> Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss to low lying assets including significant number of hotels. Power cuts, business interruption, infrastructure damage, depreciation of asset values, reputational damage to Hong Kong viewed as being an “unprepared destination”. 		
<i>Tourist attractions / tourism services</i>						
<ul style="list-style-type: none"> Increased demand from air conditioning and refrigeration in hotels, tourist attractions and transport hubs. Increased demand combined with supply constraints may lead to power cuts and business interruption / reputational damage. Health risks to 	<ul style="list-style-type: none"> Power cuts, asset damage, business interruption. Risk to visitor health and safety during flood events. Secondary impacts i.e. power 	<ul style="list-style-type: none"> Risk to visitor health and safety during flood events. Secondary impacts i.e. power cuts, supply chain failures. 	<ul style="list-style-type: none"> Damage to assets and infrastructure including communications. Reduction in quality / availability of some tourism 	<ul style="list-style-type: none"> Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss to low 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<p>staff and visitors should power fail. Reduced thermal comfort for overseas visitors. Possible increases in outward tourism as Hong Kong residents seek cooler climates during the hottest times of the year. Reduction or even loss of some species upon which eco-tourism depends leading to a potential reduction in eco-tourists.</p> <ul style="list-style-type: none"> • Increase in very hot days - Negative health impacts on elderly guests. 	<p>cuts, supply chain failures. Reduction in quality / availability of some tourism activities eg. outdoor tourism attractions or events. Poor visitor perception of Hong Kong, adverse publicity.</p>	<p>Reduction in quality / availability of some tourism activities i.e. golf courses, water rides in theme parks. Reduction in water quality. Poor visitor perception of Hong Kong, adverse publicity. Reduction or even loss of some species upon which eco-tourism depends leading to a potential reduction in eco-tourists.</p>	<p>activities eg. outdoor tourism attractions or events. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business interruption – Hong Kong perceived to be a “dangerous” destination.</p>	<p>lying assets Loss of mangroves and other species at Mai Po and Deep Bay, reduction or even loss of some species upon which eco-tourism depends leading to a potential reduction in eco-tourists. Power cuts, business interruption, infrastructure damage, depreciation of asset values, reputational damage to Hong Kong viewed as being an “unprepared destination”.</p>		
<i>Transportation</i>						
<ul style="list-style-type: none"> • Increased demand from air conditioning and refrigeration. Risk of power cuts and business interruption / reputational damage. Health risks to staff and visitors should power fail. Reduced thermal comfort for overseas visitors. Possible increases in outward tourism as Hong Kong residents seek cooler climates 	<ul style="list-style-type: none"> • Power cuts, asset damage, business interruption. Risk to visitor health and safety during flood events. Secondary impacts i.e. power cuts, supply chain failures. 	<ul style="list-style-type: none"> • Risk to visitor health and safety during flood events. Secondary impacts i.e. power cuts, supply chain failures. Risks of interruption to transport services 	<ul style="list-style-type: none"> • Damage to assets and infrastructure including communications. Risk of loss of life and limb. Staff unable to get to work. Power cuts, business 	<ul style="list-style-type: none"> • Significant disruption likely to international trade. Business continuity issues. Raised insurance costs. Risk of loss to low lying assets i.e. the runway at Chek 		

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
<p>during the hottest times of the year. Reduced lift for aircraft potentially causing delays and passengers left stranded at the airport. Loss of ecotourism revenue.</p> <ul style="list-style-type: none"> Increase in very hot days - Negative health impacts on elderly guests. Impacts of extreme temperatures on transport include damage to infrastructure i.e. buckling of rail tracks, melting tarmac, loss of thermal comfort in some forms of transport i.e. cable car. Disruption to sightseeing and visitor dissatisfaction as a result. 	<p>Interruption to transport services. Passengers stranded at the airport raising operating costs and visitor dissatisfaction, adverse publicity.</p>	<p>i.e. MTR, buses, aviation. Passengers stranded at the airport raising operating costs and visitor dissatisfaction. Loss of ecotourism revenue.</p>	<p>interruption, interruption to mass transit system and sight seeing, grounding of flights, stoppage of ferries and passengers left stranded at the airport / terminals, reputational damage – Hong Kong perceived to be a “dangerous” destination. Loss of ecotourism revenue.</p>	<p>Lap Kok. Power cuts, business interruption, infrastructure damage, depreciation of asset values, reputational damage to Hong Kong viewed as being an “unprepared destination”. Loss of fares from ecotourists.</p>		

Water Resources

<p><i>Hong Kong Impounding and Service Reservoirs</i></p>						
<ul style="list-style-type: none"> Increased consumer demand for water. Greater rates of evaporation leading to reductions in raw water yield. Possible risk of power interruptions leading to interruptions in water pumping and treatment. 	<ul style="list-style-type: none"> Reduced water quality. Reduced yield due to increase in wet season overflow. Possible damage to dam structures from over topping. Possible damage to surrounding property and assets from overflow flooding. 	<ul style="list-style-type: none"> Reduced yield due to reduction in dry season. Rainfall leading to risk of supply interruptions with subsequent socio-economic damage, rising costs, health impacts and reputational damage. 	<ul style="list-style-type: none"> Reduced water quality. Increased risk of reservoir overflow. Possibility of reduced yield as a result. Possible damage to dam structures. Possible damage to surrounding property and assets from overflow 			

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
	<p>Increased risk of power cuts, business interruption and inability of staff to get to work – possibly reducing operational performance. Risk to staff life and limb. Asset damage. Reputational damage.</p>		<p>flooding. Increased risk of power cuts, business interruption and inability of staff to get to work – possibly reducing operational performance. Risk to staff life and limb. Asset damage. Reputational damage.</p>			
<i>Water Supply Imports from Dongjiang</i>						
<ul style="list-style-type: none"> Increased consumer demand for water. Greater rates of evaporation leading to reductions in raw water yield. Reduction in water quality from erosion, salinity etc. Greater processing requirements. Possible risk of power interruptions leading to interruptions in water pumping and treatment. 	<ul style="list-style-type: none"> Reduced water quality. Reduced yield due to increase in wet season overflow. Possible damage to dam structures from over topping. Possible damage to surrounding property and assets from overflow flooding. Increased risk of power cuts, business interruption and 		<ul style="list-style-type: none"> Reduced water quality. Increased risk of reservoir overflow. Possibility of reduced yield as a result. Possible damage to dam structures. Possible damage to surrounding property and assets from overflow flooding. Increased risk of power cuts, business 		<ul style="list-style-type: none"> Increased salinity of the PRD, possible salinization of freshwater aquifers. Increased risk of flooding leading to industrial pollution of the water supply. 	

Increase in Surface Temperatures	Increase in Heavy Rain, Thunderstorm Days etc.	Increase in Frequency / Severity of Drought and Years with Low Annual / Seasonal Rainfall	Increase in Frequency and / or Severity of Extreme Weather Events eg Tropical Cyclones	Sea Levels Rise	Increase in Ocean Acidity	Other Impacts
	<p>inability of staff to get to work – possibly reducing operational performance. Risk to staff life and limb. Asset damage. Reputational damage. Increased risk of flooding leading to industrial pollution of the water supply.</p>		<p>interruption and inability of staff to get to work – possibly reducing operational performance. Risk to staff life and limb. Asset damage. Reputational damage. Increased risk of flooding leading to industrial pollution of the water supply.</p>			

Annex B

Review of Extant Adaptive
Capacity in Hong Kong by
Sector

Table B1 *General Existing Policies / Measures that may Contribute to Adaptive Responses (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)*

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Reference
Environmental Protection Department	Inter-departmental Working Group on Climate Change (IWGCC)	Comprised of 5 bureaux and 16 departments, the Inter-departmental Working Group on Climate Change was established in 2007. The Working Group is to co-ordinate, develop and promote actions in reducing GHG emissions and adapting to climate change.	Not Specified	Mandatory	Prepare	The bureaux and departments involved include: Environment Bureau Development Bureau Transport and Housing Bureau Food and Health Bureau Education Bureau Economic Analysis and Business Facilitation Unit, Financial Secretary's Office Environmental Protection Department Hong Kong Observatory Electrical and Mechanical Services Department Housing Department Planning Department Agriculture, Fisheries and Conservation Department Architectural Services Department Buildings Department Civil Engineering and Development Department Drainage Services Department Food and Environmental Hygiene Department Health Department Home Affairs Department Leisure and Cultural Services Department Transport Department Water Supplies Department	Actions in Hong Kong in Climate Change. n.d. Environmental Protection Department. < http://www.epd.gov.hk/epd/english/climate_change/hkactions.html > [Accessed 29 Jan 09]
Environmental Protection	Joint exercise on marine	The exercise was conducted to ensure the comparability	Not Specified	Mandatory	Prepare	-	Co-operation with the Mainland.

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Reference
Department	monitoring with the State Oceanic Administration's National Marine Environment Monitoring Centre, South China Sea Environment Monitoring Centre and Government Laboratory	of marine monitoring data between Hong Kong and the Mainland. The exercise was to prepare for Hong Kong's participation in the National Marine Environment Monitoring Network.					Environmental Protection Department. < http://www.epd.gov.hk/epd/misc/ehk03/eng/hk/hk_collaboration.html > [Accessed 8 June 09]
Hong Kong Observatory	Joined the Asia-Pacific satellite data re-transmission services	The Observatory can share satellite data with other meteorological services in the region. Satellite data is one of the important sources of data for numerical weather prediction models.	Not Specified	Mandatory	Prepare	-	Hong Kong Observatory 2007-2008. < http://www.weather.gov.hk/about/hko/hko2007-2008e.pdf > [Accessed 8 June 09]
Hong Kong Observatory	Educational Package on Climate Change	The package comprises of an animated cartoon DVD, a booklet, a power point presentation CD, climate change factsheets and a copy of the " <i>An Inconvenient Truth</i> ", and was distributed to schools in Hong Kong in 2007. The aim is to increase awareness and understanding of climate change and its impacts.	Not Specified	Voluntary	Prepare	The contents of the package can be viewed online. HKO has also given presentations in primary and secondary schools to promote awareness and understanding of climate change in Hong Kong.	Educational Package on Climate Change. 2007. Hong Kong Observatory. < http://www.hko.gov.hk/climate_change/ed_package/start.htm > [Accessed 29 Jan 09]
Education Bureau	Provision of teacher	These programmes aim at	Not Specified	Voluntary	Prepare	-	Example of teacher training programme:

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Reference
	development programmes and support materials on climate change	introducing effective strategies, enriching teachers' knowledge and providing support in teaching climate change in schools					<p>"Cross-KLA subject collaboration on the learning and teaching of climate change"</p> <p><Activity ID: CDI020071765></p> <p>Example of support materials:</p> <p>"Climate change — a cross-curricular learning and teaching resource pack"</p>
Education Bureau	Organisation of student activities and school events on climate change	These activities and events aims at strengthening students' understanding of the climate change issue and providing opportunities for students to apply what they have learnt	Not Specified	Voluntary	Prepare	-	<p>Example: Student Environmental Protection Ambassador Scheme 2009/09 (Theme: climate change)</p> <p><http://www.childhealthhongkong.com/school_system/2009_10/files/EDB_CM08128E.pdf></p>
HKO (together with Guangdong Meteorological Bureau, the Macao Meteorological and Geophysical Bureau, and the Hongkong	<i>Climate is changing, act now!</i> Exhibition	The aim was to improve the public's understanding of climate, including the causes of climate change and its impacts and mitigation measures.	Not Specified	Voluntary	Prepare	-	<p>Climate is Changing, Act Now! Exhibition. n.d. Hong Kong Observatory. <http://www.weather.gov.hk/climate_change/act_now_exhibition2008/exhibition_e.htm> [Accessed 29 Jan 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Reference
and Shanghai Banking Corporation Limited)							
Emergency Support Unit Security Bureau	Contingency Plan for Natural Disasters	<p>Summary of Government alerting systems and organizational framework in responding to natural disasters and severe weather.</p> <p>The controlling authorities consist of three phases. Phase I deals with rescue of life, protection of property and containment of further deterioration Phase II deals with returning the community to an acceptable condition which satisfies the physical, psychological, and social needs of the community. Phase III is to restore the community to the state prior to the disaster.</p>	Not Specified	Mandatory	Prepare, respond	<p>Natural disasters and severe weather conditions which this report covers include: tropical cyclones, rainstorms, floods, landslips, thunderstorms, and tsunamis. Phase One is under the direction of emergencies services such as Fire Services Department and/or Hong Kong Police Force with the support from other departments and agencies. Phase Two is led by Home Affairs Department is the lead coordinating department with cooperation from Social Welfare Department and Housing Department. Phase Three includes Departments involved include Home Affairs Department, Highways Department, Housing Department, and other departments with a heavy emphasis on public works.</p>	<p>Contingency Plan for Natural Disasters <http://www.sb.gov.hk/eng/emergency/ndisaster/CPND%20(3-2009).pdf> [Accessed 16 Sep 09]</p>
Emergency Support Unit Security Bureau	Emergency Response System	<p>The policy of the emergency response system of Hong Kong which operates under a graduated three tier system through the three phases of emergency response. Tier One involves emergency services operating under their own</p>	Not Specified	Mandatory	Prepare, respond	<p>Tier One includes command and control centres that assess the situation, Police Headquarters Command and control Centre and Police Regional Higher Commands, and Fire Services Communication Centre.</p> <p>Tier Two generally include incidents which are likely to have threats to life, property, security, and which may grow to be more</p>	<p>The Government of Hong Kong Special Administrative Region Emergency Response System <http://www.sb.gov.hk/eng/emergency/ers/ers.htm> [Accessed 16 Sep 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Reference
		direction. If necessary, Tier One services will alert the Security Bureau Duty Officer thus activating Tier Two Responses involving the SBDO and Emergency Support Unit. Tier Three involves the Emergency Monitoring and Support Centre and it is activated when a major incident involving threats to life, property, and security.				complex. Tier operates through the three phases of emergency response which are rescue, recovery and restoration.	
International and Local NGOs	Combat Climate Change Coalition (CCCC)	Comprised of Greenpeace China, Oxfam Hong Kong and WWF Hong Kong, and twelve local NGOs, CCCC aims to urge the HK Government to cut greenhouse gases and develop a holistic policy for climate change.	Not Specified	Voluntary	Prevent	The CCCC goals reflect those of mitigation strategies rather than adaptation. Local NGOs include: Breakthrough Limited Catholic Messengers of Green Consciousness Hong Kong Confederation of Trade Unions Hong Kong Church Renewal Movement Hong Kong Social Workers' General Union Roundtable Network Senior Citizen Home Safety Association St. James' Settlement - Community Oriented Mutual Economy The Boys' & Girls' Clubs Association of Hong Kong The Chinese YMCA of Hong Kong The Hong Kong Asthma Society The Hong Kong Federation of Women's Centres	Greenpeace China, Oxfam Hong Kong, WWF Hong Kong and Twelve Other Community Organisations Ally against Climate Change < http://www.greenpeace.org/china/en/press/release/establish-cccc-20090525 > [Accessed 16 Sep 09]

Table B2 Existing Policies / Measures that may Contribute to Adaptive Responses to Agriculture (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
General Policies / Measures								
The Agriculture, Fisheries and Conservation Department	Public Health (Animals and Birds) (Chemical Residues) Regulation	The regulation aims to control feeding of chemicals to food animals. It also established the "Maximum Residue Limits (MRL)" for 37 other chemicals in meat, offal or milk with limits in line with international standards.	Not Specified	Mandatory	Prepare	-	• Human health risks	CAP 139N Public Health (Animals and Birds) (Chemical Residues) Regulation < http://www.legislation.gov.hk/eng/home.htm >[Accessed 2 June 09]
The Agriculture, Fisheries and Conservation Department	Poultry (Slaughtering for Export) Regulations	It regulates the poultry slaughtering for exporting to other countries and districts including licences, premises and equipments, method of slaughter and how to prepare poultry products.	Not Specified	Mandatory	Prepare	-	• Increased proliferation of bacteria and microorganisms • Human health risks	CAP 139E Poultry (Slaughtering for Export) Regulations < http://www.legislation.gov.hk/eng/home.htm >[Accessed 3 June 09]
The Agriculture, Fisheries and Conservation Department	Public Health (Animals and Birds) (Licensing of Livestock Keeping) Regulation	The regulation states the application and revocation of licence of livestock keeping in Hong Kong.	Not Specified	Mandatory	Prepare	-	• Increased proliferation of bacteria and microorganisms • Human health risks	CAP 139L Public Health (Animals and Birds) (Licensing of Livestock Keeping) Regulation < http://www.legislation.gov.hk/eng/home.htm > [Accessed 3 June 09]
The Agriculture, Fisheries and Conservation Department	Public Health (Animals and Birds) Regulations	The general regulations which control the public health imported of animals and birds.	Not Specified	Mandatory	Prepare			CAP 139A Public Health (Animals and Birds) (Licensing of Livestock Keeping) Regulation < http://www.legislation.gov.hk/eng/home.htm >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
The Agriculture, Fisheries and Conservation Department	Agricultural Policy	The agricultural policy is described on the Agriculture, Fisheries, and Conservation Department's website as one which follows the general policy of the free market. The role of the government is to provide basic infrastructure and technical support but leaves the industry to adjust to market forces.	Not Specified	Mandatory	Prepare			[Accessed 16 Sep 09] AFCD Agriculture in HK < http://www.afcd.gov.hk/english/agriculture/agr_hk/agr_hk.html > [Accessed 16 Sep 09]
Pig Husbandry Health, Welfare and Food Bureau	Voluntary Surrender of Pig Farming Licences	The Voluntary Surrender of Pig Farming Licences was launched in April 2006. The scheme aims to reduce the number of pig farms in Hong Kong thereby reducing associated public health and environmental pollution problems. Under the scheme, pig farmers are granted ex gratia payments or loans for surrendering their livestock licences or terminating their farm business.	The granted ex gratia payments or loans to pig farmers will range between \$450,000 and \$25.45 million depending on the size of their farms.	Voluntary	Prevent	As to October 2008, 222 pig farmers had surrendered their licences under this scheme.	<ul style="list-style-type: none"> • Increased proliferation of bacteria and microorganisms • Human health risks 	Voluntary Surrender of Pig Farming Licences < http://www.fhb.gov.hk/en/committees/board/2006/paper20060406_63.html > [Accessed 2 June 09] Hong Kong the fact: agriculture and fisheries < http://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf > [Accessed 2 June 09]
Poultry Production Food & Health Bureau	Live chicken import cap	Hong Kong limits the number of live chickens import from Mainland. The bureau will monitor the live chicken supply and maintain close liaison with the trade. The number of imported live chickens will be suitably adjusted for major festive occasions to meet the	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Increased proliferation of bacteria and microorganisms • Human health risks 	Live chicken import cap to stay < http://news.gov.hk/en/category/healthandcommunity/070904/html/070904en05004.htm > [Accessed 3 June 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		stronger demand.						
Food & Health Bureau	Reduce live chicken number in Hong Kong	Agriculture, Fisheries and Conservation Department limited the live chicken population in Hong Kong of 2,000,000 in 2006.	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Increased proliferation of bacteria and microorganisms • Human health risks 	Progress of Comprehensive Plan of Action to Deal with the Global Problem of Avian Influenza < http://www.fhb.gov.hk/download/committees/board/doc/info_paper_6.pdf > [Accessed 9 June 09]
Agriculture, Fisheries and Conservation Department	Voluntary Surrender Scheme for Poultry Farmers	The Voluntary Surrender Scheme for Poultry Farmers was launched in 2005. The scheme aims to reduce the number of pig farms in Hong Kong thereby reducing associated public health and environmental pollution problems. Under the scheme, Farmers are granted ex gratia payments.	The Government has set aside \$344.5 million for making ex-gratia.	Voluntary	Prevent	As to October 2008, 143 poultry farmers had surrendered their licences under this scheme.	<ul style="list-style-type: none"> • Increased proliferation of bacteria and microorganisms • Human health risks 	Voluntary Surrender Scheme for Poultry Farmers < http://www.info.gov.hk/gia/general/200508/05/08050126.htm > [Accessed 2 June 09] Hong Kong the fact: agriculture and fisheries < http://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf > [Accessed 2 June 09] Voluntary surrender scheme opens < http://www.news.gov.hk/en/category/healthandcommunity/050805/html/050805en05003.htm > [Accessed 2 June 09]
Fruit, Flower and Vegetable Production								
Agriculture, Fisheries and Conservation Department & the Vegetable Marketing Organization	Accredited Farm Scheme	The objective of Accredited Farm Scheme is to protect the environment and consumers against residues of agricultural pesticides, which was introduced in 1994. Strictly monitoring is carried out in accredited farms	Not Specified	Voluntary	Prepare	As to the end of 2007, there were 225 farms in Hong Kong and the mainland of China accredited, supplying more than 80 tonnes of accredited produce	<ul style="list-style-type: none"> • Changes in disease regime • Human health risks 	Accredited Farm Scheme < http://www.afcd.gov.hk/english/agriculture/agr_accfarm/agr_accfarm_intro/agr_accfarm_intro.html > [Accessed 2 June 09] Hong Kong the fact:

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		on uses of pesticides and produce is further checked for pesticide residue before they are sold at accredited retail outlets.				daily.		agriculture and fisheries < http://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf >[Accessed 2 June 09]

