



渠務署

Drainage Services Department

AECOM

**Agreement No. CE77/2021 (DS)
Strategic Planning Study on Flood
Management Against Sea Level Rise
and Extreme Rainfall – Feasibility Study**

**Executive Summary
December 2025**

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1 INTRODUCTION

1.1 Background of the Study

Hong Kong is a sub-tropical coastal city located in the path of tropical cyclones. Moreover, Hong Kong is one of the highest precipitation among cities in the Pacific Rim. Under its unique geographical and meteorological settings, Hong Kong faces the risk of flooding during adverse weather.

Climate change has caused rising mean sea levels, more intense tropical cyclones and more frequent extreme rainstorm, thus increasing the risk of flooding over the territory. The complexity of climate change and its anthropogenic drivers leads to climate change projections with considerable uncertainty in particular for long term projections. Notably, Super Typhoons Hato in 2017 and Mangkhut in 2018 and the extraordinary rainfall events occurred worldwide in 2021 underscore the growing unpredictability and frequency of extreme weather events.

Together with the publication of the Sixth Assessment Report (AR6) by the Intergovernmental Panel on Climate Change (IPCC) with updated climate change projections under different greenhouse gas emissions scenarios, it is time to revisit the flood protection standards and flood management strategy and formulate plans as necessary.

AECOM Asia Company Limited was commissioned by Drainage Services Department (DSD) in March 2022 to undertake the “Strategic Planning Study on Flood Management against Sea Level Rise and Extreme Rainfall – Feasibility Study” (“the Study”) to develop long-term flood management strategy under climate change for enhancing the city’s resilience.

1.2 Objectives of the Study

The objectives of the Study can be divided into three main parts:

- (i) To review current flood protection practices including the flood protection standards and relevant design parameters to ensure their adequacy.
- (ii) To assess and evaluate the flood risks in Hong Kong under various climate change scenarios, in order to identify vulnerable areas, and enable formulation of appropriate mitigation measures.
- (iii) To develop a comprehensive flood management strategy tailored to address the increasing risks associated with extreme sea levels and extreme rainfall due to climate change. This strategy would encompass a range of measures, including structural and non-structural measures aiming at enhancing flood resilience of the city.

1.3 Expert Panel for the Study

A dedicated expert panel was established to provide expert advice and views on the Study. The panel comprised academia and experts from local, the Mainland and international backgrounds. Their extensive knowledge and experiences were instrumental in developing the Study's forward looking management strategies to the challenges of climate change.

Lead Panelist

Prof. Joseph LEE Hun-wai, President of Macau University of Science and Technology, Macau