Table B3 Existing Policies / Measures that may Contribute to Adaptive Responses to Aquaculture and Fisheries (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Agriculture, Fisheries and Conservation Department	Committee on Sustainable Fisheries The committee was set up in 2006 to study the long term goals and directions as well as feasible options and implementation strategy for the sustainable development of the fisheries industry, with regard to fisheries trends, ecological sustainability, economic viability and other relevant factors, such as financial implications and social impact. It also considers the fisheries management options to conserve fisheries resources in Hong Kong waters.	Not Specified	Voluntary	Prevent, Prepare	-	• Depletion of fish stocks	Agriculture, Fisheries and Conservation Department Annual Report 2007-2008 < http://www.afcd.gov.hk/english/publications/publications_dep/publications_dep.html > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	Fisheries Development Loan Fund The loan aims to promote sustainable fisheries development. It helps fishermen switch to sustainable fisheries or related operations and develop sustainable aquaculture businesses.	\$290 million	Voluntary	Prevent, Prepare	-	• Depletion of fish stocks	Fisheries Development Loan Fund < http://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_techsup/fish_cap_fdlf.html > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	The Fisheries Education Centre The education centre promotes the public awareness of the need and importance for fisheries conservation.	Not Specified	Voluntary	Prepare	In 2007, there were 4000 people visiting the centre.	• Depletion of fish stocks	Aberdeen Fisheries Education Centre opens < http://afcd.gov.hk/textonly/english/publications/publications_press/pr382.html > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	Fisheries Protection Ordinance The ordinance aims to protect fish and against destructive fishing practices, such as fishing with explosives, toxic substances, electricity, dredging and suction devices.	Not Specified	Mandatory	Prevent	-	• Depletion of fish stocks	CAP 171 Fisheries Protection Ordinance < http://www.legislation.gov.hk/eng/home.htm > [Accessed 3 June 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Agriculture, Fisheries and Conservation Department	Marine Fish Culture Ordinance Under the ordinance, all marine fish culture activities in Hong Kong are required to operate under licence in designated fish culture zones.	Not Specified	Mandatory	Prevent, Prepare	-	<ul style="list-style-type: none"> • Depletion of fish stocks • Human health risks 	CAP 353 Marine Fish Culture Ordinance < http://www.legislation.gov.hk/eng/home.htm > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	Fish Health Inspection Programme The programme aims to promote the sustainable fish culture in Hong Kong and reduce the negative environmental impact. Early detection of fish disease outbreaks, training was provided to fish farmers on disease prevention measures and fish disease diagnosis and treatment services were given in case of an outbreak. The culture techniques were also provided to farmers.	Not Specified	Voluntary	Prevent, Prepare	-	<ul style="list-style-type: none"> • Human health risks • Depletion of fish stocks 	Agriculture, Fisheries and Conservation Department Annual Report 2007-2008 < http://www.afcd.gov.hk/english/publications/publications_dep/publications_dep.html > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	Marine Fish (Marketing) Ordinance The ordinance aims to ensure the orderly marketing of fresh marine fish. It regulates the wholesale marketing of marine fish and against the illegal marine fish selling.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Human health risks 	CAP 291 Marine Fish (Marketing) Ordinance < http://www.legislation.gov.hk/eng/home.htm > [Accessed 3 June 09]
Agriculture, Fisheries and Conservation Department	Regular monitoring work in fish culture zones The Department conducts regular monitoring on the water quality of fish culture zones and implements red tide monitoring and management measures. Rapid risk assessment will be reported after red tide incidents.	Not Specified	Voluntary	Prevent, Prepare, Respond	-	<ul style="list-style-type: none"> • Depletion of fish stocks • Human health risks 	Agriculture, Fisheries and Conservation Department Annual Report 2007-2008 < http://www.afcd.gov.hk/english/publications/publications_dep/publications_dep.html > [Accessed 3 June 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
Agriculture, Fisheries and Conservation Department	AFCD Accredited Fish Farm Scheme	Good aquaculture practices and hygiene standards must be met and a predefined management system must be followed by participating farms. This improves transparency and safety of local aquaculture products and allows products that have passed the quality assurance tests with satisfactory results to be marketed under the unique brand name of the scheme.	Not Specified	Voluntary	Prevent	-	<ul style="list-style-type: none"> Human health risks 	AFCD Accredited Fish Farm Scheme < http://hkaffs.org/en/index.html > [Accessed 21 December 09]

Table B4 Existing Policies / Measures that may Contribute to Adaptive Responses to Biodiversity and Nature Conservation (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
Agriculture, Fisheries and Conservation Department (AFCD)	Protection of Endangered Species of Animals and Plants Ordinance	The Ordinance gives effect to CITES in Hong Kong. A licence is required to import, introduce, export, re-export or in possession of the listed species. The Ordinance applies to all parties who conduct activities involving endangered species except for those situations specified in the Ordinance.	Not Specified	Mandatory	Prevent, Prepare	A reward scheme has been set up to provide financial incentive for the public to provide information on illegal import, export and possession of endangered species. The Endangered Species Resource Centre has been established to promote public awareness on endangered species protection. The department also have a range of activities and programs in place to raise public awareness and improve the understanding of endangered species protection.	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species • Other stresses on species associated with human activities 	Endangered Species Protection. 2006. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_end/con_end.html > [Accessed 30 Jan 09] Protection of Endangered Species of Animals and Plants Ordinance in <i>The Ordinance</i> . 2006. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_end/con_end_reg/con_end_reg_ord/con_end_reg_ord.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	Wild Animals Protection Ordinance	The Ordinance protects important habitats by designating the areas as restricted areas under Schedule 6 to restrict access to these areas. Currently, there are 3 restricted areas namely Yim Tso Ha Egretty, Mai Po Marshes and Sham Wan Beach. The purpose is to protect wild animals (and their eggs and nests) specified under Schedule 2 of the Ordinance. A permit issued by the Department is	Not Specified	Mandatory	Prevent	Hunting, disturbance to the nests and eggs of protected wild animals are prohibited except in accordance with a special permit. Possession of protected wild animals is also not allowed. Feeding is also not allowed.	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems associated with human activities 	Chapter 170 Wild Animals Protection Ordinance in Bilingual Laws Information System. n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=170&Count=30&/habitats > [Accessed 30 Jan 09] Nature Outlook: Review of

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	required to gain access into these restricted areas.						Nature Conservation Policy. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_prce/con_nncp_prce.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department; Ocean Park Hong Kong	The sea turtles are protected through the Wild Animals Protection Ordinance and the Protection of Endangered Species of Animals and Plants Ordinance. In addition to these two Ordinances (which led to the restriction of the nesting site), AFCD has also implemented various measures to conserve the species such as satellite tracking and artificial incubation.	Not Specified	Mandatory	Prepare	Artificial incubation is considered as the last option to help save the sea turtle eggs. This is especially the case when the developing embryos are likely to die due to poor nesting conditions. In addition, incidental observation and records of stranded individuals are kept for study purposes. Two green turtles have also been fitted a satellite transmitter which traced their movement and their migration route. This has provided further understanding on the migration of Green Turtles nesting in the Sham Wan Restricted Area.	<ul style="list-style-type: none"> • Changes in sea turtle species distributions / occurrence • Loss of some species • Impacts to sea turtle behaviours / adaptations • Other stresses on sea turtle and their ecosystems / habitats associated with human activities 	Conservation of sea turtles in Hong Kong. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_fau/con_fau_sea/con_fau_sea_con.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department Chinese White Dolphin in Hong Kong	The programme outlines a conservation plan which aims to better manage the habitats of the dolphins, to raise awareness, conduct further population and ecological studies and promote cross-boundary co-operation.	Not Specified	Mandatory	Prepare	Management improvement includes minimising the impacts of coastal development on dolphins and designating more marine protected area.	<ul style="list-style-type: none"> • Changes in Chinese White Dolphin species distributions / occurrence • Loss of some species • Impacts to Chinese 	The Conservation Programme for the Chinese White Dolphin in Hong Kong. 2000. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/publications/publications_cn/files/conpgm.pdf > [Accessed

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						White Dolphin behaviours / adaptations • Stresses on Chinese White Dolphin and their ecosystems / habitats associated with human activities	30 Jan 09]
Lands Department	Practice Note: Land owners and their authorised persons are responsible to ensure that no trees are unnecessarily felled and that proposed tree felling or transplanting obtains written consent from the Director of Lands in certain leases.	Not Specified	Mandatory	Prevent	-	• Changes in species distributions / occurrence • Loss of some species • Other stresses on species / ecosystems / habitats associated with human activities	Practice Note: Application for Tree Felling or Transplanting for private projects. 2002. Lands Department. < http://www.landsd.gov.hk/en/images/doc/8-2002.pdf > [Accessed 03 Feb 09]
Agriculture, Fisheries and Conservation Department	Ecological Assessment Helps to protect ecologically important areas from adverse development impact by requiring proponents of designated projects to avoid causing adverse environmental impacts as far as practicable. If total avoidance is not practicable, the project proponents are required to mitigate the adverse impact to an acceptable level. AFCD is responsible for reviewing ecological assessments in	Not Specified	Mandatory	Prevent	-	• Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems / habitats associated with developments	Review of Ecological Assessment of Major Development Proposals. < http://www.afcd.gov.hk/english/conservation/con_nat/con_nat_intro/con_nat_intro_rev.html > [Accessed 11 Nov 09] Environmental Impact Assessment Ordinance - Technical Memorandum . < http://www.epd.gov.hk/eia/english/legis/index3.html > [Accessed 11 Nov 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	environmental impact assessment studies, planning studies and development applications.						
Agriculture, Fisheries and Conservation Department; Country and Marine Parks Authority	Country Parks Ordinance The Ordinance provides for the designation, control and management of country parks and special areas in Hong Kong. The ecology and biodiversity of these areas are conserved and recreational and educational needs are met at the same time. Developments and activities are regulated to ensure the areas are preserved. In addition to Country Parks, smaller areas with high conservation value – such as special areas, are also protected. These special areas, in general, emphasize more on conservation and education than on recreation.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Changes in species distributions / occurrence in country parks and special areas • Loss of some species / ecosystems / habitats in country parks and special areas • Other stresses on species / ecosystems / habitats associated with human activities 	Chapter 208 Country Park Ordinance in <i>Bilingual Laws Information System</i> . n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=196&Count=30&Expand=208#208 > [Accessed 30 Jan 09] Nature Outlook: Review of Nature Conservation Policy. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_prce/con_nncp_prce.html > [Accessed 30 Jan 09]
Planning Department	Town Planning Ordinance Land use is regulated in order to meet the intended use of individual areas (planned by the government, such as residential, commercial or industrial areas). The Ordinance also prevents development or incompatible land uses on ecologically sensitive sites. Both government and private land can be designated as conservation zonings.	Not Specified	Mandatory	Prevent	Conservation zonings categories: *Special scientific interest (SSSI) - areas with rare fauna or flora species or representative habitats; stringent control imposed; all activities require approval from Town Planning Board. * Conservation area (CA), Coastal protection area (CPA) - protect the natural characteristics and landscape of	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems / habitats associated with developments 	Chapter 131 Town Planning Ordinance in <i>Bilingual Laws Information System</i> . n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=109&Count=30&Collapse=131.2#131.2 > [Accessed 30 Jan 09] Nature Outlook: Review of Nature Conservation Policy. n.d. Agriculture, Fisheries and

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
					the sites (not necessarily for its ecological value); apart from agricultural and conservation related activities, approval from Town Planning Board is required for all other activities.		Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_prce/con_nncp_prce.html > [Accessed 30 Jan 09]	
Town Planning Board	Green Belt Zoning	Allow the development of green corridors by conserving existing landscape features and prevent urban development from dominating by defining an outer limit. Application needs to be submitted to the Board for developments in a Green Belt Zone.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems / habitats associated with developments 	Town Planning Board guidelines for application for development within green belt zone under section 16 of the Town Planning Ordinance. 1991. Town Planning Board. < http://www.info.gov.hk/tpb/species/ecosystems/en/forms/Guidelines/pg10_e.p/habitats > [Accessed 03 Feb 09]
Town Planning Board	Wetland Buffer Area	To protect the ecological integrity of the fishponds and wetlands within the Wetland Conservation Area (WCA) and to prevent developments that would have a negative off-site impact on the ecological value of fishponds.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Changes in species distributions / occurrence in fish ponds and wetlands • Loss of some species / ecosystems / habitats in fish ponds and wetlands • Depletion of fish stocks in fish ponds • Other stresses on species / ecosystems / habitats associated with developments 	Town Planning Board Guidelines for application for developments within deep bay area under section 16 of the Town Planning Ordinance. 1999. Town Planning Board. < http://www.info.gov.hk/tpb/en/forms/Guidelines/pg12b_e.p/df > [Accessed 03 Feb 09]
Town Planning Board	Wetland Conservation Area	To conserve the ecological value of the fish ponds which form an integral part of the wetland ecosystem in the Deep Bay Area.	Not specified	Mandatory	Prevent	New developments are not allowed unless it is required to support the conservation of the area or if it is an essential	<ul style="list-style-type: none"> • Changes in species distributions / occurrence in fish ponds 	Town Planning Board Guidelines for application for developments within deep bay area under section 16 of the Town Planning

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
					infrastructural project with overriding public support with an ecological impact assessment.	<ul style="list-style-type: none"> Loss of some species / ecosystems / habitats in fish ponds Depletion of fish stocks in fish ponds Other stresses on species / ecosystems / habitats associated with developments 	Ordinance. 1999. Town Planning Board. < http://www.info.gov.hk/tpb/en/forms/Guidelines/pg12b_e.pdf > [Accessed 21 Dec 09]
Agriculture, Fisheries and Conservation Department	Conservation Site The Mai Po and Inner Deep Bay area was listed as a Wetland of International Importance under the Ramsar Convention to conserve the wetland habitats and the wildlife especially migratory birds at the site. A Conservation Strategy and Management Plan for the Ramsar site is in place to lay down a general framework for the conservation and wise use of the area and to raise public awareness of the importance of Mai Po and Inner Deep Bay wetlands.	Not Specified	Mandatory	Prepare	Sites within the Mai Po and Inner Deep Bay area have also joined the East Asian - Australian Shorebird Reserve Network and the Anatidae Site Network in the East Asian Flyway.	<ul style="list-style-type: none"> Changes in species distributions / occurrence, in particular migratory birds at the site Loss of some species / ecosystems / habitats at the site Other stresses on species / ecosystems / habitats at the site 	Birds of Hong Kong in HK Species. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/hkbiodiversity/speciesgroup/speciesgroup_birds.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	Forests and Countryside Ordinance Under the subsidiary legislation of the Ordinance - Forestry Regulations, <i>no person shall without lawful excuse sell, offer for sale, or have in his possession or under his custody or control any portion of the listed plants. But these regulations do not apply to plants grown outside Hong Kong or on any land held from the Government under a lease, licence or permit or by virtue of an Ordinance.</i>	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> Changes in species distributions / occurrence Loss of some species Other stresses on species associated with human activities 	Chapter 96 Forests and Countryside Ordinance in <i>Bilingual Laws Information System</i> . n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=76&Count=30&Expand=96.1#96.1 > [Accessed 30 Jan 09] Forestry Regulations. 2006.

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
							Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_flo/con_flo_for/con_flo_for.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	Marine Parks Ordinance An Ordinance to provide for the designation, control and management of marine parks and marine reserves, and for purposes connected therewith. (Enacted 1995)	Not Specified	Mandatory	Prevent, Prepare	For the purposes of this Ordinance, it shall be the duty of the Authority-(a) to make recommendations to the Chief Executive in Council for the designation of areas as marine parks or marine reserves (Amended 34 of 2000 s. 3);(b) to control and manage marine parks and marine reserves, and to take such measures in respect of marine parks and marine reserves as the Authority considers necessary, for the purposes of (i) protecting, restoring and, where the Authority considers necessary, enhancing the marine life in and marine environment of any marine park or marine reserve; (ii) managing the uses of resources in marine parks to meet the needs and aspirations of present and future generations of mankind; (iii) facilitating recreational activities in marine parks; and (iv) providing opportunities for educational and scientific	<ul style="list-style-type: none"> • Changes in species distributions / occurrence in designated areas • Loss of some species / ecosystems / habitats in designated areas • Other stresses on species / ecosystems / habitats associated with human activities 	Hong Kong Ordinances. Marine Parks Ordinance. - Chapter 476. < http://www.hklii.org/hk/legislation/en/ord/476/ > [Accessed 20 Apr 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
					studies in the marine life in and marine environment of marine parks and marine reserves; and(c) generally to administer this Ordinance (Enacted 1995).			
Planning Department	Hong Kong Planning Standards and Guidelines Chapter 10 (HKPSG)	The chapter is divided into several parts. Firstly, some general principles of conservation are reviewed. Secondly, there is a discussion of measures to conserve natural landscapes and habitats, followed by measures to conserve monuments, historical buildings, archaeological sites and other antiquities. A brief review of conservation enforcement is provided at the end.	Not Specified	Mandatory	Prevent	The definition of conservation follows four principles that should be adopted in land use planning: - retain significant landscapes and ecological attributes and heritage features as conservation zones; - restrict uses within conservation zones to those which sustain particular landscapes and ecological attributes and heritage features; - control adjoining use to minimise adverse impacts on conservation zones and optimise their conservation value; and - create, where possible, new conservation zones in compensation for areas of conservation value, which are lost to development.	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems / habitats associated with developments and human activities 	Hong Kong Planning Standards and Guidelines - Chapter 10 (HKPSG). Planning Department. < http://www.pland.gov.hk/tech_doc/hkpsg/english/ch10/ch10_text.htm > [Accessed 20 Apr 09]
Agriculture, Fisheries and Conservation Department	Hong Kong Herbarium	Collect, identify and preserve Hong Kong flora species. The Herbarium supports the studies on the taxonomy, ecology and conservation of flora species in Hong Kong. It provides assistance	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Loss of some flora species 	Hong Kong Herbarium. 2006. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_flo/con_flo_hkh/con_flo_hkh.html >

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	to government departments, researchers and students regards to Hong Kong flora species with its extensive collection and supporting library. The Hong Kong Herbarium also produces the <i>Check List of Hong Kong Plants</i> which is updated regularly.						[Accessed 30 Jan 09] Introduction in Hong Kong Herbarium. n.d. Agriculture, Fisheries and Conservation Department. < http://www.hkherbarium.net/Herbarium/frame.html > [Accessed 30 Jan 09]
Environment and Conservation Fund	Environment and Conservation Fund Ordinance. ECF supports educational activities, research, technology demonstration and other environmental and conservation related projects and activities.	The Environment and Conservation Fund (ECF) was established in 1994 under the Ordinance. ECF supports educational activities, research, technology demonstration and other environmental and conservation related projects and activities.	Approximately \$1 billion since establishment (as of Jan 2009)	Voluntary	Prepare	Interested parties may submit an application which will be assessed against a set of criteria.	• Changes in species distributions / occurrence • Loss of some species • Impacts to organism's seasonal behaviours / adaptations Application for ECF. n.d. Environment and Conservation Fund. < http://www.ecf.gov.hk/en/application/index.html > [Accessed 30 Jan 09] Guide to Application. 2007. Environment and Conservation Fund. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_new/files/MAGuidetApplication2007.doc > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	Field Investigation	Trial pilots have been set up and monitoring carried out to assess the growth performance of various species in different environments and the effectiveness of a range of tree establishment techniques. In addition, methods to improve seedling establishment including the use of weed mat and tree	Not Specified	Mandatory	Prepare	-	• Changes in species distributions / occurrence • Loss of some species • Impacts to organism's seasonal behaviours / adaptations Enriching our countryside with native flora. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_flo/con_flo_enr/con_flo_enr.html > [Accessed 30 Jan 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	guard are now in experimental stage.						
Agriculture, Fisheries and Conservation Department	Afforestation A selection of the seeds of native species has been collected to produce seedlings for afforestation.	Not Specified	Mandatory	Recover	-	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some native species 	Enriching our countryside with native flora. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_flo/con_flo_enr/con_flo_enr.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	The Greenhouse of Field Investigation Unit Based at Tai Tong Nursery, it is equipped with a climate control system as well as environmental growth chambers and seed depository. More than 100 species, especially the more fragile species and orchids have been conserved.	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Loss of some species, especially the more fragile species and orchids 	Conserving the rare and endangered flora. n.d. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_flo/con_flo_con/con_flo_con.html > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department	New Nature Conservation Policy (2004) The policy aims to protect and conserve biodiversity for the present and future generation, while taking into account of the social and economic aspects. The objective is to identify, monitor and assess ecosystems, conservation areas, activities effecting biodiversity, and promote biodiversity conservation. Works such as research, surveys and raising awareness are conducted in partnership with NGOs, private sectors, communities, the academia and	Not Specified	Mandatory	Prevent, Prepare	Under the new policy, 12 priority sites have been identified based on an agreed scoring system for enhanced protection.	<ul style="list-style-type: none"> • Changes in species distributions / occurrence • Loss of some species / ecosystems / habitats • Other stresses on species / ecosystems / habitats 	New Nature Conservation Policy. 2004. Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp.html > [Accessed 30 Jan 09]

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	etc.						
<i>Measures under the New Conservation Policy</i>							
Agriculture, Fisheries and Conservation Department	Management Agreement Scheme (MA) to NGOs, including green groups, educational institutions and community organisations to encourage landowners in entering agreements to enhance conservation measures at prioritised sites. NGOs will have management rights over the landowners after providing funds as an exchange in enhancing identified high value conservation sites. The landowners are to co-operate with NGOs in carrying out conservation measures. The Management Agreement scheme has been reviewed and proved effective, and has also raised awareness of biodiversity conservation.	Approved allocation of \$4.62 million from the Environment and Conservation Fund (ECF) Committee for the implementation of three pilot MA projects. ECF has approved further funding for the projects to continue for another 2 years.	Voluntary	Prevent	-	-	Legislative Council Panel on Environmental Affairs: Pilot Scheme for Management Agreements under the New Nature Conservation Policy. 2005. Agriculture, Fisheries and Conservation Department and Environmental Protection Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/files/legco2.pdf > [Accessed 30 Jan 09] New Nature Conservation Policy. 2004. Environment, Transport and Works Bureau and Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_leaf/files/leaflet2.pdf > [Accessed 30 Jan 09]
Agriculture, Fisheries and Conservation Department, Environmental Protection Department	Public-Private Partnership (PPP) Private areas are allowed under the condition where the developer has to manage and conserve the (remaining) site (with high importance).	Not Specified	Voluntary	Prevent	The development is still required to comply with the relevant statutory requirements and take suitable measures to address the issues identified in the assessment by the Advisory Council on the Environment.	-	Legislative Council Panel on Environmental Affairs: Progress of implementation of the New Nature Conservation Policy. 2008. Environmental Protection Department and Agriculture, Fisheries and Conservation Department.