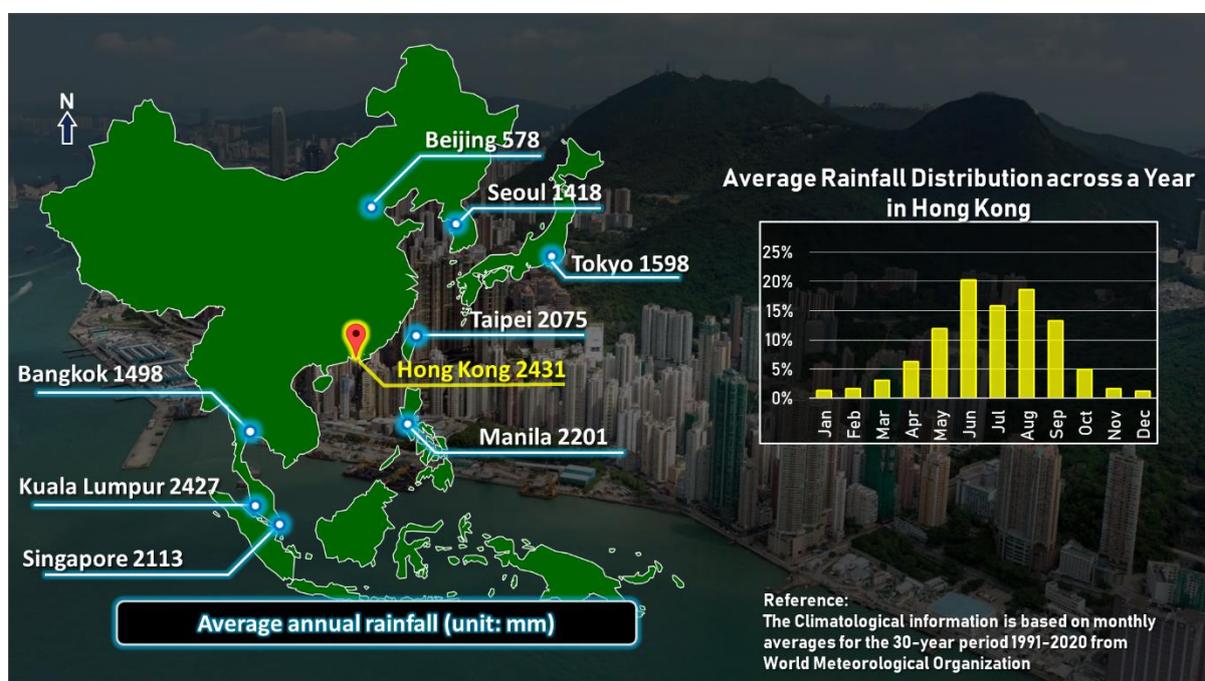
Members

- Mr. CHENG Xiaotao, Former Vice Chief Engineer, China Institute of Water Resources and Hydropower Research, the People's Republic of China
- Mr. HE Zhibo, Vice Chief Engineer, Pearl River Water Resources Commission, Ministry of Water Resources, the People's Republic of China
- Prof. Roger FALCONER, Emeritus Professor, Cardiff University, United Kingdom
- Prof. CHEN Ji, Professor, Department of Civil Engineering, The University of Hong Kong

2 REVIEW OF CURRENT FLOOD PROTECTION PRACTICES

2.1 Challenges to Drainage Systems

Hong Kong's subtropical climate is characterized by one of the highest annual rainfall totals in the Pacific Rim, averaging approximately 2,400 millimeters. This precipitation is highly seasonal, with over 80% concentrated between May and September, creating a persistent challenge for flood management.



Average Annual Rainfall in the Pacific Rim

The severity of this challenge was underscored on 7-8 September 2023, when a record-breaking rainstorm delivered an unprecedented intensity of 158 mm per hour. The event's 12-hour total exceeded 600 mm — equivalent to one-quarter of the annual average.

Located in the regular path of tropical cyclones, Hong Kong faces the combined threat of storm surges and high astronomical tides. This interaction creates a severe backwater effect at drainage outfalls, leading to backflow that floods the low-lying inland areas.

Hong Kong's geographical setting also presents a unique challenge for flood prevention. The city is a highly urbanized metropolis with approximately 7.5 million people spreading across roughly 1,115 square kilometers. The steep terrain at its upstream and high urban density accelerate rainwater runoff. Intense rainfall can cause rainwater to rush down slopes from hilly areas, rapidly overwhelming urban drainage networks and leading to flash floods. Remarkably, about 75% of the population lives in just 25% of extensively developed land. Even localized flooding can lead to significant disruptions in daily life.

Climate change presents further acute challenges for Hong Kong, with projections indicating rainfall increase and sea level rise that will exacerbate flood risks.

In summary, Hong Kong faces a dual flooding threat: flash floods from intense rainfall and inundation from coastal storm surges during typhoons, both exacerbated by its dense urban form and climate change.

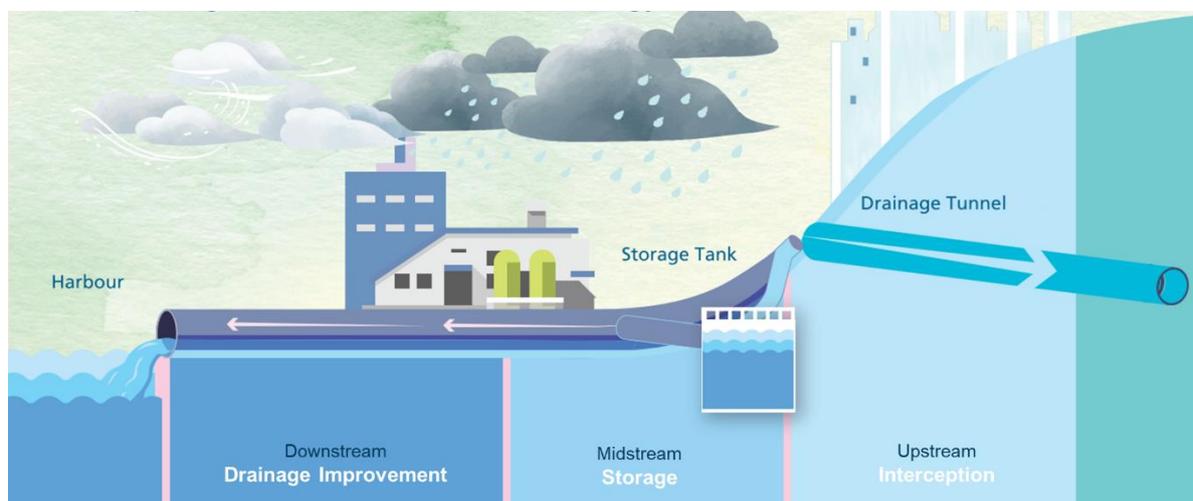


**Steep Terrain and Dense Urban Development
Geographical Setting of Hong Kong**

2.2 Current Flood Prevention Approach

DSD has developed a territory-wide Drainage Master Plan to systematically review the existing drainage systems of various districts. Tailored to the topographical characteristics and constraints of different areas, DSD has adopted a three-pronged flood prevention approach in implementing drainage improvement works to reduce flood risks in various districts:

- **Upstream – Interception:**
Building drainage tunnels to intercept stormwater from the mid-levels and discharge it directly into the sea or to other channels.
- **Midstream – Storage:**
Building stormwater storage tanks in the mid-stream for temporary stormwater storage to attenuate the peak runoff and relieve the discharge load of the downstream drainage system.
- **Downstream – Drainage Improvement:**
Carrying out river training works or build new drainage channels and drains to upgrade the capacity of drainage system.



Three-pronged Flood Prevention Approach

So far, key drainage infrastructures include four drainage tunnels with a total length of more than 20 km, five underground stormwater storage tanks with a combined capacity of approximately 250,000 m³, equivalent to 100 standard swimming pools, over 2,400 km stormwater drains and over 370 km engineered channels. This comprehensive network operates effectively to protect the city from flooding.

DSD has actively encouraged the wider adoption of "blue-green drainage infrastructure" elements in the design of drainage system with a view to enhancing the adopting capacity of drainage system through promoting infiltration, storage, purification, reuse and discharge and other beneficial uses.

DSD has developed an inventory of flood prone locations. This inventory enables the "just-in-time clearance" that directs proactive inspections and clearance operations prior to adverse weather events, with a view to minimizing disruptions to the community.

DSD has also established a dedicated emergency organization, supported by professional and technical staff, to ensure a coordinated and effective response to flooding incidents. Central to this organization is the Emergency Control Centre, which oversees the deployment of emergency teams, disseminates information regarding flooding, and communicates with other emergency organizations during adverse weather events.

2.3 Flood Protection Standards

A review of flood protection standards in Hong Kong against other major cities by the Study showed that they are generally comparable. While direct comparison is difficult due to differing drainage system classifications, Hong Kong's standards are on par with the major cities in Mainland and overseas.