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
							< http://www.afcd.gov.hk/english/conservation/con_nncp/files/ea0428cb113313e.pdf > [Accessed 30 Jan 09]
Enhancement of Existing Conservation Measures resulting from the review of the Nature Conservation Policy	Ecological Monitoring To maintain and develop a Hong Kong ecological database by conducting ecological surveys. In order to update and assess the status of rare species and its conservation status, experts are consulted regularly. Information about the conservation value of different sites is available to government departments in connection with land use and development planning.	Not Specified	Mandatory	Prepare	-	-	Legislative Council Panel on Environmental Affairs: Progress of implementation of the New Nature Conservation Policy. 2008. Environmental Protection Department and Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/files/ea0428cb113313e.pdf > [Accessed 30 Jan 09]
	Planning Control Land use is controlled and restricted through the land use zoning system to ensure sites with high conservation status are protected. The Schedule of Uses in respect of the Outline Zoning Plans of priority sites for enhanced conservation has also been amended.	Not Specified	Mandatory	Prevent	Priority Sites: * Ramsar Site * Sha Lo Tung * Tai Ho * Fung Yuen * Luk Keng Marsh * Mui Tsz Lam and Mau Ping * Wu Kau Tang * Long Valley and Ho Sheung Heung * Deep Bay Wetland outside Ramsar Site * Cheung Sheung * Yung Shue O * Sham Chung	-	Legislative Council Panel on Environmental Affairs: Progress of implementation of the New Nature Conservation Policy. 2008. Environmental Protection Department and Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/files/ea0428cb113313e.pdf > [Accessed 30 Jan 09]
	Raising Attract members of the general	Not Specified	Mandatory	Prepare	-	-	Legislative Council Panel on

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory Instrument	Remarks	Potential Consequences Addressed	Reference
awareness	public to country parks by improving facilities and diversifying visitors' experience by presenting nature conservation in various themes.					Environmental Affairs: Progress of implementation of the New Nature Conservation Policy. 2008. Environmental Protection Department and Agriculture, Fisheries and Conservation Department. < http://www.afcd.gov.hk/english/conservation/con_nncp/files/ea0428cb113313e.pdf > [Accessed 30 Jan 09]

Table B5 Existing Policies / Measures that may Contribute to Adaptive Responses to Built Environment and Infrastructure (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
General Infrastructure								
Environmental Protection Department	Review of the Territorial Development Strategy - Hong Kong 2030: planning vision and strategy	The Hong Kong 2030 strategy is the framework for future developments in Hong Kong. It sets out a range of actions to improve the city's infrastructure while achieving government policy targets and addressing social, economic and environmental needs. The review began in 2000, comprises of a strategic environmental assessment study which addresses long-term environmental sustainability issues. The recommendations in the strategy are categorised into three levels: directions, themes, and measures. Directions are broad statements that guide major proposals in achieving objectives; themes address more specific issues; and measures are the potential actions.	Not Specified	Mandatory	Prepare	-	-	Hong Kong 2030 Planning Vision and Strategy. 2007. Planning Department. < http://www.pland.gov.hk/p_study/comp_s/hk2030/eng/finalreport/ > [Accessed 11 Feb 09]
Planning Department	Hong Kong Planning Standards and Guidelines	The guidelines provide basic planning criteria and design standards in balancing the needs of social and economic developments and its impact on the environment. Other guidelines include development sensitives, environmental considerations, utility services, potentially hazardous installations and etc. It also provides specific guidelines for the Hong Kong Island, Kowloon, New Towns and Rural Areas	Not Specified	Mandatory	Prevent	The guidelines identified urban design issues that need to be considered in general and specific areas. In relation to waterfront development, the guidelines made a range of suggestions such as the Building Free Zone, air ventilation, development height profile and etc.. The waterfront development guidelines are mainly <i>to make Victoria Harbour attractive, vibrant, accessible and symbolic of Hong Kong</i> . This includes guidelines on	-	Hong Kong Planning Standard and Guidelines. n.d. Planning Department. < http://www.pland.gov.hk/tech_doc/hkpsg/english/index.htm > [Accessed 02 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						the height of the buildings, open space for recreational and/or retail activities, landscaping and etc.		
Drainage Services Department	Stage III of the Shenzhen River Regulation Project	The Hong Kong government and Shenzhen government made efforts to conduct the Shenzhen River Regulation Project. The third stage of works involved improving four kilometres of river channel, reconstructing Lo Wu Railway Bridge, Lo Wu Old Pedestrian Bridge, Man Kam To Vehicular Bridges and two Dongjiang Water Mains. The completion of Shenzhen River Regulation Project ensures transportation between the two places without interruption by flooding, enables infrastructure projects to proceed steadily and creates the favourable conditions for economic development in Hong Kong and Shenzhen.	Not Specified	Mandatory	Prevent	-	-	HK and Shenzhen's joint effort completes regulation of Shenzhen River. < http://www.info.gov.hk/gia/general/200704/24/P200704240276.htm > [Accessed 8 June 09]
The Hong Kong Institute of Architects (HKIA) The Hong Kong Institution of Engineers (HKIE) The Hong Kong Institute of Landscape Architects (HKILA) The Hong	Hong Kong Professional Green Building Council	The HKPGBC conducts collaborative research on local and global developments on green building, promotes seminars and training on the subject, and advises government on a green building labelling scheme.	Not Specified	Voluntary	Prepare, prevent	-	-	Hong Kong Professional Green Building Council < http://www.hkpgbc.org/index.html > [Accessed 16 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Kong Institute of Surveyors (HKIS) The Hong Kong Institute of Planners (HKIP)								
Building Stock								
Buildings Department	Code of Practice on Wind Effects in Hong Kong 2004	The Code of Practice provides equations on calculating total wind force on a building, total along-wind force on enclosed building, wind tunnel testing and etc. These are to be incorporated into the design of buildings, but do not apply to buildings of unusual shapes or where wind conditions are influenced by complicated topography.	Not Specified	Mandatory	Prevent	-	• Asset damage from wind	Code of Practice on Wind Effects in Hong Kong. 2004. Buildings Department. < http://www.bd.gov.hk/english/documents/code/windcode2004.pdf > [Accessed 03 Feb 09]
Housing Department	Micro-Climate Studies Enhance Environmental Performance of Housing Block	Use of micro-climate studies in housing projects in order for designers to plan for enhanced environmental performance. Micro-climate studies examine the climate characteristics of the housing estate site, such as wind speed, natural ventilation, solar heat gain, daylight and noise.	Not Specified	Voluntary	Prevent, Prepare	-	-	Micro-climate studies enhance environmental performance of housing blocks. 8 April 2007. Press Release. Housing Department. < http://www.housingauthority.gov.hk/en/aboutus/news/pressreleases/0,,2-0-16185--0,00.html > [Accessed 29 Jan 09]
Electrical and Mechanical Services Department	Prescriptive Building Energy Codes	The four codes on building services installations were developed by the Electrical & Mechanical Services Department (EMSD), progressively from 1998 to 2000, and implemented on a voluntary basis under	Not Specified	Voluntary	Prepare	-	-	Energy Efficiency Registration Scheme for Buildings. < http://www.emsd.gov.hk/emsd/eng/pee/eersb_

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		<p>EMSD's Hong Kong Energy Efficiency registration Scheme for Buildings (HKEERSB). These four codes respectively stipulate the minimum efficiency standards of corresponding components and systems.</p> <p>The four codes of practice include:</p> <ul style="list-style-type: none"> • Energy Efficiency of Lighting Installations • Energy Efficiency of Air Conditioning Installations • Energy Efficiency of Electrical Installations • Energy Efficiency of Lift and Escalator Installations 						pub_cp.shtml > [Accessed 09 Nov 09]
Electrical and Mechanical Services Department	Performance-based Building Energy Code	This performance approach considers the various components of building energy consumption, addresses to their interrelation, allows trade-off among them, and provides room for innovative design.	Not Specified	Voluntary	Prepare	The PB-BEC is targeted to provide - an alternative path of compliance to the prescriptive codes, but not to replace them.		Performance-based Building Energy Code, 2007. < http://www.emsd.gov.hk/emsd/e_download/pe/e/pb-bec_2007.pdf> [Accessed 09 Nov 09]
Buildings Department	Code of Practice for Overall Thermal Transfer Value in Buildings 1995	This Code of Practice provides technical guidance for developers, engineers and other persons responsible for the design and construction of buildings. It includes general principles of control of overall thermal transfer, appropriate standards for thermal conductivity, surface film resistance, absorptivity for wall and roof surfaces and air space resistance for walls and roofs.	Not Specified	Mandatory	Prevent	This Code applies to all hotels and commercial buildings as defined in the Building (Energy Efficient) Regulation.	<ul style="list-style-type: none"> • Loss of thermal comfort • Increased use of mechanical cooling 	<p>Code of Practice for Overall Thermal Transfer Value in Buildings 1995. Building Authority. < http://www.bd.gov.hk/english/documents/code/e_ottv.htm> [Accessed 03 Feb 09]</p> <p>Building (Energy Efficiency) Regulation, 1995. < http://www.arch.hku.hk</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								/research/BEER/bee-reg.htm> [Accessed 09 Nov 09]
Electrical and Mechanical Services Department	HK Energy Efficiency Registration Scheme for Buildings	<p>Launched in October 1998 by the Electrical & Mechanical Services Department, the Scheme serves to promote the application of the Building Energy Codes (BECs)</p> <p>A registration certificate will be issued to a building that successfully meets the individual BEC standards. In addition, a registered building can also use the Scheme's "Energy Efficient Building Logo" on related documents to publicize the achievement on energy efficiency.</p>	Not Specified	Voluntary	Prepare			<p>HK Energy Efficiency Registration Scheme for Buildings. < http://www.emsd.gov.hk/emsd/eng/pee/eersb.shtml> [Accessed 09 Nov 09]</p> <p>Hong Kong Energy Efficiency Registration Scheme for Buildings, 2007. < http://www.emsd.gov.hk/emsd/e_download/pee/hkeersb.pdf> [Accessed 09 Nov 09]</p>
Planning Department / School of Architecture, Chinese University of Hong Kong	Feasibility study on climatic map and standards for Wind Environment	The urban climatic map could help identify streets of better ventilation, spots of better comfort, the problematic zones, and buildings which have negative effect on wind penetration. Such necessary information will provide a sound basis for town planners and designers to make planning decisions.	Not Specified	Mandatory	Prepare	Climatic mapping provides planners a holistic point of view of the city. How development of one district will affect nearby districts will easily be revealed in the map.	<ul style="list-style-type: none"> • Urban Heat Island effect 	<p>Urban Climatic Map and Standards for Wind Environment - Feasibility Study Inception Report: October 2006. http://www.pland.gov.hk/p_study/prog_s/ucmapweb/ucmap_project/content/reports/inception_report.pdf> [Accessed 28 Aug 09]</p>
Electrical and District		The Government plans to implement a	Not	Mandatory	Prepare	The DCS is the first project of its	<ul style="list-style-type: none"> • Increased use Territory-Wide 	

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Mechanical Services Department	cooling systems at Kai Tak Development	district cooling system at the Kai Tak Development to supply chilled water to buildings in the new development area for centralised air-conditioning. DCS is a centralised cooling system which provides chilled water to the air-conditioning system of user buildings for cooling purpose. The central chiller plant supplies chilled water and conveys it to the user buildings via underground chilled water pipe network.	Specified			kind to be implemented by the Government in Hong Kong.	of mechanical cooling	Implementation Study for Water-cooled Air Conditioning System in Hong Kong < http://www.emsd.gov.hk/emsd/e_download/pe/wacs_tws_es_eng.pdf > [Accessed 28 Aug 09]
Architectural Services Department	Green roof applications in Hong Kong	The Architectural Services Department has worked on the initiative since 2001, and finished many projects on new Government buildings, including schools, offices, hospitals, community facilities and quarters The Department completed the Study on Green Roof Application in Hong Kong in 2007 which reviewed the latest concepts and design technology of green roof and recommended technical guidelines suitable for application in Hong Kong, covering various aspects including choice of plants, waterproofing layer, thermal insulating layer, drainage layer, planting soil, irrigation as well as maintenance and repair.	Not Specified	Voluntary	Prevent, Prepare	The study also included 6 short term recommendations and 3 medium to long recommendations on green roof directions for Hong Kong.	<ul style="list-style-type: none"> • Loss of thermal comfort • Increased use of mechanical cooling 	Study on Green roof applications in Hong Kong < http://www.archsd.gov.hk/english/knowledge_sharing/1353-Green-Roofs-ES-2007-02-16.pdf > [Accessed 4 Sep 09] 'Green roofs' set for new housing estates < http://news.gov.hk/en/category/environment/061115/html/061115en04004.htm > [Accessed 4 Sep 09]
Leisure and Cultural Services Department	Green School Subsidy Scheme	The Green School Subsidy Scheme provided 665 schools and kindergartens with cash to add more greenery to their campuses and to organise greening education activities for their students with technical advice given by visiting instructors.	Tree planting projects will not exceed \$20,000 for each school	Voluntary	Prepare	The objective of the scheme is to encourage campus greening, promote a green culture among students and cultivate their interest in growing plants.	-	Greening School Subsidy Scheme 2009/2010 < http://www.lcsd.gov.hk/green/subsidy/en/index.php > [Accessed 4 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Housing Department	To explore the feasibility of implementing the Green Roof environmental improvement programme in PRH estates	Explore the feasibility of implementing the "Green Roof" programme was implemented at Wo Lok Estate and Fu Shan Market building.	Not Specified	Voluntary	Prepare	-	<ul style="list-style-type: none"> Loss of thermal comfort Increased use of mechanical cooling 	Year-end Review of the Housing Authority's 2008/09 Corporate Plan < http://www.housingauthority.gov.hk/hdw/content/document/en/aboutus/ha/paperlibrary/ha/ha2009.pdf > [Accessed 3 Sep 09]
Transport Infrastructure								
Airport Meteorological Office (AMO) Observatory	Aviation Weather Services under Hong Kong	The AMO is responsible for provision of warnings on hazardous weather which may affect the safety of aircraft operations within a designated airspace over the northern part of the South China Sea. It is also responsible for making weather observations, and issue weather forecasts.	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> Infrastructure associated with bad weather business / operation interruption 	Aviation Weather Services < http://www.hko.gov.hk/aviat/amt_e/airportmet_ser_e.htm > [Accessed 4 June 09]
Hong Kong Observatory	Design of coastal projects	As there are more storm surges and long term sea level rise, their effects have been taken into consideration in the design of coastal projects.	-	Voluntary	Prepare	-	<ul style="list-style-type: none"> Impacts associated with relative sea level rise, e.g. coastal flooding, asset damage, health and safety risks 	HKO announces findings on long-term sea level change in HK < http://www.weather.gov.hk/wxinfo/news/2004/pre0614e.htm > [Accessed 4 June 09]
Transport Department	Intelligent Transport Systems	The department has been developing the Intelligent Transport Systems (ITS) which can help alleviate climate change impacts. For	Not Specified	Mandatory	Respond	-	<ul style="list-style-type: none"> Impacts associated with climate change 	The Development of Intelligent Transport Systems (ITS) in Hong

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		example, the Journey Time Indication System being in operation since 2003 provides motorists with traffic information to make suitable route choices to cross the harbour so as to avoid traffic congestion, thus bringing about benefits of reduction in fuel consumption and polluted emissions.						Kong < http://www.td.gov.hk/about_us/technology/the_development_of_intelligent_transport_systems/index_t.htm > [Accessed 4 June 09]
Civil Engineering and Development Department	Highway Slope Manual	The manual provides a standard of good practice on slope engineering for project planning, design, construction and maintenance on highway slopes. The manual recommended a geotechnical review to be conducted when planning for new highway and road improvement projects, and a geotechnical assessment if necessary. It also suggested site investigations should take place not only in the planning stage, but also throughout the project. Ground investigations such as identification of weak zones through soil tests, observations of possible adverse topographical features, surface water distribution and seepage points needs to be incorporated into the geotechnical hazard models. Groundwater is to be investigated as well for its potential impacts on the design and stability assessment of geotechnical works for a highway project. The manual provides a general guidance on how the above assessments should be carried out. Other issues that need to be taken into consideration are also suggested: drainage, landscaping, safety precautions, maintenance and emergency preparedness.	Not Specified	Voluntary	Prevent	-	<ul style="list-style-type: none"> Infrastructure and asset damage from landslides 	Highways Slope Manual in Publications. N.d. Civil Engineering and Development Department. < http://www.cedd.gov.hk/eng/publications/manuals/manu_em2.htm > [Accessed 03 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Highways Department	Structures Design Manual for Highways and Railways	The Structures Design Manual for Highways and Railways sets out standards and provides guidance on the design of highway and railway structures in Hong Kong. The manual suggested a range of measures to be carried out for constructing highways such as: use of materials, testing materials against heat stress, testing of welds, wind loading design and etc.	Not Specified	Mandatory	Prevent	BS5400 is adopted - British Standard 5400 provides recommendations on design and construction of steel, concrete and composite bridges use in highway and railway.	<ul style="list-style-type: none"> • Risk of subsidence and foundation damage • Damage to transport infrastructure e.g. rail bucking, tarmac melt 	Structures Design Manual for Highways and Railways. 3rd e.d. 2006. Highways Department. < http://www.hyd.gov.hk/eng/public/publications/sdm/filelist.htm > [Accessed 03 Feb 09]
Slope Stability								
Civil Engineering and Development Department (Landslip Preventive Measures Branch of the Geotechnical Engineering Office)	Landslip Preventive Measures (LPM) Programme	The aim of the on-going LPM Programme is to reduce the risk of landslide from substandard Government slopes. Private slopes are also investigated and private owners will be required to upgrade substandard slopes (according to the Building Ordinance). The department has identified 2500 substandard government slopes where upgrading works are scheduled to complete by 2010, and 3000 private slopes are being studied.	\$12.2 billion since 1976 (as of 1 March 2009) \$600 million p.a. for the 10 year extended programme (2000-10)	Mandatory	Prevent, Prepare	-	<ul style="list-style-type: none"> • Infrastructure and asset damage from landslides 	LPM Project in On-going projects. n.d. Civil Engineering and Development Department. < http://www.cedd.gov.hk/eng/projects/landslip/land_lpm.htm > [Accessed 04 Feb 09] The Landslip Preventive Measures (LPM) Programme in <i>Information Note 04/2008</i> . 2008. Civil Engineering and Development Department. < http://www.cedd.gov.hk/eng/publications/information_notes/doc/in_2008_04e.pdf > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Geotechnical Engineering Office, Civil Engineering and Development Department	How to Protect Your Family and Yourself when the Landslip Warning is in Force Leaflet	A leaflet to inform the public how to protect themselves and their family when landslip warning is in force.	Not Specified	Voluntary	Prevent, Prepare	-	Slope safety	How to Protect Your Family and Yourself when the Landslip Warning is in Force < http://hkss.cedd.gov.hk/hkss/eng/download/leaflet/leaflet-how-to-protect-your-family-eng.pdf > [Accessed 17 June 09]
Hong Kong Slope Safety, Civil Engineering and Development Department	How to Keep Your Slope Safe website	The website provides the information on the slope maintenance, who is responsible for the slope safety, standard of good practice on slope maintenance etc.	Not Specified	Mandatory	Prevent, Prepare	-	Slope safety	How to Keep Your Slope Safe< http://hkss.cedd.gov.hk/hkss/eng/download/how2keep/index.htm > [Accessed 17 June 09]
Geotechnical Engineering Office, Civil Engineering and Development Department	Layman's Guide to Slope Maintenance	The guidance recommends a standard of good practice for the maintenance of man-made slopes and retaining walls. It provides information on how to conduct maintenance inspections and maintenance works necessary to avoid the instability of slopes.	Not Specified	Voluntary	Prevent, Prepare	-	Slope safety	Layman's Guide to Slope Maintenance < http://hkss.cedd.gov.hk/hkss/eng/download/layman/Layman_guide_e_2006.pdf > [Accessed 17 June 09]
Geotechnical Engineering Office, Civil Engineering and Development Department	GEO Emergency Service to Government Departments	When the Landslip Warning is in force, the GEO Emergency Control Centre operates to provide geotechnical advice about landslides for government departments. When landslides happen, despatch geotechnical engineers will go to incident spot to advise on emergency measures (e.g. road closures) and urgent repair works.	Not Specified	Mandatory	Respond	-	Slope safety	GEO Emergency Service < http://hkss.cedd.gov.hk/hkss/eng/safemeasure/emergency/emergency.htm > [Accessed 17 June 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
The Geotechnical Engineering Office (GEO) and Hong Kong Observatory	Landslip Warning System	Landslip Warning is issued according to the rainfall data monitored by GEO and HKO. If the 24-hour rainfall is expected to be heavy enough to cause numerous landslides, the Landslip Warning will be issued.	Not Specified	Mandatory	Prepare	-	Slope safety	Detailed Information on Landslip Warning System < http://hkss.cedd.gov.hk/hkss/eng/safemeasure/warning/landslip.htm > [Accessed 17 June 09]

Drainage Infrastructure (including stormwater drainage, sewerage systems and wastewater treatment facilities)