Flood Protection Standards of Hong Kong and Major Cities

City	Classification	Design Return Period (Years)
Hong Kong	Urban drainage branch	50
	Urban drainage trunk	200
Shenzhen and Guangzhou	Design criteria for urban drainage	50
	Design criteria for flood protection	200
Singapore	Area with catchment of more than 1 000 ha	50
	Airport runway or any area as specified by the Board	100
Tokyo	Inland drainage	20
	City-managed rivers	100
	National-managed rivers	200
London	Surface water drainage	30
	Watercourse	100
New York	Flood control design criteria for drainage projects	100

2.4 Design Parameters

The Study updated the design parameters of the Stormwater Drainage Manual (SDM). Following the update of design extreme sea level and climate change parameters based on historical sea levels and IPCC AR6 projections respectively in 2022, the Study recommended a further update to design rainfall intensities after the September 2023 extreme event. The revised SDM, promulgated in March 2024, resulted in an update of design rainfall for various return periods. For example, the 200-year return period design rainfall incorporating climate change effect up to mid 21st century are shown below:

60min Design Rainfall Intensities (200-year return period up to mid 21st century) in the SDM

HKO Headquarter	North District Area	Tai Mo Shan Area	West Lantau Area
172mm/hr	131mm/hr	180mm/hr	174mm/hr

3 FLOOD RISK ASSESSMENT

3.1 Climate Change Considerations

The IPCC serves as the United Nations' primary source for disseminating information on climate change, including summaries of current scientific reports and journal articles. Established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), the IPCC aims to equip governments at all levels with scientific data to develop climate policies. It offers scientific assessments regarding the foundation of climate change, its implications, potential future risks, and options for mitigation.

The IPCC's AR6 employed a set of five core scenarios taking into consideration different trends in greenhouse gas concentrations to generate climate projections for the 21st century. The actual pathway remains highly uncertain, dependent on global emission reduction efforts.

The Study considered that flood risk assessment for the intermediate and very high greenhouse gas emissions scenarios at mid-century (2050) and the end of the century (2100) would cover possible flooding impact brought by climate change in medium to long term planning horizons. This is generally in line with the Mainland's and overseas practices.

3.2 Analytical Assessment

The Study collected updated data and information, e.g. drains and river networks and digital terrain models, paved and unpaved ratios, past flooding records, etc., from relevant government departments.

Considering the above data and information, computational hydraulic model (InfoWorks ICM model) was used to simulate and assess the flood risks for whole Hong Kong with various design return periods up to 200-year taking into account of climate change projection up to 2100.

The assessment also utilized the latest climate change projection data including rainfall increase, mean sea level rise and storm surge increase to evaluate the flood risk for all districts.

With reference to the projection data from the IPCC’s AR6, for mid-century (2050), the differences between SSP2-4.5 (11.1% increase of rainfall, 0.20m increase of mean sea level) and SSP5-8.5 (10.6% increase of rainfall, 0.23m increase of mean sea level) are insignificant. Thus, a representative case (11.1% increase of rainfall, 0.23m increase of mean sea level plus storm surge increase for corresponding return period and tide station) is adopted for flood risk assessment.

For the end of the century (2100), depending on the effectiveness of decarbonization efforts by various nations, there is high uncertainty regarding the extent of climate change, which will result in varying intensities of rainfall and sea level rise. As the difference between intermediate and very high greenhouse gas emissions scenarios is more prominent, the Study conducted flood risk assessment for both SSP2-4.5 (16.6% increase of rainfall, 0.56m increase of mean sea level plus storm surge increase for corresponding return period and tide station) and SSP5-8.5 (34.3% increase of rainfall, 0.78m increase of mean sea level plus storm surge increase for corresponding return period and tide station).

To summarise, modelling simulations were performed to analyze the following climate change scenarios:

- Mid-century (2050) intermediate (SSP2-4.5) / very high (SSP5-8.5) greenhouse gas emissions scenario
- End of the century (2100) intermediate greenhouse gas emissions scenario
- End of the century (2100) very high greenhouse gas emissions scenarios

Climate Change Design Parameters adopted in this Study (change relative to the 1995-2014 average)

		Rainfall Increase	Mean Sea Level Rise (m)
Mid-century (2050)	SSP2-4.5	11.1%	0.23
	SSP5-8.5		
End of the century (2100)	SSP2-4.5	16.6%	0.56
	SSP5-8.5	34.3%	0.78

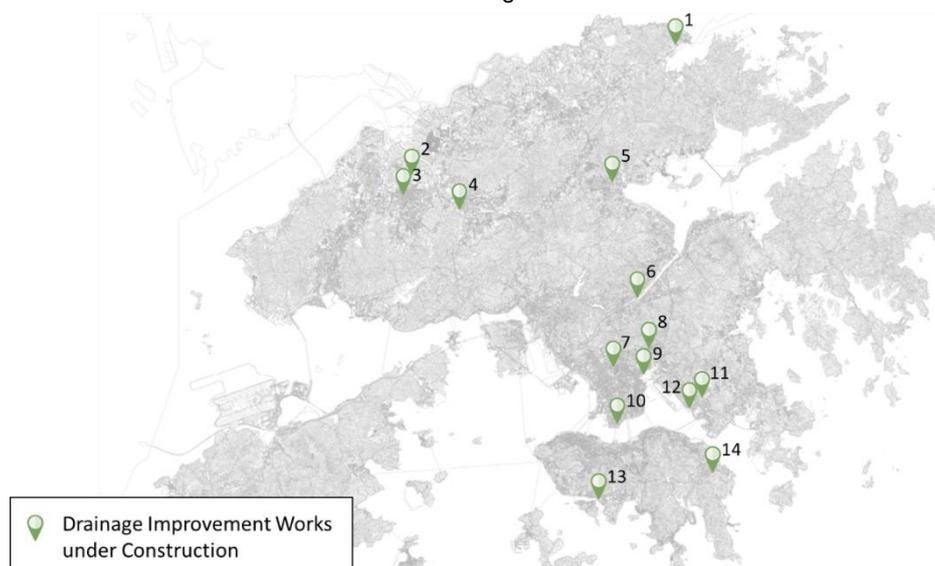
3.3 Assessment Results

So far up to mid 2025, DSD has 15 on-going drainage improvement works projects which are anticipated to complete progressively by the end of 2030. The result of the flood risk assessment revealed the relatively high flood risk at these areas and re-affirmed the necessity of these on-going projects. These projects cover Wong Tai Sin, Hong Kong Island East and other areas hit by severe flood in the past.

	Project Title
1#	Drainage Improvement Works at North District – Phase 1
2	Yuen Long Barrage Scheme
3	Improvement of Yuen Long Town Nullah (Town Centre Section)
4	Drainage Improvement Works at Yuen Long – Stage 2
5#	Drainage Improvement Works in Tai Po – Phase 1
6#	Drainage Improvement Works in Sha Tin and Sai Kung – Phase 1
7#	Drainage Improvement Works in Mong Kok - Phase 1
8#	Drainage Improvement Works in Wong Tai Sin
9#	Drainage Improvement Works in Kowloon City
10#	Drainage Improvement Works in Tsim Sha Tsui
11#	Drainage Improvement Works in Kwun Tong – Phase 1
12#	Drainage Improvement Works in Kwun Tong – Phase 2
13	Drainage Improvement in Southern Hong Kong Island – Package 2B
14	Drainage Improvement Works in Eastern District – Phase 1
15*	Rehabilitation of Underground Stormwater Drains – Remaining Works

Remark: *Across whole territory

#With Construction of Stormwater Storage Scheme



Remarks: Works under *Rehabilitation of Underground Stormwater Drains – Remaining Works* are carried out across the whole territory