Drainage Services Department	Preventive Maintenance	Approximately 79% of total drains and watercourses are inspected every year especially before and during wet seasons. Closed circuit televisions are installed to monitor drains where man-entry inspections are not possible. Tidal channels are desilted and dredged regularly to ensure maximum flood carrying capacities.	Approximately \$100 million (p.a.)	Mandatory	Prevent	Status: ongoing Annual inspection on the flood control installations is conducted to ensure that they would be fully operational in times of rainstorm. DSD also works with other departments to keep streets clean to prevent litter from blocking roadside gullies and catchpits. Stormwater drainage asset inventory and maintenance systems are also being developed as part of the regional drainage master plans (mostly developed). The system will provide an accurate up-to-date record of the inventory and the hydraulic and structural performance of the drainage system. This will allow early identification of faults and deficiencies in the system, and to draw up action plans and	<ul style="list-style-type: none"> Discharge problems at drainage outflows – risking backing up Flooding of system beyond designed capacity 	Preventive Maintenance in Flood Prevention. n.d. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/preventive_maintenance/index.htm > [Accessed 30 Jan 09]
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Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						maintenance schedules.		
Drainage Services Department	Land Drainage Ordinance	The Ordinance was enacted in 1994, where the Government has the authority to access private land to carry out maintenance works and to remove obstructions to watercourses.	Not Specified	Mandatory	Prevent	Status: ongoing	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – up • Flooding of system beyond designed capacity • Asset damage from flooding 	Chapter 446 Land Drainage Ordinance in <i>Bilingual Laws Information System</i> . n.d. Department of Justice. < http://www.legislation.gov.hk/eng/home.htm > [Accessed 02 Feb 09] Land Drainage Ordinance in Flood Prevention. n.d. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/land_use_management/legislation/ldo/index.htm > [Accessed 02 Feb 09]
Drainage Services Department	Rural Drainage Rehabilitation Scheme – drainage rehabilitation works at Sha Po Tsuen Stream	Widening and straightening of the Sha Po Tsuen Stream to raise flood protection level of the area and reduce the risk of flooding during heavy rainstorms.	\$60.9 Million	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> • Flooding of system beyond designed capacity • Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_recently_completed/index_UID_824.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Tsuen Wan and Kwai Chung	Construction of about 1,200m drainage pipes and structural rehabilitation of about 450m existing drains and culverts.	Approximately \$81 million	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> • Flooding of system beyond designed capacity • Asset 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
							damage from flooding	/our_projects/flood_rece ntly_completed/index_UI D_839.htm> [Accessed 30 Jan 09]
Drainage Services Department	Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai drainage improvements	Alleviate flooding problems at Cheung Kong, Tai Kong Po, Tsat Sing Kong and Ha Che of Kam Tin and San Wai Tsuen of Ngau Tam Mei by constructing five secondary drainage channels in the area.	Approximately \$140 million for stage one, not specified for stage two	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> Flooding of system beyond designed capacity Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_rece ntly_completed/index_UI D_825.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement Works at Yung Shue Long New Village in Lamma Island, Tseng Lan Shue in Sai Kung and Shui Lau Hang in Ta Kwu Ling	Construction of drainage improvement works: <ul style="list-style-type: none"> a) at Yung Shue Long New Village, Lamma Island - <ul style="list-style-type: none"> i) about 130 metres of a 2-metre wide rectangular concrete channel; ii) deepening of about 44 metres of an existing concrete channel by 0.5 metre; and, iii) a maintenance access and ancillary drainage works. b) at Tseng Lan Shue, Sai Kung - <ul style="list-style-type: none"> i) about 140 metres of a 4-metre wide box culvert; and ii) a maintenance access and ancillary drainage works. c) at Shui Lau Hang, Ta Kwu Ling - <ul style="list-style-type: none"> i) about 440 metres of a 3.5-metre wide 	Approximately \$46 million	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> Discharge problems at drainage outflows – risking backing up Flooding of system beyond designed capacity Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_rece ntly_completed/index_UI D_959.htm > [Accessed 30 Jan 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		rectangular concrete channel; and ii) a maintenance access and ancillary drainage works.						
Drainage Services Department	Drainage improvement for Ma Wat River at Kau Lung Hang	To alleviate flooding problems in Kau Lung Hang and increase flood protection standards to meet long-term development needs by constructing approximately 1.8 km long drainage channels near Kau Lung Hang and north of Hong Lok Yuen, Tai Po.	Approximately \$230 million	N.A.	Prevent	Status: completed	• Asset damage from flooding	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_recently_completed/index_UID_971.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Northern Hong Kong Island - Intercepting drains at Queen's Road Central	To alleviate flooding hazards in low-lying area in Sheung Wan by: 1) constructing 530 metres of stormwater drains ranging from 900 millimetres (mm) to 1500 mm along Lok Ku Road and Queen's Road Central; and 2) constructing 130m of single cell drainage box culverts of internal size 2250mm wide and about 1250mm high along Gilman's Bazaar	Approximately \$46 million	N.A.	Prevent	Status: completed	• Asset damage from flooding	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_recently_completed/index_UID_1051.htm > [Accessed 30 Jan 09]
Drainage Services Department	Yuen Long bypass floodway	This aims to alleviate flooding problems in the low-lying area to the south of Yuen Long Town and reduce flooding hazards of Yuen Long Town through: 1) the construction of a drainage channel of about 3.8km long from Sham Chung Tsuen to Kam Tin River near Sha Po Tsuen; 2) the construction of an inflatable dam and a low flow pumping station at the downstream	\$476.2 million	N.A.	Prevent	Status: completed	• Asset damage from flooding	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_recently_completed/index_UID_265.htm > [Accessed 30 Jan 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		end of the proposed drainage channel; 3) the construction of 18 box culverts; 4) the construction of roads and ramps with associated drainage and water works along the proposed drainage channel; 5) environmental mitigation measures including creation of an artificial wetland and landscaping works; and 6) environmental monitoring and audit programme.						
Drainage Services Department	San Tin Eastern Main Drainage Channel	Aims to alleviate flooding problems in the low-lying areas at the east of San Tin and Ki Lun Tsuen of Yuen Long through: 1. the construction of a trapezoidal drainage channel of about 2.2km long from Castle Peak Road along the western side of San Sham Road to Shenzhen River; 2. the construction of an inflaTable Bam and a low flow pumping station; 3. the construction of a vehicular bridge; 4. the construction of roads and ramps with associated drainage and water works; 5. environmental mitigation measures including compensatory planting, wetland creation and landscape works; and 6. an environmental monitoring and audit programme	\$354.2 million	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_rece ntly_completed/index_UI D_777.htm > [Accessed 30 Jan 09]
Drainage Services Department	Village Flood Protection for Tai Kiu and Shui Pin Tsuen, Yuen	Aims to alleviate flood risks in 2 low-lying villages in Yuen Long - Tai Kiu and Shui Pin Tsuen. Tai Kiu Pumping Station:1. A floodwater storage pond 2. A floodwater pumping station and associated electrical and	Approximately \$63 million	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> • Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Long, New Territories	mechanical works; and 3. Associated internal access and drainage works Shui Pin Tsuen Pumping Station:1. An underground floodwater storage tank 2. A floodwater pumping station and associated electrical and mechanical works; and 3. Associated internal access and drainage works.						/our_projects/flood_rece ntly_completed/index_UI D_958.htm> [Accessed 30 Jan 09]
Drainage Services Department	Main drainage channels for Yuen Long and Kam Tin	Aims to alleviate flooding problems in the low-lying areas of Kam Tin along the Kam Tin River between Wang Toi Shan and Kam Tin San Tsuen through the construction of: <ol style="list-style-type: none"> 1. a drainage channel of about 3.1km long along the section of Kam Tin River between Kam Tin San Tsuen and Wang Toi Shan; 2. an inflatable dam, an air blower house, an irrigation water tank and a pumping chamber; 3. a gauging station to replace the existing Kam Tin River Gauging Station; 4. roads with associated drainage works; 5. four vehicular bridges and five footbridges; 6. environmental mitigation measures including landscaping works; and 7. an environmental monitoring and audit programme for the works. 	\$419.3 million for stage 2 (Kam Tin San Tsuen to Wang Toi Shan section)	N.A.	Prevent	Status: completed	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_rece ntly_completed/index_UI D_778.htm > [Accessed 30 Jan 09]
Drainage Services Department	Main drainage channel for Ngau Tam Mei	The project aims at alleviating the flooding problems in the lower catchment area of Ngau Tam Mei of Yuen Long, including Chuk Yuen Tsuen, Yau Mei San Tsuen, Man Yuen Tsuen and Tai San Wai area. The scope of the project comprises the	\$442.5 million for phase 1 (Yau Mei San Tsuen to Tai Sang Wai	N.A.	Prevent	Status: completed (Phase 1)	<ul style="list-style-type: none"> • Asset damage from flooding 	Flood Prevention Projects Recently Completed. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_rece ntly_completed/index_UI

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		construction of : - 1. a drainage channel of about 2.3km long from Castle Peak Road near Yau Mei San Tsuen to Tai Sang Wai; 2. an inflatable Bam and a low flow pumping station; 3. an irrigation pumping station; 4. roads and ramps with associated drainage and water works; 5. four vehicular bridges; and 6. environmental mitigation measures including landscaping works.	section)					D_245.htm> [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement in Tuen Mun and Sham Tseng	Construction of: 1,100 m of drainage channel at So Kwun Wat, and 750 m of drainage pipeline, drainage channel and box culvert at Nai Wai.	\$76.5 million for Package B	N.A.	Prevent	Status: ongoing	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	On-going flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_ongoing/index_UID_1205.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement in Southern Lantau	Aims to alleviate flooding problems at Pak Ngan Heung, Luk Tei Tong, Tai Tei Tong and Ling Tsui Tau in Mui Wo, and some local areas at Cheung Sha Sheung Tsuen, Lo Uk Tsuen and Pui O Ham Tin San Tsuen in Southern Lantau through the construction of drainage channels, box culverts, drains and	\$97.7 million	N.A.	Prevent	Status: ongoing	<ul style="list-style-type: none"> • Asset damage from flooding 	On-going flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_ongoing/index_UID_1122.htm >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		ancillary drainage works.						m> [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement Works in Sha Tin	Construction of about 2.8 km of upgrading works and new drains in the Sha Tin urban area.	\$72.4 million	N.A.	Prevent	Status: ongoing	<ul style="list-style-type: none"> Flooding of system beyond designed capacity Asset damage from flooding 	On-going flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_ongoing/index_UID_846.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement in Kwu Tung South and Fu Tei Au, Sheung Shui	Construction of about 1.8km of drainage channels in Kwu Tung South and Fu Tei Au, Sheung Shui, New Territories.	\$58.3 million	N.A.	Prevent	Status: ongoing	<ul style="list-style-type: none"> Asset damage from flooding 	On-going flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_ongoing/index_UID_1115.htm > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement works in Ping Kong, Kau Lung Hang, Yuen Leng, Nam Wa Po and Tai Hang areas	Construction of about 5.1 km long drainage channels/box culverts in Ping Kong, Kau Lung Hang, Yuen Leng, Nam Wa Po and Tai Hang areas.	Approximately \$260 million	N.A.	Prevent	Status: ongoing	<ul style="list-style-type: none"> Asset damage from flooding 	On-going flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/flood_ongoing/index_UID_1165.htm > [Accessed 30 Jan 09]
Drainage Services Department	Reconstruction and Improvement of Kai Tak Nullah (Choi	The project includes the reconstruction and decking of a section of approximately 400m along the Nullah from its upstream near Po Kong Village Road to Tai Shing Street/Tung Tai Lane and the reconstruction and	Approximately \$1600 million	N.A.	Prevent	Status: to be commenced in early 2010	<ul style="list-style-type: none"> Discharge problems at drainage outflows – risking backing 	Up-coming flood prevention projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Hung Road Section) in Wong Tai Sin	rehabilitation of approximately 200m along Nullah from Tai Shing Street/Tung Tai Lane to Tung Kwong Road.					up • Flooding of system beyond designed capacity • Asset damage from flooding	/our_projects/flood_up_coming/index_UID_1052.htm> [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement in Southern Hong Kong Island	Upgrade of 4.6km long stormwater drains within urban catchments in Pokfulam, Tin Wan, Aberdeen, Ap Lei Chau and Stanley, and construction of small-scale drainage improvement works within rural catchments in Pokfulam Village and Shek O.	Approximately \$50 million	N.A.	Prevent	Status: to be commenced in early 2011	• Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding	Up-coming flood prevention projects. n.d. Drainage Services Department. <http://www.dsd.gov.hk/our_projects/flood_up_coming/index_UID_1164.htm> [Accessed 30 Jan 09]
Drainage Services Department	Drainage Improvement Works in Pok Fu Lam, Wah Fu, Tin Wan, Aberdeen, Wong Chuk Hang and Shek O of Southern Hong Kong Island	Upgrade of 1.3km long stormwater drains within urban catchments in Pokfulam, Wah Fu, Tin Wan, Aberdeen, Wong Chuk Hang and Shek O, and construction of drainage improvement works within rural catchments in Pokfulam Village and Shek O.	Approximately \$50 million	N.A.	Prevent	Status: up-coming	• Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from	Up-coming flood prevention projects. n.d. Drainage Services Department. <http://www.dsd.gov.hk/our_projects/flood_up_coming/index_UID_1294.htm> [Accessed 30 Jan 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Drainage Services Department	Rural Drainage Rehabilitation Scheme	Construction of: 3.9km drainage channel along a section of Sheung Yue River from Tsiu Keng Lo Wai to Fanling Highway; 500m drainage channel along a section of Ying Pun Ho from Chan Uk Po to the confluence with Sheung Yu River; 500m drainage channel along Kwu Tung Stream from Fanling Highway to the confluence with Sheung Yue River; total of 4.2km maintenance access roads along the proposed drainage channels; and demolition and reprovision of 6 footbridges and 2 agricultural weirs.	\$359 million	N.A.	Prevent	Commencement: 30 April 1999 Completion Date: End 2001	flooding • Asset damage from flooding	Sewerage Treatment. n.d. Drainage Services Department. < http://www.dsd.gov.hk/sewerage/sewage_treatment/index_t.htm > [Accessed 30 Jan 09]
Drainage Services Department	West Kowloon Drainage Improvement	Improvement of 11km of stormwater drains.	\$1,214 million	N.A.	Prevent	Location of significant improvements and benefits of Stage 2 phase 2 and stage 3 phase 1 works: Yau Ma Tei, Mong Kok, Tai Kok Tsui, Sham Shui Po Start: Mar 2001 Complete: Mid 2007	• Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	West Kowloon Drainage Improvement Transfer Scheme	Construction of the 3.7km Lai Chi Kok stormwater transfer tunnel, 6 drop shafts together with associated stilling basin and outfall structures.	\$1.8 billion	Mandatory	Prevent	Location of significant improvements and benefits: Lai Chi Kok, Cheung Sha Wan and Shum Shui Po Start: Early 2008 Complete: End 2012	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf> [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Northern Hong Kong Island - Hong Kong West Drainage Tunnel	Construction of 18km stormwater drainage tunnel.	\$3,045 million	N.A.	Prevent	Location of significant improvements and benefits: Causeway Bay, Wan Chai, Central, Sheung Wan, Kennedy Town Start: End of 2007 Complete: Early 2012	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Northern Hong Kong Island - western lower catchment works	Construction of 4.4km stormwater drains.	\$251 million	N.A.	Prevent	Location of significant improvements and benefits: Chai Wan, Shau Kei Wan, North Point, Causeway Bay, Wan Chai, Central, Sheung Wan, Kennedy Town Start: Early 2008 Complete: End 2012	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement works in Tai Po	Construction of 9.8km of stormwater drains and a stormwater pumping station and drainage channels.	\$123 million	N.A.	Prevent	Location of significant improvements and benefits: Tai Po Town Areas, Lam Tsuen Valley, Wun Yiu, Yuen Tun Ha, She San Tsuen, Tung Tsz, Shuen Wan, Wai Ha, Ting Kok Road Start: Early 2008 Complete: Early 2011	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								30 Jan 09]
Drainage Services Department	Drainage improvement works in upper Lam Tsuen River, She Shan River, upper Tai Po River, Ping Long and Kwun Hang	Construction of 4.4km drainage channels and box-culvert.	\$426 million	N.A.	Prevent	Location of significant improvements and benefits: Upper Lam Tsuen River, She Shan River, upper Tai Po River, Ping Long and Kwun Hang Start: End 2007 Complete: Mid 2011	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Tsuen Wan, Kwai Chung and Tsing Yi - Tsuen Wan drainage tunnel	Construction of 5.35km stormwater drainage tunnel.	\$1,260 million	N.A.	Prevent	Location of significant improvements and benefits: Tsuen Wan and Kwai Chung Start: End 2007 Complete: End 2011	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Sai Kung	Construction of 2km drainage channels.	\$158 million	N.A.	Prevent	Location of significant improvements and benefits: Sha Ha, Pak Kong, Ho Chung, Sai Kung Town Start: End 2007 Complete: End 2009	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Drainage Services Department	Drainage improvement in East Kowloon	Construction of 11km stormwater drains.	\$188 million (Package B phase 2)	N.A.	Prevent	Location of significant improvements and benefits: Hung Hom, Ma Tau Wai, Kowloon City, Kwun Tong, San Po Kong Package B Phase 2 Start: Apr 2007 Complete: Early 2011	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in Northern Hong Kong Island - Sheung Wan stormwater pumping station	Construction of stormwater pumping station.	\$178 million	N.A.	Prevent	Location of significant improvements and benefits: Sheung Wan Start: Jun 2006 Complete: End 2009	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2006-07</i> . 2007. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0607/EN/appendices/DSD_AR06_App(A).pdf > [Accessed 30 Jan 09]
Drainage Services Department	Drainage improvement in East Kowloon	The project aims to alleviate flooding problems in East Kowloon including Tsim Sha Tsui, To Kwa Wan, Wong Tai Sin and Yau Tong areas. The project includes the construction of approximately 5km long stormwater drains and box culverts started in May 2005 for completion in Oct 2008.	\$250 million for Package A	N.A.	Prevent	Location of significant improvements and benefits: Tsim Sha Tsui, To Kwa Wan, Wong Tai Sin, Yau Tong Package A Start: May 2005 Complete: January 2009 (Status: in Progress as of 10 Feb 09)	• Asset damage from flooding	On-going Flood Prevention Projects. n.d. Drainage Services Department. < http://www.dsd.gov.hk/our_projects/our_project_status_ongoing/index_UID_960.htm > [Accessed 09 Feb 09]
Drainage Services Department	River training works for the Upper River	Training of drainage channel.	\$756 million	N.A.	Prevent	Start: Aug 1999 Complete: Mar 2003	• Asset damage from flooding	Appendix A - Major Flood Control Projects in <i>DSD Annual Report 2005-</i>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		Indus						06. 2006. Drainage Services Department. < http://www.dsd.gov.hk/annual_reports/0506/eng/appendix-A_eng.pdf > [Accessed 02 Feb 09]
Drainage Services Department	Village Flood Protection Scheme for San Tin Villages	The scheme aims to prevent floodwater with a return period of 1 in 200 years from entering the village areas from downstream channels, and at the same time capable of collecting and storing runoff from San Tin villages for subsequent discharge to the existing streams without affecting the life and property of the villagers.	Almost \$130 million	Mandatory	Prevent, Prepare	Status: completed The major elements of the scheme are: * 1.9km long flood protection embankment * 2.2ha floodwater storage pond * 2 storey high pumping station * 680m twin-cell concrete box culverts connecting the pumping station * maintenance access connecting the floodwater storage pond and pumping station	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	Village Flood Protection Scheme for San Tin Villages. 1999. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/access_information/code_access_information/list/VFPS%20for%20San%20Tin%20Villages.pdf > [Accessed 30 Jan 09]
Drainage Services Department	Flood Protection Standards	A set of flood protection standards is for the planning and design of the public stormwater drainage systems. The standards are developed based on factors including land use development scenarios, economic growth, socio-economic needs, consequences of flooding, and benefit-cost analysis of flood mitigation measures.	Not Specified	Mandatory	Prepare	Status: on-going All stormwater facilities in new developments have to be designed to withstand a severe flood event, which will occur at the Average Recurrence Interval (approximately once within the period) stated below: - Urban drainage trunk systems (200 years) - Urban drainage branch systems (50 years)	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	Flood Protection Standards. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/flood_protection_standards/index.htm > [Accessed 15 April 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						<p>- Main rural catchment drainage channels (50 years)</p> <p>- Village drainage (10 years)</p> <p>- Intensively used agricultural land (2-5 years)</p> <p>The definition of flood events is based on the combination of rainfall intensity and tide levels.</p> <p>It will not be always possible or practical to upgrade the existing drainage systems, especially those within the old urban areas, to the current standards. In these special circumstances, a pragmatic approach is necessary in order to determine the best possible flood protection levels that can be achieved having regard to the constraints imposed by the existing highly intensive development.</p>		
Drainage Services Department	Flood Warning System	Real-time water levels monitoring at major rivers and channels to provide information for analysing the flood situation and alerting rescue departments. Local flood warning systems are installed at flood prone villages to alert villagers when the flood water reaches a predetermined level. The warnings are announced through flood sirens or through automatic telephone calls to the village representatives.	Not Specified	Mandatory	Prepare, Respond	Status: on-going	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset 	Chapter 4 Ready for the Rainy Days in <i>DSD Annual Report 00/01</i> . 2001. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/TC/publications_publicity/publicity_materials/annual_reports/0001rpt/05e.html > [Accessed 30 Jan 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Drainage Services Department	Emergency Planning	To manage flood hazards, DSD has set up a 24-hour hotline which enables their direct labour force / contractors to deal with the flooding complaints as soon as possible. DSD tries to ensure that complaints received in the morning are investigated on the same day or the next morning for those received after 1 pm. Complaints received are recorded by a computerised Drainage Complaints Information System so that data could be retrieved and analysed later.	Not Specified	Mandatory	Prepare, Respond	Status: on-going	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up system beyond designed capacity • Asset damage from flooding 	Emergency Planning. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/preventive_maintenance/emergency_planning/index.htm > [Accessed 15 April 09]
Drainage Services Department	Emergency and Storm Damage Organisation	To handle emergency and flooding problems outside office hours.	Not Specified	Mandatory	Prepare, Respond	Status: on-going	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up system beyond designed capacity • Asset damage from flooding 	Emergency Planning. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/preventive_maintenance/emergency_planning/index.htm > [Accessed 15 April 09]
Drainage Services Department	An Emergency Control Centre	The centre is overseen by senior professionals and is activated when the situation warrants in order to coordinate emergency clearance of blocked drains and watercourses throughout	Not Specified	Mandatory	Prepare, Respond	Status: on-going	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – 	Emergency Planning. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/preventive_maintenance/emergency_planning/index.htm > [Accessed 15 April 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		the territory, to handle the large number of complaints and reports of flooding, and to disseminate information within the Government and to the public. Crucial hydraulic structures, such as the facilities within the flood pumping station and the inflaTable Bams at major channels constructed for stormwater quality improvement, are closely monitored by telemetry and video surveillance for visual monitoring of important electrical, mechanical and civil components.					risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding	ention/preventive_maintenance/emergency_planning/index.htm> [Accessed 15 April 09]
Drainage Services Department	Drainage Master Plan Studies	The Drainage Services Department has commissioned 8 Stormwater Drainage Master Plan (DMP) Studies to provide recommendations on flood prevention, meeting long term development needs, together with the cost involved.	Not Specified	Mandatory	Prepare	Status: studies completed; measures in progress Some of the recommendations made in these studies have been or will be implemented. The models used in these studies included MIKE 11 and HydroWorks.	• Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding	Drainage master plan studies in Flood Prevention. n.d. Drainage Services Department. < http://www.dsd.gov.hk/flood_prevention/our_achievement/other_areas/index.htm > [Accessed 30 Jan 09] Flood Prevention Drainage Master Plan < http://www.dsd.gov.hk/flood_prevention/long_term_improvement_measures/dmp/index.htm > [Accessed 16 Sep 09]
Drainage Master Plan Studies:								
Drainage Services Department	Yuen Long, Kam Tin, Ngau Tam Mei and Tin	The main objective of the YLDMP is to recommend first aid, short and long term improvement measures for the secondary and local stormwater drainage systems	Cost of recommend ed measures:	Voluntary	YLDMP - Prepare	Status: studies completed; measures in progress The study has identified a list of		Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai Drainage Master Plan Study:

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Shui Wai Drainage Master Plan Study (YLDMP)	within the study area. The Asset Inventory and Management System and Real Time Flow Monitoring System was developed and implemented in the study. The recommendations (such as minimum floor levels and drainage criteria) were accompanied by an implementation programme with cost estimates.	\$535 million for stage 1 (Sep 2001 to Jun 2006) Stage 2: \$130 million (Oct 2007 to Sep 2010)		dations - Prevent	flood prone villages, and the necessary measures required for those areas without flood protection measures. In addition, it identified areas where further work is required, such as the construction of secondary channels, drainage networks, and setting minimum floor levels for new buildings in the floodplain (prevention from a 200 year return period flood event).		Executive Summary. 1999. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/YL%20KT%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]
	Stormwater Drainage Master Plan Study in Northern Hong Kong Island	The objectives of the study is to: * examine and assess the conditions and inadequacies of the stormwater drainage systems and associated facilities within the Study Area; * recommendations to improve drainage system to meet current standards and future needs together with construction cost estimates * develop a prioritised programme/staging of works based on costs and benefits for implementation of the recommended works; and * develop a stormwater drainage assest inventory and management system	Total cost of recommend ed measures: \$2,141.24M	Voluntary	Study - Prepare Recommen dations - Prevent	Status: study completed The study has conducted assessments through hydraulic modelling, utility intrusion investigation, and flood and rainfall survey. A range of recommendations were made in the study on potential options for improvement, taking into account of the geological aspects, transport network and etc. Three drainage improvement works items were recommended: * Hong Kong West Drainage Tunnel * Lower Catchment Improvement * Sheung Wan Stormwater Pumping Station		Stormwater Drainage Master Plan Study in Northern Hong Kong: Executive Summary. 2003. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/NHK%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]
	Stormwater	The objectives of the study is to:* examine	Total	Voluntary	Study -	Status: study completedThe study		Stormwater Drainage

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Drainage Master Plan Study in Tsuen Wan, Kwai Chung and Tsing Yi Drainage	and assess the conditions and inadequacies of the stormwater drainage systems and associated facilities within the Study Area;* recommendations to improve drainage system to meet current standards and future needs together with construction cost estimates* develop a prioritised programme/staging of works based on costs and benefits for implementation of the recommended works; and * develop a stormwater drainage assest inventory and management system	Estimated Capital Costs for proposed improvement works: \$1,184 million		PrepareRecommendations - Prevent	assessed the drainage system in the area, including the 13 major catchments, through the use of computer models. Two major recommendations were made at the end of the study, each of which was assessed against a set of criteria such as the configuration of the systems, topography and geology; land requirements; interfaces with utilities and underground structures; highway and traffic considerations; environmental considerations; maintenance and reliability; capital and operating costs. The study has also identified the remaining risks that may occur under certain circumstances and recommended regular inspections.		Master Plan Study in Tsuen Wan, Kwai Chung and Tsing Yi: Executive Summary. 2002. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/TW%20Study%20Report%20Eng.pdf > [Accessed 02 Feb09]
	Stormwater Drainage Master Plan Study in Tuen Mun and Sham Tseng (TMDMP)	Similar to the above Drainage Master Plan Studies commissioned by the government, the objective of the TMDMP is to assess the drainage system in the proposed area, and to provide recommendations on improvements, together with the estimated costs and timeline.	Total Estimated Cost for implementing the proposed programme : \$75 million (at Dec 1998 prices), \$0.55 million for structural	Voluntary	Study - PrepareRecommendations - Prevent	Status: study completed Recommendations were made addressing issues identified in the assessments: * First aid measures for flood prone areas * Drain-laying in streets * Demolition of vehicular bridge * Bank raising * Box culvert and pipe * Trapezoidal channel with grasscrete banks		Stormwater Drainage Master Plan Study in Tuen Mun and Sham Tseng: Executive Summary. 2002. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/TMST%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
			repairs					
	Drainage Master Plan Study in the Northern New Territories	Similar to the above Drainage Master Plan Studies commissioned by the government, the objective is to assess the drainage system in the proposed area, and to provide recommendations on improvements, together with the estimated costs and timeline.	Total Estimated Cost for implementing the recommendations: \$1,386 million	Voluntary	Study - Prepare Recommendations - Prevent	Status: study completed Proposed improvement works: * Upgrading and rehabilitation of pipes and culverts to provide improvement to the existing drainage systems in identified areas * Construction of drainage channels * Improvement on secondary and local channels		Drainage Master Plan Study in the Northern New Territories: Executive Summary. 2003. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/NNT%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]
	Stormwater Drainage Master Plan Study in Sha Tin and Tai Po	Similar to the above Drainage Master Plan Studies commissioned by the government, the objective is to assess the drainage system in the proposed area, and to provide recommendations on improvements, together with the estimated costs and timeline.	Total Estimated Cost for implementing the recommended programme: \$386 million Structural Repairs: \$8.3 million	Voluntary	Prepare	Status: study completed Recommendations were: * Drain-laying in streets * Modifications to river bank walls * Construction of flood water pumping station * Installation of flap valves at outfalls * Construction of floodwall * Drainage diversion		Stormwater Drainage Master Plan Study in Sha Tin and Tai Po: Executive Summary. 2003. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/STTP%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]
	Stormwater Drainage Master Plan Study in Sai Kung	Similar to the above Drainage Master Plan Studies commissioned by the government, the objective is to assess the drainage system in the proposed area, and to provide	Total Estimated Cost for implementing	Voluntary	Prepare	Status: study completed Recommendations include: * Widen and deepen the rivers to a trapezoidal channel with		Stormwater Drainage Master Plan Study in Sai Kung, East Kowloon and Southern Lantau:

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Kung, East Kowloon and Southern Lantau		recommendations on improvements, together with the estimated costs and timeline.	\$802.5 million Structural Repairs: \$4.4 million			grasscrete and masonry bank and natural bed * Construction (or enlarge) of box vulvert * Construction of concrete kerbs along riverbanks * Construction of high parapet wall * Construction of pipes Development and implementation of Asset Inventory and Management System (AMS) and Real Time Flow Monitoring System (RTFM)		Executive Summary. 2003. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/SK%20EKLN%20Study%20Report%20Eng.pdf > [Accessed 02 Feb 09]
Stormwater Drainage Master Plan Study in Southern Hong Kong Island		Similar to the above Drainage Master Plan Studies commissioned by the government, the objective is to assess the drainage system in the proposed area, and to provide recommendations on improvements, together with the estimated costs and timeline.	Total Estimated Cost for implementation: \$4.2 million Structural Repairs: \$4.4 million	Voluntary	Prepare	Status: study completed Proposed Plan: * First Aid Measures * Overall improvement programme (enlarge pipes, construction of box vulvert and etc) * Roadside drainage improvement		Stormwater Drainage Master Plan Study in Southern Hong Kong Island: Executive Summary. 2005. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/flood_prevention/our_achievement/other_areas/SHKI%20Study.pdf > [Accessed 02 Feb 09] (Available in Chinese only)
Civil Engineering and Development	Design, Construction and Handing Over of	General requirements for the design and approval of Drainage and Sewerage projects are given in the Project Administration Handbook for Civil Engineering Works, 2008	Not Specified	Mandatory	Prepare	Extreme Sea Levels are given by the Hong Kong observatory, return periods depend on the design life. Water Quality Control	• Discharge problems at drainage outflows –	Design, Construction and Handing Over of Drainage and Sewerage Works. Civil Engineering

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								Engineering and Development Department. < http://www.dsd.gov.hk/FileManager/EN/publications_publicity/other_publications/technical_manuals/Sewer%20Manual%20Part%201.pdf > [Accessed 16 April 09]
Drainage Service Department and Environmental Protection Department	Sewerage Master Plan	In 1989, a sewage disposal strategy was adopted by the Government. Since then, 16 Sewerage Master Plan Studies have been undertaken by Environmental Protection Department to cover all of Hong Kong. In order to account for the growth of the population in Hong Kong, the 16 Sewerage Master Plans are being reviewed to accommodate the changes in planned population.	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Discharge problems at drainage outflows – risking backing up • Flooding of system beyond designed capacity • Asset damage from flooding 	Sewerage Master Plan. Drainage Service Department 2009. < http://www.dsd.gov.hk/sewerage/sewerage_improvement_content/sewerage_master_plan_project/index.htm > [Accessed 16 April 09]
Hong Kong Observatory in co-operation with the Lands Department and Hong Kong Polytechnic University	Vertical ground movement measurements	Measurements of the vertical ground movement at tide gauge stations, using satellite-based Global Positioning System techniques started in 2004. This data will support long term sea level change studies in future.	Not Specified	Mandatory	Prepare	Information on predicted and real time tide are provided on the Hong Kong Observatory website.	<ul style="list-style-type: none"> • Impacts associated with relative sea level rise, e.g. coastal flooding, health and safety risks 	Press Release HKO announces findings on long-term sea level change in HK (14 June 2004). Hong Kong Observatory. < http://www.weather.gov.hk/wxinfo/news/2004/pre0614e.htm > [Accessed 15 Apr 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Hong Kong Observatory	Tidal information	A number of automatic tide gauges have been installed at sites along the coast of Hong Kong since 1950s. The North Point/Quarry Bay (NPQB) tide gauge station provides the longest tidal records in Hong Kong.	Not Specified	Mandatory	Prepare	Tide gauge station at North Point measured the sea level of Victoria Harbour from 1954 to 1985, and then was relocated to Quarry Bay in 1986. Both stations were built on reclaimed land (other stations were not built on reclaimed land) and the Port Works Division of the Civil Engineering Department carried out the monitoring of settlement of the station. Station at Tai Po Kau has been recording sea levels in Tolo Harbour since 1963. Station at Tsim Bei Tsui since 1974. Station at Waglan Islands since 1976. Station at Shek Pik since 1997.	<ul style="list-style-type: none"> Impacts associated with relative sea level rise, e.g. flooding, health and safety risks 	HKO Reprint 556 Long Term Sea Level Change in Hong Kong. Hong Kong Observatory.
Works Branch	Technical Circular No. 6/90 - Greenhouse Effect - Allowance in Design	The possible implications of the Greenhouse Effect should be considered at an early stage in all designs - make an allowance for the Greenhouse Effect, assuming a 10 mm increase in mean sea-level per year.	Not Specified	Voluntary	Prevent, Prepare	Allowance for the Greenhouse Effect in designs should not generally be made, except for the following circumstances:(i) Where doing so would entail no extra capital or maintenance costs;(ii) Where doing so would entail minimal extra capital (2% maximum increase) and/or maintenance costs;(iii) For projects of design life of at least 50 years that are particularly sensitive to sea-level changes, and where to increase levels or make other alterations at a later stage would	<ul style="list-style-type: none"> Impacts associated with relative sea level rise, e.g. coastal flooding, asset damage, health and safety risks 	

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Environmental Protection Department	Environmental Impact Assessment Ordinance	For assessing the impact on the environment of certain projects and proposals, for protecting the environment and for incidental matters. Designated projects must apply for an environmental permit which must outline prevention and mitigation measures. If total avoidance is not practicable, the project proponents are required to mitigate the adverse impact to an acceptable level.	Not Specified	Mandatory	Prevent	-		Chapter 499 Environmental Impact Assessment Ordinance in Bilingual Laws Information System. n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=486&Count=30&Expand=499#499 > [Accessed 17 Sep 09]

Table B6 Existing Policies / Measures that may Contribute to Adaptive Responses to Business and Industry (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
Qualifications Framework (QF) Secretariat under the Education Bureau and the Logistics Industry Training Advisory Committee (ITAC)	Specification of Competency Standards (SCS) for logistics Industry	The standards consists of competency standards of different levels including these major functional areas Operation Management, Planning and Design of Logistics Solutions, Sales, Marketing and Customer Services, Cargo Transport and Handling, Cargo Safety and Security, Import/Export Documentation, Insurance and Legal Matters, E-Logistics, Occupational Safety and Health and Quality Management. According to this standard, training providers can design training programmes that would help learners achieve the specified competency standards. Environmental management, environmental assessment of working procedure, environmental protection and contingency procedures for environmental accidents are covered in different levels in the Quality Management chapter. It requires practitioners to consider how to reduce the environmental accidents and minimise its impacts.	-	Voluntary	Prepare	-	• Environmental accidents associated with climate change, e.g. heavy rainfall, tropical cyclones, thunderstorm, hot weather etc.	Specification of Competency Standards (SCS) < http://www.hkqf.gov.hk/guie/SCS_list.asp > [Accessed 8 June 09]

Table B7 Existing Policies / Measures that may Contribute to Adaptive Responses to Energy Supply (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
Hong Kong SAR Government	Scheme of Control Agreements (SCA)	New Scheme of Control Agreements was reached with the two power company in Hong Kong in 2008. The terms listed under the new agreements will encourage emission reduction, energy efficiency; enhance service quality and operational performance, and the use of renewable energy. Consumers are also protected where it ensures reliable and secure electricity supply is available at a reasonable price.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Increased use of mechanical cooling • Risk of power interruption due to supply/demand mismatch, power spikes and load shedding • Reduction in peak capacity • Increased transmission system losses as lines sag 	<p>New Scheme of Control Agreements reached with the two power companies. Press Releases. 7 January 2008. Information Services Department. <http://www.info.gov.hk/gia/general/200801/07/P200801070187.htm> [Accessed 04 Feb 09]</p> <p>Scheme of Control Agreement. n.d. Hong Kong Electric Holdings Limited. <http://www.heh.com/hehWeb/AboutUs/SchemeOfControlAgreement/Index_en.htm> [Accessed 04 Feb 09]</p>
Electrical and Mechanical Services Department	Electricity Ordinance	The Electricity Ordinance under the direction of the EMSD is designed to that there is a continued supply of electricity and that activities carried out in the vicinity of electricity supplies do not hinder safety. Part III specifically lists the powers and obligations of electricity suppliers.	Not Specified	Mandatory	Prevent, respond	-	<p>CAP 406 Electricity Ordinance <http://www.legislation.gov.hk/blis_pdf.nsf/6799165D2FEE3FA94825755E0033E532/64775510C11F557B482575EF0003EE3E/\$FILE/CAP_406_e_b5.pdf> [Accessed 17 Sep 09]</p> <p>Section 11 of the Electricity Ordinance deals with the event of an electricity interruption. In the event of an interruption, the electricity supplier shall (1) give the Electrical and Mechanical Services Director a report of the cause of the interruption and what remedial action has been or will be done to prevent a recurrence of the interruption if requested by the Director and (2) the Director may</p>	

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	<p>by notice require an electricity supplier who receives electricity directly from a source outside of Hong Kong to inform the Director and any other person specified by the Director of a loss or impending loss of all or a portion of the electricity supply from that source or of an impending failure to receive an expected supply of electricity from that source and the Director may specify in the notice the type of information required and the method and frequency of reporting it.</p> <p>Section 17: Emergency disconnection allows energy suppliers to disconnect energy at the risk of electrical accident.</p> <p>Section 18: Disconnection to ensure supply stability allows energy suppliers to disconnect supply of electricity if it will ensure the safe and stable operation of energy.</p>						
Electrical and Mechanical Services Department	<p>Electricity Supply Lines (Protection) Regulation</p> <p>The main objective of the ESLPR is to regulate construction site activities including the use of heavy machinery to prevent damaging the underground power cables and overhead lines. The ESLPR was promulgated in 2000 with a view to preventing power interruptions and electrical accidents arising from damages by third parties.</p>	Not Specified	Mandatory	Prevent	-	-	<p>CAP 406H Electricity Supply Lines (Protection) Regulation</p> <p><http://www.legislation.gov.hk/blis_pdf.nsf/6799165D2FEE3FA94825755E0033E532/DB5D88FE24875A10482575EF000458D3/\$FILE/CAP_406H_e_b5.pdf></p> <p>[Accessed 17 Sep 09]</p>

Department / Policy / Organisation Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference	
Emergency Support Unit Security Bureau	HKSAR Emergency Response System	Chapter 9 of the Emergency Response System specifies the roles and responsibilities of departments and agencies. In the event of electricity and town gas supplies being interrupted during severe weather conditions, the Director of Electrical and Mechanical Services working in close liaison with the utilities companies will be responsible for ensuring that, as quickly as practicable, carry out repair works to resume supply. Upon request, the Department will also provide special equipment to assist with search and rescue operations.	Not Specified	Mandatory	Respond	-	-	Ch.9 HKSAR Emergency Response System < http://www.sb.gov.hk/eng/emergency/ers/pdf/ERSc9.pdf > [Accessed 10 Sep 09]
Hong Kong SAR Government	Demand Side Management Agreement	The two power companies have agreed to promote energy efficiency and conservation through various programmes in co-ordination with the Government. The programmes aimed to influence consumers' electricity consumption patterns: * Energy Efficiency Programme (labelling, energy codes, guidelines) * Peak Clipping Programme (Pricing) * Load Shifting Programme * General education/ informational Programmes	Not Specified	Voluntary	Prevent, Prepare	-	<ul style="list-style-type: none"> • Increased use of mechanical cooling • Risk of power interruption due to supply/demand mismatch, power spikes and load shedding • Reduction in peak capacity 	Government and power companies sign agreements on demand side management. Press Release 31 May 2000. Information Services Department. < http://www.info.gov.hk/gia/general/200005/31/0531171.htm > [Accessed 04 Feb 09] Introduction to DSM. n.d. Hong Kong Electric Holdings Limited. < http://www.heh.com/hehWeb/CommunityAndEducation/EnergyEfficiencyAndConservation/DemandSideManagement/Index_en.htm > [Accessed 04 Feb 09]

Table B8 Existing Policies / Measures that may Contribute to Adaptive Responses to Financial Services (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Hong Kong Monetary Authority	Banking Ordinance Cap 155	Under Section 101 of the Banking Ordinance, a minimum capital adequacy ratio of 8% must be maintained. The ratio is intended to be a measurement of a bank's capital position in respect of its exposures to credit risk, market risk and operational risk (that is the risk of direct or indirect losses resulting from inadequacies or failings in the processes or systems, or of personnel, of an institution; or from external events).	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Business interruption • Poor performance of investments 	Capital Adequacy Ratio in <i>Guide to Hong Kong Monetary and Banking Terms</i> .n.d. Hong Kong Monetary Authority. < http://www.info.gov.hk/hkma/gdbook/eng/c/capital_adequacy_ratio_index.htm > [Accessed 07 Feb 09]
Hong Kong Monetary Authority	Supervisory Policy Manual	A guideline for authorised institutions in meeting the minimum standards of the Banking Ordinance and the latest supervisory policies and practices. It also provides recommendations on how may these standards be met.	Not Specified	Voluntary (Guidelines to meeting the Banking Ordinance)	Prepare (Respond, Recover)	The manual also include guidelines on the establishment of business continuity plan. It advised authorised institutions to adopt two-tier plans where one deals with near-term problems and the other to deal with a longer-term scenario. In addition, guidelines on operational risk management and strategic risk	<ul style="list-style-type: none"> • Business interruption • Poor performance of investments • Business continuity issues 	Business Continuity Planning. Guidelines and Circulars. 31 Jan 2002. Hong Kong Monetary Authority. < http://www.info.gov.hk/hkma/eng/guide/circu_date/20020131a_index.htm > [Accessed 07 Feb 09] Supervisory Policy Manual. 2008. Hong Kong Monetary Authority. < http://www.info.gov.hk/hkma/eng/bank/spma/index.htm > [Accessed 07 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						management are also included in the manual.		
Home Affairs Department - Building Management	Property- All-Risks Insurance (Property insurance)	Building owners and owners' corporations are advised to purchase property insurance in addition to the mandatory Third Party Risk Insurance. When there is any loss or damage to the common properties of the building due to fire or other risks (e.g. flooding) covered by the terms of the policy, the insured can seek the insurance company for indemnity.	Not Specified	Voluntary	Respond	Guidelines to owners' corporations on private building insurance.	<ul style="list-style-type: none"> • Damage to assets and infrastructure • Cost of insured losses 	Types of Building Insurance in Financial Management, Procurement and Insurance. n.d. Home Affairs Department - Building Management. < http://www.buildingmgt.gov.hk/en/financial_management_procurement_and_insurance/5_3_2.htm > [Accessed 07 Feb 09]

Table B9 Existing Policies / Measures that may Contribute to Adaptive Responses to Food Resources (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Agriculture, Fisheries and Conservation Department	Introduction of Controlled-Environment Greenhouse (CE Greenhouse)	Development of greenhouse technology with suitable climate in order to produce (intensively) high value crops such as white bitter cucumbers, rock melons, edible fungi and lilies. The technology has been promoted to farmers through seminars and demonstrations.	Not Specified	Voluntary (however farmers must apply for a letter of approval from the Lands Department to set up the technology)	Prepare	-	<ul style="list-style-type: none"> • Reduced agricultural output • Increased cost and lower availability of imported food 	<p>Agriculture. n.d. Agriculture, Fisheries and Conservation Department. <http://www.afcd.gov.hk/misc/download/annualreport2006/big5/agriculture.html> [Accessed 29 Jan 09]</p> <p>Introduction of Controlled-Environment Greenhouse (CE Greenhouse). n.d. Agriculture, Fisheries and Conservation Department. <http://www.afcd.gov.hk/english/agriculture/agr_ceg/agr_ceg_ceg/agr_ceg_ceg.html> [Accessed 04 Feb 09]</p>
St. James' Settlement	People's Food Bank	Established in 2003, the People's Food Bank provides the poor with temporary food assistance. It is funded by some subsidies by the Hong Kong government, but most food, money, tools, and equipment are donated by benefactors.	Not specified	Voluntary	Prepare, respond	NGOs - food bank	-	People's Food Bank < http://foodbank.sjs.org.hk/en/home.action > [Accessed 16 Sep 09]
Trade and Industry Department	Rice Control Scheme	Rice is scheduled as a reserved commodity which is to ensure that there is a reserve of rice sufficient for consumption in emergencies or short term	Not specified	Mandatory	Prepare	TID - ordinance for certain quantity of rice in HK	<ul style="list-style-type: none"> • Reduced agricultural output 	Rice Control Scheme < http://www.tid.gov.hk/english/import_export/nontextiles/nt_rice/files/rice_guidelines.pdf > [Accessed 16 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		<p>shortage supply. All rice stockholders registered with the Trade and Industry Department must comply with the scheme and only rice stockholders may import rice into Hong Kong for local consumption. The current level deemed sufficient for consumption by the local population for a reasonable period of time is fifteen days. A rice stockholder must either maintain 17% of its registered import quantity or 17% of the immediate preceding import period.</p>						09]