Drainage Improvement Works under Construction

4 RECOMMENDED FLOOD MANAGEMENT STRATEGIES

4.1 Progressive Adaptive Approach

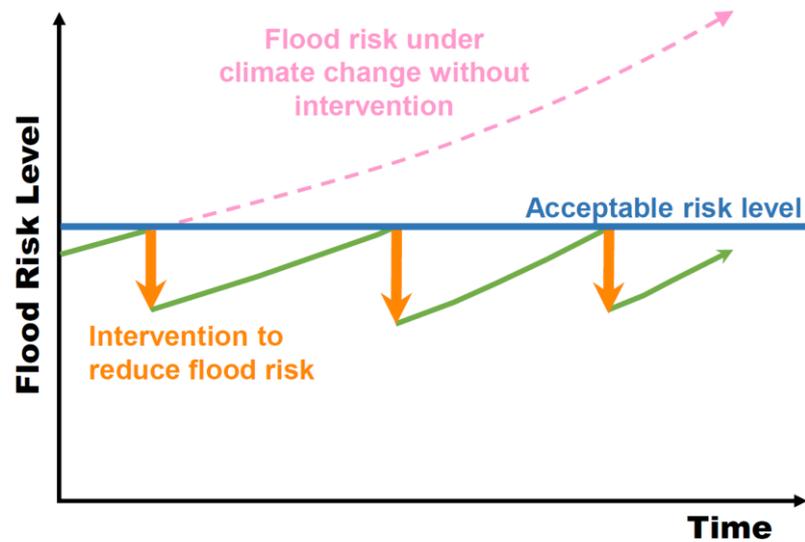
Global climate is expected to continue changing in the future. With reference to IPCC's AR6, there is insignificant difference in projections for rainfall intensity and mean sea level under intermediate and very high greenhouse gas emissions scenarios in the mid-century. Depending on the effectiveness of decarbonization efforts by various nations, there are considerable uncertainties in the climate change impacts at the end of the century. The difference between intermediate and very high greenhouse gas emissions scenarios is more prominent. In view of the diverse pathways, the Progressive Adaptive Approach is adopted by many international cities to address the uncertainties in climate change development, due to varying global efforts to reduce carbon emissions.

Similar to many international cities, Hong Kong also encounters considerable uncertainties in the impacts of climate change near the end of the century. The Progressive Adaptive Approach was recommended by the Study for implementation of drainage infrastructure. The Study considered that this approach would provide sufficient flexibility and adaptability so that the Government could have sufficient time to develop effective and cost-efficient measures according to the latest climate change development.

The Study recommended that intermediate greenhouse gas emissions scenario at mid-century would be taken as the baseline design scenario which could generally cater for the very high greenhouse gas emissions scenario at mid-century, since the projection differences between the two scenarios are insignificant as discussed in the last section.