Table B10 Existing Policies / Measures that may Contribute to Adaptive Responses to Human Health (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
General Policies / Measures								
Hong Kong Observatory	Cold and Very Hot Weather Warnings	<p>Warnings are issued by the Hong Kong Observatory when Hong Kong is threatened by cold or very hot weather. The warning aims to alert members of the public of the risk of heatstroke or low body temperature. It also notifies government departments such as the Social Welfare Department and Home Affairs Department to provide assistance to those in need (i.e. temporary shelters, distribution of blankets).</p> <p>The Hong Kong Observatory and Department of Health will also give advice on measures to prevent health issues such as hyperthermia and sunburn.</p>	Not Specified	Mandatory	Prepare, Respond	-	<ul style="list-style-type: none"> Human health risks, e.g. increase in weather harvesting of vulnerable populations, such as aged 	<p>Cold and Very Hot Weather Warnings. 2003. Hong Kong Observatory.</p> <p><http://www.hko.gov.hk/wservice/warning/coldhot.htm> [Accessed 06 Feb 09]</p>
Hong Kong Observatory	Rainstorm Warning System	<p>Rainstorm warnings are issued when heavy rain is expected and is likely to cause major disruptions such as flooding and landslips. The warnings are classified into three levels: Amber, Red and Black. Similar to other Hong Kong Observatory warning services, information is broadcasted to alert the public and allow emergency services to be prepared.</p> <p>The Hong Kong Observatory also provides guidance on safety measures to</p>	Not Specified	Mandatory	Prepare, Respond	-	<ul style="list-style-type: none"> Infrastructure and asset damage from heavy rain events, e.g. from floods, landslips, accidents etc Human health risks 	<p>Rainstorm Warning System. 2003. Hong Kong Observatory.</p> <p><http://www.hko.gov.hk/wservice/warning/rainstor.htm> [Accessed 06 Feb 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Hong Kong Observatory	Fire Danger Warning System	the public under each level of rainstorm warning. The Fire Danger Warning is to alert the public when fires may start and spread easily due to certain weather conditions (i.e. humidity, wind speed). The warnings are classified into Yellow (high risk) and Red (extreme risk).	Not Specified	Mandatory	Prepare, Respond	-	<ul style="list-style-type: none"> • Increase risk of wildfires • Human health risks 	<p>Fire Danger Warnings in <i>HKO Warnings and Signals Database</i>. n.d. Hong Kong Observatory. <http://www.hko.gov.hk/wxinfo/climat/warndb/warndb_e.shtml> [Accessed 06 Feb 09]</p> <p>Fire Danger Warning. n.d. Hong Kong Observatory. <http://www.hko.gov.hk/publica/gen_public/fdw_e.htm> [Accessed 06 Feb 09]</p>
Hong Kong Observatory	Thunderstorm Warning	Thunderstorm warning issued by the Hong Kong Observatory is to alert the public of the likelihood of thunderstorms and the affected areas. HKO also provides guidance on preventive measures (e.g. stay indoors, do not swim or engage in water sports).	Not Specified	Mandatory	Prepare, Respond	-	<ul style="list-style-type: none"> • Infrastructure and asset damage from wind, lightning strike • Human health risks 	<p>Thunderstorm Warning. 2003. Hong Kong Observatory. <http://www.hko.gov.hk/wservice/warning/thunder.htm> [Accessed 06 Feb 09]</p>
Hong Kong Observatory	Landslip Warning	When the Geotechnical Engineering Office expects the occurrence of numerous landslips, a landslip warning will be issued by the Hong Kong Observatory and broadcasted. The	Not Specified	Mandatory	Prepare, Respond	-	<ul style="list-style-type: none"> • Infrastructure and asset damage from landslips 	<p>Landslip Warning. 2003. Hong Kong Observatory. <http://www.hko.gov.hk/wservice/warning></p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		warning is to alert members of the public, engineers, contractors and others who are likely to suffer losses form landslips to take precautionary measures.					• Health risks to building occupants	ng/landslip.htm> [Accessed 06 Feb 09]
Hong Kong Observatory	Special Announcement on Flooding in the Northern New Territories	A Special Announcement on Flooding in the northern New Territories will be issued by the Hong Kong Observatory whenever heavy rain affects the area and flooding is expected to occur or is occurring in the low-lying plains of the northern New Territories.	Not Specified	Mandatory	Prepare, Respond	-	• Asset damage from flooding	Special Announcement on Flooding in the Northern New Territories. 2003. Hong Kong Observatory. < http://www.hko.gov.hk/wservice/warning/flood.htm > [Accessed 06 Feb 09]
Hong Kong Observatory	The Tropical Cyclone Warning Service	The Hong Kong Observatory will issue tropical cyclone warnings whenever a tropical cyclone centres within 800 km of Hong Kong to alert the public (and government departments) of the threats and danger a tropical cyclone poses to Hong Kong. Different levels of warning are issued according to actual or expected wind strength affecting Hong Kong. The warnings broadcasted will contain information on cyclone location, intensity and expected movement, associated weather and hazardous impact, and advice on precautionary measures.	Not Specified	Mandatory	Prepare, Respond	Separate warnings are issued for shipping, aviation and other specialised users.	• Asset damage from wind, flooding, storm surge, landslides, lightning strike etc• Human health risks	The Tropical Cyclone Warning Service. 2003. Hong Kong Observatory. < http://www.hko.gov.hk/wservice/tsheet/tcwarn.htm > [Accessed 06 Feb 09]
Hong Kong Observatory	Strong Monsoon Signal	The Strong Monsoon Signal is issued when winds associated with the summer or winter monsoon are blowing in excess of or are expected to exceed 40 kilometres per hour near sea level anywhere in Hong Kong.	Not Specified	Mandatory	Prepare, Respond	-	• Asset damage from wind • Human health risks	The Strong Monsoon Signal. 2003. Hong Kong Observatory. < http://www.hko.gov.hk/wservice/warning/smse.htm >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		The signal aims to inform the public and engineers of strong gusty wind in order to take preventive measures such as the removal of loose outdoor objects (that are likely to be blown away) and securing scaffoldings, hoardings and temporary structures.						[Accessed 06 Feb 09]
Hong Kong Observatory	Marine Weather Forecasts and Warnings	Marine weather forecasts for shipping are issued twice a day by the Central Forecasting Office of the Hong Kong Observatory. They contain warnings of winds of gale force or above, a synopsis of significant meteorological features and 24-hour forecasts of weather and sea state for ten marine areas in the South China Sea and the western North Pacific. These forecasts are broadcast via NAVTEX, an international broadcast system for disseminating navigational information by the coastal radio station for ships in the region.	Not Specified	Mandatory	Prepare, Respond	When a tropical cyclone is located within the area bounded by latitudes 10N and 30N and longitudes 105E and 125E, the Hong Kong Observatory issues additional warnings for shipping at 3-hourly intervals giving detailed information on the location, intensity and forecast movement of the tropical cyclone, and also wind and wave conditions associated with it.	• Human health risks	Marine Meteorological Services. 2003. Hong Kong Observatory. < http://www.hko.gov.hk/wservice/tsheet/marine.htm > [Accessed 06 Feb 09]
Hong Kong Observatory	Ultraviolet Index Information Service	An Ultraviolet (UV) Index of 11 or higher will trigger advisory messages from the Hong Kong Observatory about avoiding prolonged exposure to the sun and preventing eye and skin damage. The advisory messages will be included in the Observatory's hourly weather report.	Not Specified	Mandatory	Prepare, Respond	The Observatory has been measuring and disseminating UV levels since 1999 and the UV Index forecast commenced in May 2006.	• Human health risks	The Observatory enhances the Ultraviolet Index Information Service. Press Release 17 July 2008. Hong Kong Observatory. < http://www.weather.gov.hk/wxinfo/news/2008/pre0717Ae >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								htm> [Accessed 05 Feb 09]
Department of Health	Elderly Health Service	<p>The Elderly Health Services (EHS) was set up in July 1998 to promote the health of the elderly population through provision of community-based, client-oriented and quality primary health care services, with a whole person, multi-disciplinary team approach and maximum participation of everyone including the elderly themselves.</p> <p>The main services of EHS include elderly health centres and visiting health teams. Elderly health centres provide a comprehensive primary health care programme encompassing health assessment, counselling, curative treatment and health education. Visiting health teams provide health promotion programmes for the elderly to increase their health awareness and self-care ability. A total of 18 elderly health centres and 18 visiting health teams, one in each district, were established.</p>	Not Specified	Voluntary	Prevent, Prepare	<p>Other activities which EHS are involved in include education and awareness raising. Resource kits for both the elderly and elderly care providers are provided on the website along with educational information (pamphlets, books, and videos) and healthy living promotion. A newsletter is provided in traditional Chinese for the elderly to inform them of health services, tips, and information.</p>	<ul style="list-style-type: none"> • Increase in weather harvesting of vulnerable populations 	<p>Department of Health Annual Report 05/06. <http://www.dh.gov.hk/tc_chi/pub_rec/pub_rec_ar/pdf/tabB08.pdf>; <http://www.dh.gov.hk/english/pub_rec/pub_rec_ar/pdf/0203/chapterfour08.pdf> [Accessed 30 Mar 09]</p>
Department of Health	Promoting Health in Hong Kong: A Strategic Framework for Prevention	<p>The overall goal of the strategy is to improve the health and quality of life of people in Hong Kong, which will in turn help lower their chance of having non-communicable diseases. To optimise health gains, this strategic framework</p>	Not Specified	Mandatory	Prevent, Prepare	-	<ul style="list-style-type: none"> • Increase in harvesting of vulnerable population with non-communicable 	<p>Promoting health in Hong Kong: A strategic framework for prevention and control of non-communicable</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	and Control of Non-communicable Diseases	will focus on the major risk factors that are potentially preventable or modifiable and have significant impact on the health of the Hong Kong population.					diseases	diseases. n.d. Department of Health. < http://www.dh.gov.hk/english/pub_rec/pub_rec_ar/pdf/ncd/ENG%20whole%20DOC%2016-10-08.pdf > [Accessed 05 Feb 09]
Department of Health	HealthyHK	The HealthyHK website serves as a platform to disseminate statistical information related to the health of our population.	Not Specified	Not Applicable	Prepare	-	<ul style="list-style-type: none"> • Increase incidence of communicable and non-communicable diseases 	HealthyHK. n.d. Department of Health. < http://www.health.gov.hk/phishweb/en/ > [Accessed 29 Jan 09]
The Agriculture, Fisheries and Conservation Department	Public Health (Animals and Birds) Regulations	It regulates the import of animals and birds and removal of animals and birds in Hong Kong. It states that no person shall bring into Hong Kong any bird unless it is accompanied by a valid health certificate.	Not Specified	Mandatory	Prepare	-	<ul style="list-style-type: none"> • Increased proliferation of bacteria and micro-organisms • Human health risks 	CAP 139A Public Health (Animals and Birds) Regulations < http://www.legislation.gov.hk/eng/home.htm >
Senior Citizen Home Safety Association	The PE Link Service	The Senior Citizen Home Safety Association provides services to the local elderly and aims to promote their quality of lives while protecting their proper care. The PE Link Service provides elderly and those in need 24-hour emergency support through a easy-to-use communication	Sponsored by Social Welfare Department: One-off: HK\$2,500, Rent: HK\$100/	Voluntary	Prevent, respond	NGOs - e.g. Senior Citizen Home Safety Association (Personal Emergency Assistance)	<ul style="list-style-type: none"> • Human health risks 	SCHSA PE Link Service < http://www.schsa.org.hk/eng/service/pel.html > [Accessed 16 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		system.	month					
			Sponsored by Housing Department: One-off HK\$2,500					
			Sponsored by Housing Society: Rent: 1 set HK\$100/ month					
			Self Pay: One-off: HK\$2,500 with HK\$70 monthly service fee Rent: HK\$100/ month + HK\$300 deposit					

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Civic Exchange	Hedley Environmental Index	The Hedley Environmental Index estimates the costs to the community of to air pollution. These come in two forms: negative health impacts and dollar values.	Not Specified	Voluntary	Prepare			Hedley Environmental Index < http://hedleyindex.sph.hku.hk/home1.php > [Accessed 17 Sep 09]
Environmental Protection Department	Environmental Impact Assessment Ordinance	In granting or rejecting an environmental permit, the impact to the health and well being of people is considered.	Not Specified	Mandatory	Prevent			Chapter 499 Environmental Impact Assessment Ordinance in Bilingual Laws Information System. n.d. Department of Justice. < http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=486&Count=30&Expand=499#499 > [Accessed 17 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Accidents & Emergencies / External Health Stresses								
Home Affairs Department	Department Emergency Co-ordination Centre (DECC)	When weather warnings are announced by the Hong Kong Observatory, the DECC will be activated together with a 24 hour emergency hotline to provide updates on weather information and assistance to the public. The centre works in collaboration with other government departments and voluntary agencies to provide emergency relief such as temporary accommodation, hot meals, clothing and etc. Financial assistance will also be provided to those injured or family members of those who passed away in a disaster. In addition, social workers and psychologists will be organised for those in need.	Not Specified	Mandatory	Respond	In addition, other departments such as the Fire Services Department have emergency plans to manage disasters such as major fires, landslips and flooding. The Fire Services Department communication centre is linked to all fire stations, major hospitals, ambulance depots and other emergency services. This will allow other agencies such as the Government Flying Service and the Auxiliary Medical Service to rescue and provide assistance those in need. The emergency plans are reviewed and updated regularly.	• Increased number of accidents	Emergency Relief Services. n.d. Home Affairs Department. < http://www.had.gov.hk/en/public_services/emergency_services/emergency.htm > [Accessed 05 Feb 09] Emergency Services in Hong Kong: the facts. 2008. Information Services Department. < http://www.gov.hk/en/about/abouthk/factsheets/docs/emergency_services.pdf > [Accessed 05 Feb 09]
Security Bureau	Emergency Monitoring and Support Centre (EMSC)	The EMSC is activated when major emergencies or natural disasters happen or are likely to happen. It monitors the response of the emergency and support services, and provides support to these services. It briefs the Chief Executive and senior officials on developments and disseminates central government policy decisions and advice. Relevant government personnel will be mobilized	Not Specified	Mandatory	Respond	-	• Increased number of accidents	Emergency Services in Hong Kong: the facts. 2008. Information Services Department. < http://www.gov.hk/en/about/abouthk/factsheets/docs/emergency_services.pdf > [Accessed 05 Feb 09]HKSAR Government emergency structure in Daya Bay Contingency Plan of the

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		rapidly to assess the situation, to give decision-makers advice based on that assessment and to recommend countermeasures.						Hong Kong Special Administrative Region. n.d. Security Bureau. < http://www.sb.gov.hk/eng/emergency/dbcp/section4_3.htm > [Accessed 05 Feb 09]
Civil Aid Service	Civil Aid Service Central Command Centre	The centre was established in 1999 as the hub of incident control to support emergency services and government departments to enhance operational efficiencies. The Commander of the Centre is responsible and has the authority to arrange and assign resources and provide updates to all relevant parties.	Not Specified	Mandatory	Respond	-	• Increased number of accidents	CAS Central Command Centre. n.d. Civil Aid Service. < http://www.cas.gov.hk/eng/org/org_ccc.html > [Accessed 05 Feb Jan]
Security Bureau	Emergency Response System: the policy, principles and operation of the Government's emergency response system	The documents outlines the actions that will be taken under an emergency situation, including the Three Tier System, the rescue, recovery and restoration phase and communication with the public. It also sets out the roles and responsibility of departments and agencies.	Not Specified	Mandatory	Respond, Recover	The Three Tier System is designed to utilise resources effectively under an emergency situation, involving different levels of departments and agencies according to the circumstances. Emergency services such as the Hong Kong Police Force and the Fire Services Department are responsible for attending emergency situations at the Tier One Response level. Tier Two Response will be activated when incidents may threaten the safety of	• Increased number of accidents	The Government of the Hong Kong Special Administrative Region Emergency Response System: the policy, principles and operation of the Government's emergency response system. 2000. Emergency Support Unit, Security Bureau. < http://www.sb.gov.hk/eng/emergency/ers/ers.pdf > [Accessed 05 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						human life, property and security and the Security Bureau Duty Officer needs to be informed. At this level, the Emergency Support Unit will be monitored by the Government Secretariat. Tier Three Response is activated in situations where there are widespread threats to life, property and security, and require extensive Government emergency resources. The Emergency Monitoring and Support Centre will also be activated and other security committees will be involved if necessary.		
Security Bureau	Contingency Plan for Natural Disasters (including those arising from severe weather conditions)	The plan set out a variety of actions to be taken under specific events, such as tropical cyclones, rainstorm, flooding, thunderstorm and tsunami. It also listed out the roles and responsibilities of controlling authorities (categorised into phase e.g. rescue) and non-government organisations such as the media for broadcasting information.	Not Specified	Mandatory	Respond	The contingency plan is updated annually by the Security Bureau and the adequacy and effectiveness of the plan is fully tested on regular basis. All bureaux, departments and agencies are required to notify the Security Bureau of any changes (i.e. resource availability) that may affect the contingency	• Increased number of accidents	Security Bureau Circular No. 3/2007. Contingency Plan for Natural Disasters (including those arising from severe weather conditions). 2007. Emergency Support Unit. < http://www.sb.gov.hk/eng/emergency/ndisaster/cpnd-e092007.pdf >

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						plan, in order for the Security Bureau to issue amendments.		[Accessed 05 Feb 09]
Social Welfare Department / Housing Department / Marine Department / Agriculture, Fisheries and Conservation Department / Home Affairs Department (depending on the types of grant)	Emergency Relief Fund	<p>The fund is to provide financial assistance to persons who are in need of relief as a result of a natural disaster such as tempest, typhoon, rainstorm, landslide and flooding. In addition, victims of fire, house collapse, boat capsized, shipwreck, explosion, eviction from a dangerous building or building affected by a Court Order as a result of natural disaster are also eligible for assistance.</p> <p>The Social Welfare Department is specifically responsible for burial, death, disability, injury, and interim maintenance grants.</p>	Not Specified	Voluntary	Recover	-	• Increased number of accidents	<p>Emergency Relief Fund Information Leaflet. n.d. <Agriculture, Fisheries and Conservation Department. <http://www.afcd.gov.hk/english/publications/publications_agr/files/erem.doc> [Accessed 04 Feb 09]</p> <p>Emergency Relief Fund Annual Report < http://www.swd.gov.hk/doc/social-sec/ERFAR08e.pdf> [Accessed 16 Sep 09]</p>
Social Welfare Department	"Hong Kong is My Home" Social Club for Ethnic Minorities	To strengthen the supportive network of ethnic minorities, to promote mutual help amongst them	Not specified	Voluntary	Prepare	Social Welfare Dept - minority / disadvantaged groups; emergency relief		Social Welfare Department < http://www.swd.gov.hk/en/index/site_district/page_kcytm/sub_528/ > [Accessed 16 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Security Bureau	Emergency Response Operations Outside the Hong Kong SAR	The document outlines the action to be taken by government departments, agencies and relevant organisations when emergency situation arises outside of Hong Kong SAR. When Hong Kong Residents are involved in overseas emergency situation, emergency response personnel may be sent to the location to provide assistance. Otherwise, the Hong Kong government may contribute to international aid only.	Not Specified	Mandatory	Respond, Recover	-	• Increased number of accidents	Security Bureau Circular No. 4/2007. Emergency Response Operations Outside Hong Kong SAR. 2007. Emergency Support Unit, Security Bureau. < http://www.sb.gov.hk/eng/emergency/eroohk/eroohk_1107.pdf > [Accessed 05 Feb 09]
General Communicable Diseases								
Department of Health	Prevention and Control of Disease Ordinance (PCDO)	The Ordinance came into operation in July 2008, replacing the Quarantine and Prevention of Disease Ordinance. The PCDO aims to prevent and control infectious diseases and to enable compliance with the requirement of the World Health Organisation's International Health Regulations.	Not Specified	Mandatory	Prevent, Prepare, Respond	-	• Increased incidence of communicable diseases	Chapter 599 Prevention and Control Disease Ordinance in <i>Bilingual Laws Information System</i> . 2008. Department of Justice. < http://www.legislation.gov.hk/eng/home.htm > [Accessed 05 Feb 09] Prevention and Control of Disease Ordinance (Cap. 599) effective since 14 July 2008. 2008. Surveillance and Epidemiology Branch, Centre for

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								Health Protection. (36) in DH SEB CD/1-115/3. < http://www.dh.gov.hk/english/useful/useful_id/files/ltod20080711.pdf > [Accessed 05 Feb 09]
Family Health Service (Department of Health), Centre for Health Protection	Childhood Immunisation Programme	The aim of the programme is to prevent infants and children from childhood infectious diseases (tuberculosis, poliomyelitis, hepatitis B, diphtheria, whooping cough (pertussis), tetanus, measles, mumps, rubella and pneumococcus infections). Parents can bring their children to any Maternal and Child Health Centre for immunisation, free of charge (eligible persons only) or to private doctors. School Immunisation Teams of the Department of Health will visit primary schools to provide immunisation service to school children.	Not Specified	Voluntary	Prevent	On the advice of the Scientific Committee on Vaccine Preventable Diseases under the Centre for Health Protection, pneumococcal conjugate vaccine has been included in the Childhood Immunisation Programme since September 2009. The department has also published a list of vaccines that have not been included in the Childhood Immunisation Programme.	• Increased incidence of communicable diseases	Hong Kong Childhood Immunisation Programme. Centre for Health Protection. < http://www.fhs.gov.hk/english/health_info/files/i_10.pdf > [Accessed 11 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Centre for Health Protection	Centre for Health Protection Strategic Plan on Prevention and Control of Communicable Diseases 2007-2009	The strategic plan identified three key areas for the three year period: Real-time surveillance, rapid intervention and responsive risk communication. * Strengthen infectious disease surveillance system and network to improve the sensitivity and timeliness of outbreak detection* Prepare and plan for public health emergencies to implement control measures to minimise outbreaks effectively* Raise stakeholders' awareness of and preparedness for public health threats* Provide training to healthcare professionals continuously to meet new demands and needs in various public health areas.	Not Specified	Mandatory	Prevent, Prepare	-	• Increased incidence of communicable diseases	Centre for Health Protection Strategic Plan on Prevention and Control of Communicable Diseases 2007-2009. 2006. Centre for Health Protection. < http://www.chp.gov.hk/files/pdf/grp-CHP%20Strategic%20Plan%202007-09-Final.pdf > [Accessed 05 Feb 09]
Centre for Health Protection	Central Notification Office (CENO)	Central Notification Office (CENO) has been set up under the Centre for Health Protection to centralize communicable diseases notifications and monitoring in Hong Kong.	Not Specified	Mandatory and voluntary	Prevent, Prepare, Respond	-	• Increased incidence of communicable diseases	Central Notification Office On-line. n.d. Centre for Health Protection. < www.chp.gov.hk/ceno > [Accessed 05 Feb 09]
Centre for Health Protection	24-hour Outbreak Response	To investigate outbreaks of infectious diseases in the community and instigate control measures.	Not Specified	Mandatory	Respond	-	• Increased incidence of communicable diseases	Centre for Health Protection Strategic Plan on Prevention and Control of Communicable Diseases 2007-2009. 2006. Centre for Health Protection. p. 74 < http://www.chp.gov.hk/files/pdf/grp-

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								CHP%20Strategic%20Plan%202007-09-Final.pdf> [Accessed 05 Feb 09]
Hospital Authority	Infectious Disease Control Training Centre	Training Centre works in collaboration with the Centre for Health Protection to provide relevant training programs for different groups. It aims to develop a healthcare team with sound knowledge and skills in infection control and infectious disease management, to improve crisis management capability through leadership development programs.	Not Specified	Mandatory	Prepare	The Training Centre has the following main objectives: 1) Proficient Infection Control Team; 2) Effective infectious disease management service through team approach; 3) Effective leadership for Crisis Management; 4) Robust surveillance system to monitor the trend of infectious diseases in the community and to detect signs of outbreak; and 5) Proactive occupational safety and health team.	• Increased incidence of communicable diseases	Infectious Disease Control Training Centre. n.d. Hospital Authority. < http://www3.ha.org.hk/idctc/default.asp > [Accessed 05 Feb 09] Infectious Disease/ Infection Control 5-year Training Plan. n.d. Hospital Authority. < http://www3.ha.org.hk/idctc/Objectives.doc > [Accessed 05 Feb 09]
Centre for Health Protection (Department of Health)	Emergency Response Mechanism	The Centre for Health Protection has established three key centres as part of its emergency response mechanism: Risk Communication Centre, Outbreak Intelligence Centre and the Emergency Hotline Centre. The objective of the Risk Communication Centre is to provide a suitable venue for release of updated outbreak information to the media and public. The Outbreak Intelligence Centre performs ongoing,	Not Specified	Mandatory	Respond	-	• Increased incidence of communicable diseases	Centre for Health Protection Strategic Plan on Prevention and Control of Communicable Diseases 2007-2009. 2006. Centre for Health Protection. p. 12 < http://www.chp.gov.hk/files/pdf/grp-CHP%20Strategic%20

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		systematic collection, analysis, and interpretation of outbreak related data from different sources to enable real-time planning, implementation and evaluation of outbreak control strategies and ensure a closely coordinated and effective response against disease outbreak. The Emergency Hotline Centre is open for public enquiries under emergency situations.						Plan%202007-09-Final.pdf> [Accessed 05 Feb 09] New CHP's facilities ready for action. Press Releases. 23 March 2006. Information Services Department. < http://www.info.gov.hk/gia/general/200603/23/P200603230087.htm > [Accessed 11 Feb 09]
Centre for Health Protection	Emergency Response Centre	The Emergency Response Centre will act as the nerve centre of Department of Health in dealing with major outbreaks of infectious diseases. The Centre is to keep the community better informed about public health risks during major infectious disease outbreaks and work closely with other Government departments in combating the disease. During major outbreaks of infectious diseases, the ERC will collate up-to-date information about the disease from relevant departments and organisations, compile progress reports for information of the senior Government officials; inform the public the latest development via press conferences and briefings held at the Risk Communication Centre.	Not Specified	Mandatory	Prepare, Respond	-	• Increased incidence of communicable diseases	New CHP's facilities ready for action. Featured Topics 23 March 2006. Centre for Health Protection. < http://www.chp.gov.hk/content.asp?lang=en&info_id=6076 > [Accessed 05 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Department of Health, Food and Environmental Hygiene Department, Hong Kong Observatory	-	DH and FEHD are monitoring the international and local findings on the relationship between climate change and infectious diseases. DH is also working with other departments to prevent and control the spread of infectious diseases in relation to climatic factors through diseases surveillance.	Not Specified	Voluntary	Prepare	-	• Increased incidence of communicable diseases	LCQ17: Studies on relationship between local climatic factors and infectious diseases. Replies to LegCo questions. 11 May 2005. Food and Health Bureau. < http://www.fhb.gov.hk/en/legco/replies/2005/lq050511_q17.htm > [Accessed 09 Feb 09]
Centre for Health Protection	Risk Communication Advisory Group	The Group is to advise the Centre for Health Protection on risk communication strategies and development of action plans. The group also review the Centre for Health Protection existing risk communication measures.	Not Specified	Mandatory	Prepare	-	• Increased incidence of communicable diseases	Risk Communication Advisory Group. n.d. Centre for Health Protection. < http://sc.info.gov.hk/gb/www.chp.gov.hk/text/rcag1.asp?lang=en&id=136 > [Accessed 05 Feb 09]
Centre for Health Protection	Clinical Infection and Public Health Forums & Infection Control Forums	The forums, supported by the Infectious Disease Control Training Centre, take place on a monthly basis to allow health professionals to share experiences and knowledge on infectious diseases and infection control issues of public health impact.	Not Specified	Voluntary	Prepare	-	• Increased incidence of communicable diseases	Centre for Health Protection Strategic Plan on Prevention and Control of Communicable Diseases 2007-2009. 2006. Centre for Health Protection. p. 80 < http://www.chp.gov.hk/files/pdf/grp-CHP%20Strategic%20

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								Plan%202007-09-Final.pdf> [Accessed 05 Feb 09]
Respiratory Diseases								
Education Bureau, Environmental Protection Department, Department of Health	Air Pollution Index (API)	A circular is sent out recommending school authorities to reduce physical exertion and outdoor activities of vulnerable or all students (i.e. students with heart or respiratory illnesses) when API of a certain level has been detected or forecasted. Hong Kong Observatory (HKO) will notify the Central Health Education Unit and the Information and Public Relations Unit of the Department of Health to alert the public of the air pollution index.	Not Specified	Voluntary	Prepare, Prevent	The Environmental Protection Department will provide daily air pollution concentrations and warnings to schools once API exceeds 100.	<ul style="list-style-type: none"> Negative impact on air quality; increased mortality and morbidity associated with respiratory and cardiovascular conditions 	EDB Circular No.3/1998. 10 June 1998. Education Department Hong Kong. < http://www.edb.gov.hk/UtilityManager/circular/upload/SMC/MC98003E.PDF > [Accessed 29 Jan 08]
Environmental Protection Department	Review of Air Quality Objectives	The Environmental Protection Department has, in June 2007, commissioned an 18-month comprehensive study to review Hong Kong's Air Quality Objectives (AQO) on the basis of the standards by the World Health Organisation, the European Union and the United States, and to develop a long-term air quality management strategy.	Not Specified	N/A	Prevent, Prepare, Respond	The scope of the study is to review and characterize the current state of air quality in Hong Kong, to examine the reasoning by WHO and US EPA devising their respective air quality guidelines, to estimate the development of air quality in different scenarios, to assess the conditions for the implementation of different standards, to derive practicable options to revise Hong Kong's	<ul style="list-style-type: none"> Negative impact on air quality; increased mortality and morbidity associated with respiratory and cardiovascular conditions 	Environmental Protection Department website. < http://www.epd.gov.hk/epd/english/environmentinhk/air/air_quality_objectives/air_quality_objectives.html > [Accessed 30 Mar 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						AQO, and to review air quality monitoring.		
Food and Health Bureau	Emergency Preparedness for Influenza Pandemic In Hong Kong	<p>The aim is to:</p> <ul style="list-style-type: none"> * Reduce risk of human infections * Early detection of influenza pandemic * Enhance emergency preparedness and response for influenza pandemic <p>Some of the measures include: on-going surveillance and monitoring, communicate with stakeholders on preventive measures, regulate importation of live poultry, trainings on infection control, conduct research to guide response measures, three-level response system, and etc.</p>	Not Specified	Mandatory	Prevent, Prepare, Respond	-	• Increased incidence of respiratory diseases	Emergency Preparedness for Influenza Pandemic in Hong Kong. 2007. Food and Health Bureau. < http://www.chp.gov.hk/files/pdf/check_list_e_flu_eng_200708.pdf > [Accessed 05 Feb]
Food and Health Bureau	Framework of Government's Preparedness Plan for Influenza Pandemic	Establishment of the Hong Kong Government Three-level Response Systems. The three levels (Alert Response, Serious Response and Emergency Response) are based on different risk-graded epidemiological scenarios relevant to Hong Kong, and each of them prescribes a given set of public health actions required. The measures are designed to match with the World Health Organization's guideline	Not Specified	Mandatory	Prevent, Prepare, Respond	-	• Increased incidence of respiratory diseases	Framework of Government's Preparedness Plan for Influenza Pandemic. 2007. Food and Health Bureau. < http://www.chp.gov.hk/files/pdf/Flu_Plan_Framework_eng_14Mar_20050408.pdf > [Accessed 05 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		for pandemic influenza planning.						
Vector Borne Diseases								
Food and Environmental Hygiene Department	Vector surveillance measures	These include the use of Oviposition Trap (Ovitrap), Area Ovitrap Index (AOI), and Monthly Ovitrap Index (MOI), to detect and monitor the presence of adult Aedine mosquitoes.	Not Specified	Mandatory	Prepare	Advice on anti-mosquito measures (i.e. mosquito control and prevention) and prevention of dengue fever are also provided to the public, construction sites, schools, housing estates, ports, ferry, hospitals/clinics, and Picnickers and Hikers.	• Greater incidence of some vector borne diseases	Pest Control. Department of Health, Food and Environmental Hygiene Department. < http://www.fehd.gov.hk/safefood/Pcas.html > [Accessed 01 Jun 09]
Food and Environmental Hygiene Department	Pest Control	Pest control work, such as the control of rodents, mosquitoes and other arthropod pests with medical importance is carried out by the Pest Control Teams of Food and Environmental Hygiene Department. The methodology in pest control is continuously reviewed to ensure effectiveness and efficacy in abating the disease vectors. Pest control aims to prevent and control the breeding of disease vectors, and to control the breeding of arthropod pests which cause nuisance to people.	Not Specified	Mandatory	Prepare	-	• Greater incidence of some vector borne diseases	Pest Control. Department of Health, Food and Environmental Hygiene Department. < http://www.fehd.gov.hk/safefood/Pcas.html > [Accessed 01 Jun 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Water Borne Diseases								
Water Supplies Department	Water Quality	The water supplied by the Department complies with the Guidelines for Drinking-water Quality (2004) recommended by the World Health Organisation. Water quality is monitored through regular water sampling at various points in the supply and distribution system (i.e. water treatment works, service reservoirs, trunk mains, connection points and domestic taps), and the results are checked against the WHO guidelines. Tap water is safe for human consumption without boiling on the condition that buildings' plumbing system is managed properly.	Not Specified	Mandatory	Prevent	The following assumptions were made in the WHO Guidelines for Drinking-water Quality: * per capita daily consumption of 1 litre of unboiled water (developing guidelines for microbial hazard) * daily per capital consumption of 2 litres by a person weighing 60kg (for potentially hazardous chemicals)	<ul style="list-style-type: none"> • Reduced water quality • Greater incidence of some water borne diseases 	<p>Guidelines for Drinking-water Quality. 3rd e.d. Vol. 1. 2004. World Health Organization. <http://www.who.int/water_sanitation_health/dwq/GDWQ2004web.pdf> [Accessed 11 Feb 09]</p> <p>Water Quality. n.d. Water Supplies Department. <http://www.wsd.gov.hk/en/html/others/faq_wq.htm> [Accessed 11 Feb 09]</p>
Water Supplies Department	Water Safety Plan (WSP)	<p>The plan commenced in early 2007 to ensure the quality of water is maintained in Hong Kong. In order to do so, the department has planned to prevent, reduce and remove contamination during storage, distribution and handling of drinking water.</p> <p>The WSP provides details on hazard identification, risk assessment, monitoring and operational requirements, pollution control measures, as well as verification of treated water quality to confirm the overall safety of the supply system. The</p>	Not Specified	Mandatory	Prevent	<p>Based on WHO recommendations, the Department of Health and WSD have agreed on the adoption of a set of guideline values for chemical and bacteriological parameters as the health-based targets for the drinking water supply in HK.</p> <p>Additional resources including equipment and manpower are envisaged</p>	<ul style="list-style-type: none"> • Reduced water quality • Greater incidence of some water borne diseases 	<p>ACQWS Paper No. 17 Water Safety Plan For Water Supplies Department. 2006. Water Supplies Department. <http://www.wsd.gov.hk/acqws/doc/p17.pdf> [Accessed 06 Feb 09]</p> <p>Water Safety Plan for the Water Supplies Department. n.d. Water Supplies</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		<p>monitoring of water quality includes physical, chemical, bacteriological, biological and radiological examination of water samples collected at strategic points of the supply and distribution system. The water quality data of Hong Kong and the Dongjiang water supply are published and updated every six months.</p> <p>Another duty of the WSP is to set up contingency plans.</p>				<p>to cater for the fulfilment of the compliance monitoring of health-based targets, tightened operational monitoring and pollution control, reduction of identified risks, management of document control system, review and auditing work, etc. related to the implementation of the WSP. As a start-up, a new Gas Chromatograph Mass Spectrometer has been acquired and a new Trace Analysis Laboratory at Ma On Shan Water Treatment Works has been set up in order to accomplish the target. Follow-up actions will be initiated to seek other resources such as instruments to enhance monitoring and manpower including Waterworks Chemist, Engineering Laboratory Technician and operational staff to address requirements for risk reduction, source protection, operational control, compliance monitoring, document</p>		<p>Department. <http://www.wsd.gov.hk/en/text/water/water_safety.htm> [Accessed 06 Feb 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						control, WSP review and audit, etc.		
Water Supplies Department	Quality Water Recognition Scheme for Buildings (Fresh Water Plumbing Quality Maintenance Recognition Scheme prior to 2008)	The aim of the scheme is to encourage building owners to maintain buildings' plumbing systems to ensure good water quality is provided at the taps. One of three grades of certificate is awarded to successful applicants to recognize the proper maintenance of the building's plumbing systems, issued by the Water Supplies Department. The criteria is to have the plumbing system inspected every three months, defects promptly rectified, clean water tanks every three months and sample water quality regularly which needs to meet the acceptable limits of the water quality indicators.	Not Specified	Voluntary	Prevent	-	<ul style="list-style-type: none"> • Reduced water quality • Greater incidence of some water borne diseases 	Quality Water Recognition Scheme for Buildings. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/edu/fwpqmrse/fwpqmrse.htm > [Accessed 11 Feb 09]
Environmental Protection Department	Marine Water Quality Monitoring	EPD monitors the water quality of some 1,700 sq km of the territory's marine waters. The marine monitoring programme covers about 90 water and 60 sediment sampling stations in the open sea, semi-enclosed bays and typhoon shelters. The monitoring programme serves the following purposes: <ul style="list-style-type: none"> - indicate the state of health of marine waters; - assess compliance with the statutory Water Quality Objectives (WQOs); - reveal long-term changes in water quality; - provide a basis for the planning of 				-	<ul style="list-style-type: none"> • Reduced seawater quality 	Marine Water Quality Monitoring in Hong Kong. Environmental Protection Department. < http://www.epd.gov.hk/epd/english/environmentinhk/water/marine_quality/mwq_monitoring.html > [Accessed 01 Jun 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		pollution control strategies.						
Environmental Protection Department	Water Quality Objectives	Hong Kong is divided into 10 Water Control Zones (WCZs) and each WCZ has a set of Water Quality Objectives (WQOs). The rates of annual compliance with the key WQOs (i.e. dissolved oxygen, ammonia, total inorganic nitrogen and E.coli) are assessed based on all the data collected during the year.				-	• Reduced seawater quality	Marine Water Quality Monitoring in Hong Kong. Environmental Protection Department. < http://www.epd.gov.hk/epd/english/environmentinhk/water/marine_quality/mwq_monitoring.html > [Accessed 01 Jun 09]
Food Borne Diseases								
Centre for Food Safety	Food Surveillance Programme	The Food Surveillance Programme is designed to control and prevent food hazards. The food surveillance programme will be strengthened by making it more risk-based and with a wider coverage. A Food Research Laboratory has been set up within the Public Health Laboratory Centre, which was completed in late 2001. The laboratory research conducted will provide scientific data for risk assessment and formulation of food surveillance strategies. The Centre also promotes public awareness and promulgates surveillance results for public information.	Not Specified	Mandatory	Prevent	-	• Greater incidence of some food borne diseases	Food Surveillance Programme. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/programme/programme_fs/programme_fs.html > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Centre for Food Safety	Hazard Analysis and Critical Control Point (HACCP) System	The HACCP system identifies, assess and control hazards in food production processes. The system is a cost effective way to prevent potential food hazards by early identification during the production process rather than testing end products. Various food safety guidelines are available to food business and the general public to better understand food safety and prevention of food diseases.	Not Specified	Voluntary	Prevent	-	• Greater incidence of some food borne diseases	Hazard Analysis Critical Control Point (HAPCCP) System. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/programme/programme_haccp/programme_haccp.html > [Accessed 04 Feb 09]
Centre for Food Safety	Frozen Confections Regulations (this Regulation is under the Public Health and Municipal Services Ordinance)	This regulation provides a standard in which frozen confections for sale or to be stored, and restrict the sale of frozen confections.	Not Specified	Mandatory	Prevent	-	• Greater incidence of some food borne diseases	Food legislation/ guidelines in Food Laws in Hong Kong. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/food_leg/food_leg.html > [Accessed 04 Feb 09]
Centre for Food Safety	Microbiological Guidelines for Ready-to-eat Food	The guideline aims to assist inspection officers in interpreting the microbiological analyses of ready-to-eat food. Analysis results can be checked against the criteria listed in the guidelines for safety and hygiene quality. The guideline also recommends appropriate follow-up action for food safety monitoring and control measures.	Not Specified	Voluntary	Prevent	-	• Greater incidence of some food borne diseases	Microbiological Guidelines for Ready-to-eat Food. 2007 (revised). Centre for Food Safety. < http://www.cfs.gov.hk/english/whatsnew/whatsnew_act/files/MBGL_RTE%20food_e.pdf > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Centre for Food Safety	Risk Assessment in Food Safety	Risk assessment studies are conducted by the Centre, in particular, food related hazards that will affect public health are investigated. Findings are published, and made available to the public together with recommendations addressing the (potential) hazards identified.	Not Specified	Mandatory	Prevent	-	• Greater incidence of some food borne diseases	Risk Assessment in Food Safety. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/programme/programme_rafs/programme_rafs.html > [Accessed 04 Feb 09]
Centre for Food Safety	Restriction on the import of food into Hong Kong	Under the Public Health and Municipal Services Ordinance, it specified that food importers are to comply with local food standards and are encouraged to obtain health certificates from the country of origin certifying that the products are fit for human consumption. An official certificate issued by the Food Authority of the originating country or written permission from the Hong Kong Food and Environmental Hygiene Department is required for any person to bring any fresh, frozen or chilled meat and poultry into Hong Kong.	Not Specified	Mandatory	Prevent	There are specific legal requirements or administrative arrangements for the import of the following selected food items due to their perishable or high-risk nature: (a) game, meat and poultry; (b) milk and milk beverages; (c) frozen confections; and (d) marine products.	• Greater incidence of some food borne diseases	Chapter 132 Public Health and Municipal Services Ordinance in <i>Bilingual Laws Information System</i> . n.d. Department of Justice. < http://www.legislation.gov.hk/eng/home.htm > [Accessed 04 Feb 09]
Centre for Food Safety	Slaughterhouses and Disease Surveillance	The unit is responsible for disease surveillance by sampling food animals regularly, tested by the Veterinary Laboratory of the Agriculture, Fisheries and Conservation Department. Any suspected diseases discovered are to be reported. The unit is also responsible for collecting and verifying Animal Health	Not Specified	Mandatory	Prevent, Prepare	Slaughterhouses are monitored and inspected by the Department as well to ensure hygiene and environmental standards are met and only meat safe for human consumption is released for sale in market.	• Greater incidence of some food borne diseases	Slaughterhouses and Disease Surveillance. N.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/import/import_sds.html > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		Certificates of imported food animals from the Mainland and admission forms of pigs from local farms.				Slaughterhouses in Hong Kong regulated by the sub-legislation Cap 132BU Slaughterhouses Regulation under the Public Health and Municipal Services Ordinance.		
Food and Environmental Hygiene Department	Monitoring Pesticides Residues in Food	Sampling and testing of different foods for levels of pesticide residues, to ensure levels are within tolerance levels that are safe for human consumption.	Not Specified	Mandatory	Prevent	-	-	Monitoring Pesticides Residues in Food in <i>Import Control and Food Safety Guidelines</i> . n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/import/import_icfsg_11.html > [Accessed 04 Feb 09]
Food and Health Bureau, Food and Environmental Hygiene Department (FEHD), Centre for Food Safety	Food Business Regulation (under the Public Health and Municipal Services Ordinance (Cap. 132))	This regulation controls food hygiene, hygiene of food premises and food businesses by licensing. Regular inspections are conducted by the Food and Environmental Hygiene Department to ensure that licensed food premises comply with the licensing requirements and conditions as well as hygiene standards prescribed under the law.	Not Specified	Mandatory	Prevent	-	• Greater incidence of some food borne diseases	Food legislation/ guidelines in Food Laws in Hong Kong. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/food_leg/food_leg.html > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Centre for Food Safety	Food Safety Focus	<p>“Food Safety Focus” aims to raise awareness on both local and overseas food safety issues. The programme provides up-to-date information on food hazards and public health risks, and preventive measures that can be taken by the members of the public.</p> <p>Publications are released monthly on chosen food safety related topics.</p>	Not Specified	Voluntary	Prevent	-	• Greater incidence of some food borne diseases	Food Safety Focus. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/english/multimedia_pub/multimedia_pub_fsf.html > [Accessed 04 Feb 09]
Centre for Food Safety	Food Alerts/ Seasonal Food Safety Tips	The Centre for Food Safety promotes the prevention and control of food diseases relating to climate change such as cholera. The Centre also conducts risk assessment studies on food safety. <i>Food alerts</i> keeps the public updated on new findings, risks, and other food safety issues.	Not Specified	Not Applicable	Prepare, Prevent	-	• Greater incidence of some food borne diseases	Food Alerts/ Seasonal Food Safety Tips. n.d. Centre for Food Safety. < http://www.cfs.gov.hk/eindex.html > [Accessed 29 Jan 09]
Food and Environmental Hygiene Department	Food Hygiene Code	The objective of this code is to provide a set of model requirements to help food business achieve a higher degree of compliance with the food regulations as enshrined in the Public Health and Municipal Services Ordinance, and its subsidiary legislation, and attain a higher standard of food hygiene and food safety through adoption of good practices. It also provides FEHD officers and food businesses detail advice and guidance on the application of relevant regulations and ways for compliance.	Not Specified	Not Applicable	Prevent	<p>Guidelines are given on:</p> <ul style="list-style-type: none"> * General design and construction of food premises (ventilation, water supply, waste storage etc) * Cleaning, sanitizing and maintenance of food premises, equipment and utensils * Safe Food Handling (food sources, storage, packaging, transportation) * Personal health, hygiene and training of food 	• Greater incidence of some food borne diseases	Food Hygiene Code. 2003. Food and Environmental Hygiene Department. < http://www.fehd.gov.hk/publications/code/code_all_English.doc > [Accessed 04 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
						handlers		
Food and Health Bureau and Food and Environmental Health Department	Proposed Food Safety Bill	<p>The Bill aims to strengthen food safety regulations such as mandatory registration of all food importers and distributors and require food traders to record sources of food supply. It also proposed to redefine “food” in regulations to include live fish, live amphibian and edible ice.</p> <p>The Food safety Bill is planned to be introduced into the Legislative Council in the 2009-2010 session.</p>	\$21 million (involving 12 posts) to enhance food safety work before enactment of the Bill.	Will become Mandatory	Prevent	-	<ul style="list-style-type: none"> Greater incidence of some food borne diseases 	<p>Examination of Estimates of Expenditure 2008-09: Controlling officer's reply to initial written question. FHB(FE)004. 2008. Food and Environmental Hygiene Department. <http://www.fehd.gov.hk/legco/2008-09/eng/FHB(FE)004.pdf> [Accessed 04 Feb 09]</p> <p>The Proposed Food Safety Bill (for consultation). 2008. Food and Health Bureau. <http://www.fhb.gov.hk/download/pres_s_and_publications/consultation/080121_food/e_food_safety_bill.pdf> [Accessed 04 Feb 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Occupational Health and Safety								
Labour Department	Code of Practice in Typhoons and Rainstorms	Taking into account the interests of employers, employees and the wider community, the Labour Department seeks to provide advice and practical guidelines on work arrangements in times of typhoons and rainstorms.	Not Specified	Voluntary	Prepare, Respond	Employers are asked to release non-essential employees from work when Typhoons Warning Signal 8 or above are approaching the city, and not to require them to come to work when Typhoon Warning Signal 8 or the Black Rainstorm signal are hoisted.	• Human safety and health risks	Code of Practice in times of Typhoons and Rainstorms. 2009. Labour Department. < http://www.labour.gov.hk/eng/public/wcp/Rainstorm.pdf > [Accessed 16 April 09]
Occupational Safety and Health Branch (Labour Department)	Prevention of Heat Stroke at Work in Hot Environment	A leaflet aimed to promote heatstroke prevention at work place, especially where outdoor manual work is required. It presented key information on heatstroke, such as the risk factors, symptoms of heatstroke and preventive measures. It also advised employers to make arrangements for employees to rest in cool or shady place during very hot periods regularly and minimise physical demand.	Not Specified	Voluntary	Prevent	-	• Increase in weather harvesting of vulnerable populations	Prevention of Heat Stroke at Work in a Hot Environment. 2007. Labour Department. < http://www.labour.gov.hk/eng/public/oh/heat.pdf > [Accessed 11 Feb 09]
Occupational Safety and Health Branch (Labour Department)	Risk Assessment for the Prevention of Heat Stroke at Work	A booklet aimed to prevent heat stress by workers engaged in manual work. Educates the reader through assessment and preventive measures. The accompanying checklist helps employers assess their workplace for heat stress dangers.	Not specified	Voluntary	Prevent	In 2009, the Labour Dept enhanced publicity efforts to ensure adequate protection of workers from heat stroke at work. Heat stroke prevention at work was extensively promoted through public health talks and various publicity channels.	• Increase in weather harvesting of vulnerable populations	Risk Assessment for the Prevention of Heat Stroke at Work < http://www.labour.gov.hk/eng/public/oh/HeatStress.pdf > [Accessed 16 Sep 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Labour Department	Occupational Safety and Health Ordinance (Cap. 509)	The Ordinance and its subsidiary legislation specify the responsibility of employers to ensure the safety and health of all employees. In particular to health issues, employers must ensure that sufficient potable water is provided at the workplace for the consumption by employees; employers are legally responsible for assessing the risk of heat stroke for their employees working in a hot environment and take appropriate preventive measures (especially when very hot weather warning has been issued by the Hong Kong Observatory); and employers are to ensure the workplace is adequately ventilated by fresh air.	Not Specified	Mandatory	Prevent	In 2009, the Labour Department enhanced enforcement efforts to ensure adequate protection of workers from heat stroke at work. -	<ul style="list-style-type: none"> • Increase in weather harvesting of vulnerable populations 	<p>Chapter 509 Occupational Safety and Health Ordinance in <i>Bilingual Laws Information System</i>. n.d. Department of Justice. http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=509&Count=30&Expand=509#509 [Accessed 11 Feb 09]</p> <p>Summer occupational safety and health - prevention of heat stroke at work in <i>Labour in Focus</i>. 2005. http://www.labour.gov.hk/eng/major/LabourInFocus/05.htm [Accessed 11 Feb 09]</p>
Labour Department	Factories and Industrial Undertakings Regulations (Cap. 59A Reg 38)	Regulation 38 stipulates that in every notifiable workplace an adequate supply of drinking water either from a public main or from a source approved by a health officer shall be made available and conveniently accessible to all persons employed.	Not Specified	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Increase in weather harvesting of vulnerable populations 	<p>Chapter 59A Factories and Industrial Undertakings Regulations http://www.legislation.gov.hk/blis_pdf.nsf/6799165D2FEE3FA</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
								94825755E0033E532/88636DC3EA9BF29A482575EE0034D5C2/\$FILE/CAP_59A_e_b5.pdf> [Accessed 21 Dec 09]
Labour Department	Construction Sites (Safety) Regulations (Cap 59I Reg 66)	Construction sites shall provide at site a supply of wholesome drinking water.	Not Specified	Mandatory	Prevent	-	• Increase in weather harvesting of vulnerable populations	Chapter 59I Construction Sites (Safety) Regulations < http://www.legislation.gov.hk/blis_pdf.nsf/6799165D2FEE3FA94825755E0033E532/CB7ACD5F5F2AF7D1482575EE00356ACA?OpenDocument&bt=0 > [Accessed 21 Dec 09]
Occupational Safety and Health Branch (Labour Department)	Occupational Disease Casebook - Occupational Infection	Occupational biological hazards are outlined through case studies to promote preventive measures on occupational infection (e.g. Tuberculosis, Legionnaires' Disease)	Not Specified	Voluntary	Prevent	-	• Increase in weather harvesting of vulnerable populations	Occupational Disease Casebook: Occupational Infection. 2006. Labour Department. < http://www.labour.gov.hk/eng/public/ohb95.pdf > [Accessed 11 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Occupational Safety and Health Branch (Labour Department)	Guidance Notes on Health Hazards in Construction Work	The guidelines have listed out a range of potential health hazards in relation to construction works and provided recommendations on preventive measures. Some of the health hazards identified were: silica dust, lead dust, asbestos dust, excessive noise, gases, vapours and fumes, entry into confined spaces, ionizing radiation, vibration, heat and manual handling. It is recommended that possible health hazards should be identified prior to commencement of construction work.	Not Specified	Voluntary	Prevent	-	• Increase in weather harvesting of vulnerable populations	Guidance Notes on Health Hazards in Construction Work. 2004. Labour Department. < http://www.labour.gov.hk/eng/public/oh/OHB82.pdf > [Accessed 11 Feb 09]
Education Bureau	Tropical Cyclones and Heavy Persistent Rain Arrangements for Kindergartens and Day Schools	Arrangements for schools and kindergartens under inclement weather conditions.	Not Specified	Mandatory	Prepare, Respond	Day-schools are closing when Typhoon Warning Signal 8 is expected and resume when Signal 8 or above is replaced by Signal 3 (for kindergartens and schools for physically handicapped children Signal 3 and Signal 1, respectively). Rainstorm warnings concern stages Red and Black, suspending school lessons when the rainfall event takes place before lessons start, and continuing lessons when the event takes place once lessons have started.	• Human health risks	Tropical Cyclones and Heavy Persistent Rain Arrangements for Kindergartens and Day Schools. Education Bureau. Circular No. 3/2007. < http://www.edb.gov.hk/UtilityManager/circular/upload/EMBC/EMBC07003E.pdf > [Accessed 16 April 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Education Bureau	Tropical Cyclones and Heavy Persistent Rain Arrangements for Evening Schools	Arrangements for evening schools under inclement weather conditions.	Not Specified	Mandatory	Prepare, Respond	Schools close when Typhoon Signal 8 or above are hoisted, but resume lessons when Signal 8 is replaced before 5:00 pm and no full-day school closure has been announced. Concerning the closure due to either Red or Black rainstorms, see above.	• Human health risks	Tropical Cyclones and Heavy Persistent Rain Arrangement for Evening Schools. Education and Manpower Bureau. Circular No. 4/2007. < http://www.edb.gov.hk/UtilityManager/circular/upload/EMBC/EMBC07004E.pdf > [Accessed 21 December 09]

Table B11 Existing Policies / Measures that may Contribute to Adaptive Responses to Leisure and Tourism (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary/ Mandatory	Type of Instrument	Remarks	Potential Impacts Addressed	Reference
Agriculture, Fisheries and Conservation Department	Shut down a Marine Park	In May 2007, Coral Beach of the Hoi Ha Wan Marine Park was closed for the purpose of allowing damaged coral to recover.	-	Mandatory	Respond	-	-	Agriculture, Fisheries and Conservation Department Annual Report 2007-2008 < http://www.afcd.gov.hk/english/publications/publications_dep/publications_dep.html > [Accessed 4 June 09]
Hong Kong Observatory	A network of automatic weather stations to monitor weather conditions	The Observatory set up the automatic weather stations in some tourist spots, e.g. Stanley, Sheung Shui and Pak Tam Chung. Real-time weather photos of several tourist spots are provided, e.g. Tsim Sha Tsui, Cheung Chau, Lau Fau Shan, Wetland Park, Tai Lam Chung, Peng Chau, Hong Kong South, Victoria Harbour and Waglan Island. This information enables the public and tourists to assess the latest weather conditions and help to plan their travels accordingly. Wind data of Sha Chau, Ngong Ping, Tai Mei Tuk, Tap Mun and Tate's Cairn is also provided for windsurfers and paragliders.	-	Mandatory	Prevent, Prepare	-	<ul style="list-style-type: none"> • Impacts associated with bad weather • Human health and safety risks 	Hong Kong Observatory 2004-2005 < http://www.weather.gov.hk/abouthko/hko2004-2005e.pdf > [Accessed 4 June 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary/ Mandatory	Type of Instrument	Remarks	Potential Impacts Addressed	Reference
Leisure & Cultural Services Department	Arrangement during typhoons and rainstorms (applicable to LCSD camps only)	It states the arrangement of Day camp, Residential and Evening Camps and the campers who have checked in when typhoon signal No. 3 or above remains hoisted or Black Rainstorm Warning Signal is still in force. Similar arrangements are also in place for their other services, such as Dr. Sun Yat-sen Museum, Museum of Coastal Defence, Antiques and Monuments Office, Museum of History, Art Promotion Office, Water Sports Centres etc.	-	Mandatory	Respond	-	<ul style="list-style-type: none"> Impacts associated with bad weather Human health and safety risks 	Arrangement during typhoons and rainstorms (applicable to LCSD camps only) < http://www.lcsd.gov.hk/camp/en/arrang.php > [Accessed 5 June 09]
Environmental Protection Department	Beach Water Quality Monitoring	The department has monitored the beach water quality since 1986. It conducts the monitoring every week and reports the Beach Rating in the form of press release.	-	Mandatory	Prepare	-	<ul style="list-style-type: none"> Human health and safety risks 	Beach Water Quality Report 1986 - 2000 < http://www.epd.gov.hk/epd/english/environmentinhk/water/beach_quality/bwq_report8600_ch1.html > [Accessed 5 June 09]
Leisure & Cultural Services Department	Flag Signals	The department implements the flag signals for safety reasons. There are five kinds of flag signals, Windsock, Red Flag, Shark Warning Flag, Yellow Flag and N Flag. Red flag will be hoisted due to bad water quality, bad	-	Mandatory	Prevent, Prepare	-	<ul style="list-style-type: none"> Human health and safety risks 	Safety Guideline < http://www.lcsd.gov.hk/watersport/en/guid_flag.php > [Accessed 5 June 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary/ Mandator y	Type of Instrument	Remarks	Potential Impacts Addressed	Reference
		weather e.g. heavy rainfall, tropical cyclones, thunderstorm, etc. In that case, people should stop all water activities.						

Table B12 Existing Policies / Measures that may Contribute to Adaptive Responses to Water Resources (as of February 2008 from the Inter-departmental Working Group on Climate Change of Hong Kong Government)

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
External Supply from Dongjiang								
Water Supplies Department	Agreement for the supply of Dongjiang water to Hong Kong for 2009-2011	The agreement will guarantee a stable and flexible supply of Dongjiang water up to 2011 based on the actual needs of Hong Kong. This will provide for Hong Kong's water demand even under extreme drought conditions with a return period of one in 100 years. Daily water supply is flexible to tie in with seasonal fluctuations in the local yield. The flexibility will allow better control of storage level in reservoirs and avoid wastage and save pumping costs.	2009: \$2,959 million 2010: \$3,146 million 2011: \$3,344 million	Mandatory	Prevent	-	<ul style="list-style-type: none"> • Increased demand for water • Greater rates of evaporation • Risk of supply interruption 	Agreement ensures stable supply of Dongjiang Water to Hong Kong. Press Releases 11 December 2008. < http://www.info.gov.hk/gia/general/200812/11/P20081211098.htm > [Accessed 06 Feb 09]
Hong Kong Impounding and Service Reservoirs								
Water Supplies Department	Total Water Management Programme	<p>The aim of this programme is to promote water conservation and explore new water resources to secure Hong Kong's future water supply. It also aims to better prepare Hong Kong for uncertainties such as climate change.</p> <p>To address water demand, the key measures are: promote water conservation; leakage control; promote the use of water saving devices; water reclamation (use of seawater for toilet flushing); and tiered tariff structure to encourage</p>	Not Specified	Mandatory	Prevent, Prepare	Regards to water supply: activities that may threaten the quantity and quality of water are assessed and monitored regularly and new water resources are to be explored (such as expansion of water gathering	<ul style="list-style-type: none"> • Increased demand for water • Greater rates of evaporation • Risk of supply interruption • Reduced yield due to rainfall variability 	ACQWS Paper No.20 Total Water Management Strategy in Hong Kong. 2008. Advisory Council on the Environment. < http://www.wsd.gov.hk/acqws/doc/p20.pdf > [Accessed 29 Jan 09]
								Total Water Management in Hong Kong. n.d. Water Supplies Department.

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		<p>water conservation.</p> <p>The Hong Kong Government has adopted a voluntary water efficiency labelling scheme for different plumbing fixtures and water-consuming appliances. The first group applies to showers for bathing. The aim of this is to promote water conservation, to promote public awareness, and to provide consumers an ability to select water saving products.</p>				grounds, desalination plant)		<p><http://www.wsd.gov.hk/en/html/pdf/TWMe.pdf> [Accessed 02 Feb 09]</p> <p>The Hong Kong Voluntary Water Efficiency Labelling Scheme on Showers for Bathing <http://www.gov.hk/en/business/support enterprises/bf/pdf/c onsultation/08025_cp _en.pdf> [Accessed 16 Sep 09]</p>
Water Supplies Department	"Little Drop's Marvellous Journey" Roving Exhibition Panels	Students are the targeted audience of this water conservation promotion resource. The exhibition panel may be loaned to schools for a maximum of two weeks. The panels illustrate the water cycle and water treatment and distribution process in Hong Kong.	Not Specified	Voluntary	Prepare	-		<p>Little Drop's Marvellous Journey Roving Exhibition Panels. n.d. Water Supplies Department. <http://www.wsd.gov.hk/en/html/edu/exhib/little_drops.htm> [Accessed 06 Feb 09]</p>
	Easy Roll-up Banners	<p>These banners are another approach in promoting water conservation (and water quality). They are not only available to schools but also to management companies. The banners are divided into four themes:</p> <p>* Save Water for the Future, Every</p>	Not Specified	Voluntary	Prepare	-		<p>Easy Roll-up Banners. n.d. Water Supplies Department. <http://www.wsd.gov.hk/en/html/edu/w_conserve/easybanner.htm> [Accessed 06 Feb 09]</p>

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Leakage detection and monitoring systems	<p>Drop Counts</p> <p>* Save Water Save Dollars</p> <p>* Quality Water Recognition Scheme for Buildings</p> <p>* Prevent Water Leaks</p> <p>As part of the on-going Replacement and rehabilitation programme, the leakage detection and monitoring systems have been upgraded to enhance its operational performance. Flows meters and data loggers are installed in selective supply zones and distribution networks are monitored. The daily pressure and flow data are collected and stored in centralised computers for department staff to analyse and identify leakage and arrange remedial work.</p>	Not Specified	Voluntary	Prevent	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]
	Comprehensive Pressure Management Scheme	The aim is to reduce leakage in the distribution networks while maintaining a stable supply pressure.	Not Specified	Mandatory	Prevent	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]
	Water Pricing	The four-tier water pricing system aims to promote water conservation. The minimum supply of water required for health and hygiene is supplied to consumers at no cost. Water consumption thereafter will be charged on volume base. The cost at second tier will take into account of the Government's contribution	Not Specified	Mandatory	Prevent, Prepare	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
		through rates, where the third tier of water supply will be charged at a non-subsidised production cost. The fourth tier will be charged 40 percent higher than the third tier.						
	Water Conservation Campaign	The campaign comprises of talks, seminars and exhibitions in housing estates and schools and across print and electronic media. At the same time, three water treatment plants have held public open days with guided tours which highlighted the technical aspects of water treatment. There were also exhibitions on water science, metering system and the mains replacement and rehabilitation programme.	Not Specified	Voluntary	Prepare	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]
	Water Efficiency Labelling Scheme	Similar concept to the Energy Efficiency Labelling Scheme, it promotes the use of water saving devices by indicating to consumers the levels of water consumption and efficiency rating of plumbing fixtures and appliances used in toilet, kitchen, bathroom and laundry.	Not Specified	Voluntary	Prepare	-		ACQWS Paper No. 20 Total Water Management Strategy in Hong Kong. 2008. Advisory Council on the Environment. < http://www.wsd.gov.hk/acqws/doc/p20.pdf > [Accessed 06 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Replacement and Rehabilitation Programme	The Programme aims to replace or rehabilitate approximately 3,000km of aged water mains in 15 years to improve the condition of the water supply network in order to maintain a reasonable level of services to consumers.	Approximately \$15.7 billion	Mandatory	Prevent	-		ACQWS Paper No.20 Total Water Management Strategy in Hong Kong. 2008. Advisory Council on the Environment. < http://www.wsd.gov.hk/acqws/doc/p20.pdf > [Accessed 06 Feb 09]
								Replacement and Rehabilitation Programme of Water Mains. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/edu/rehab/index.htm > [Accessed 06 Feb 09]
	Reprovisioning of the Shum Wan Shan Fresh Water Pumping Station	Aims to enhance the reliability of water supplies to Tsueng Kwan O.	Not Specified	Mandatory	Prevent	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]
	Salt Water Supply System	Install mains along Castle Peak Road between Lok On Pai and Fu Tei. Construction of a pumping station at Lok On Pai, a service reservoir at Tai Kwai Tsuen and the laying of 8.4km of salt water mains (Stage 2).	\$347 million (for Lok On Pai works)	Mandatory	Prevent	Construction will begin in early 2009.		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
	Reprovisioning Works at Sha Tin Water Treatment Works	To increase the capacity of the Tai Po Water Treatment Works by 550,000 cubic metres per day	Approximately \$2.7 billion	Mandatory	Prevent	Construction is scheduled to begin in early 2010 and to be completed by the end of 2013.		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]
	Improvements to Mid-level and high-level water supplies	Construction of service reservoir, pumping station and mains to improve water supplies in the mid- and high-level areas on Hong Kong Island.	\$235 million	Mandatory	Prevent	-		Annual Report 2007-2008. n.d. Water Supplies Department. < http://www.wsd.gov.hk/en/html/pdf/rpt0708/menu.htm > [Accessed 06 Feb 09]

Department / Organisation	Policy / Measure	Description	Cost of Policy / Measure	Voluntary / Mandatory	Type of Instrument	Remarks	Potential Consequences Addressed	Reference
Drainage Services Department, Water Services Department	Ngong Ping Sewage Treatment Works	The Ngong Ping Sewage Treatment Works is the first to produce reclaimed water in Hong Kong. The reclaimed water is used for toilet flushing in the area, rearing aquarium fishes and controlled irrigation within the facility. The treatment plant uses the Sequencing Batch Reactor technology (SBR) to remove nutrients and solids. Dual media filter is used to remove fine suspended solids that the SBR was not able to filter. Bacteria and virus will be sterilized using ultra-violet light tubes. A deodorisation unit has also been installed to remove odour from gases generated from the treatment plant before being discharged into the atmosphere.	Not Specified	Mandatory	Prevent	-		Ngong Ping Sewage Treatment Works. 2007. Drainage Services Department. < http://www.dsd.gov.hk/FileManager/EN/publications_publicity/publicity_materials/leaflets_booklets_factsheets/NPSTW.pdf > [Accessed 11 Feb 09] Use of Reclaimed Water. n.d. Hong Kong SAR. < http://www.gov.hk/en/residents/environment/water/userclaimedwater.htm > [Accessed 09 Feb 09]
	Inter-reservoir Transfer Scheme (IRTS)	Construction of 2.8km long water tunnel for transferring overflow from Kowloon Byewash reservoir to Lower Shing Mun Reservoir. The works for the IRTS are scheduled to commence in early 2010 for completion in 2012.	Approximately \$26 million	Mandatory	Prepare	UpcomingStart: Early 2010Complete: 2012	• Reduced yield due to rainfall variability	West Kowloon in Flood Prevention. n.d. Drainage Services Department.< http://www.dsd.gov.hk/flood_prevention/our_achievement/west_kowloon/index.htm > [Accessed 10 Feb 09]