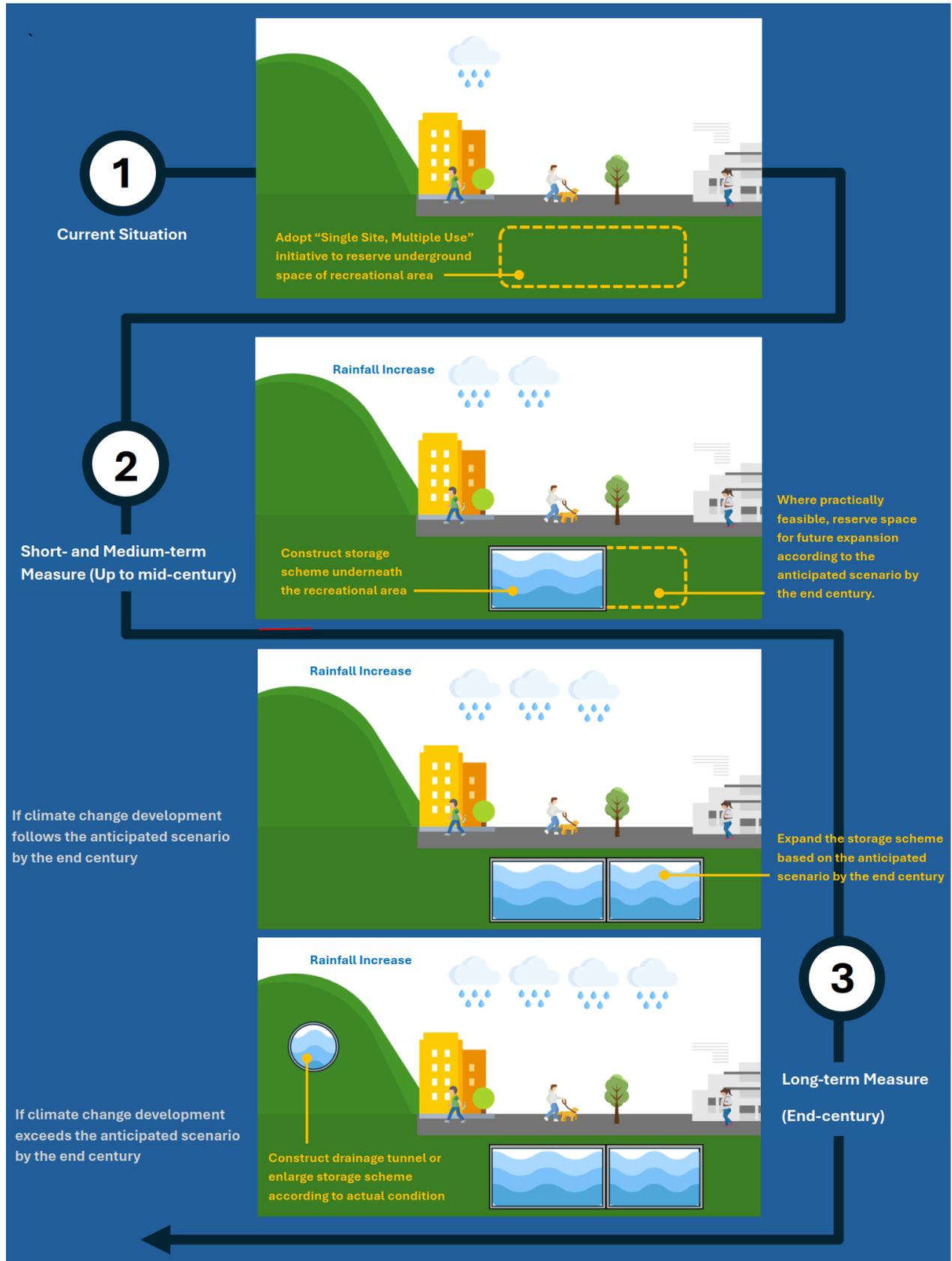
Where practically feasible, design provisions should be included to enable timely and cost-effective upgrade of the drainage infrastructure in the future as needed, so as to combat the climate change impact up to the very high greenhouse gas emissions scenarios at the end of the century.

This approach would also help avoiding the premature implementation of extensive drainage infrastructure, thus preventing unnecessary construction, operation and maintenance costs. Meanwhile, it would ensure the decision maker to plan ahead following the latest climate change development.



Concept of Progressive Adaptive Approach

In long run, close monitoring of the latest climate change trend and refinement of the implementation plan from time to time would be required under principle of Progressive Adaptive Approach. To implement the Progressive Adaptive Approach, the Study recommended a regular review on drainage system performance aligning the IPCC Assessment Report cycle or in times of need, taking into account the latest climate change considerations, land use changes and completed drainage improvement works.



Illustrative Example of the Application of Progressive Adaptive Approach

The illustrative example demonstrates the implementation strategy of drainage infrastructure. For an area prone to potential flood risk under the current situation, the underground space beneath the recreational area can facilitate the "Single Site, Multiple Use" initiative to implement measures to mitigate possible flood risks up to mid-century. In the short and medium-term (up to mid-century), a stormwater storage scheme can be constructed underneath the recreational area, with space reserved for future expansion of the stormwater storage tank where practically feasible based on the anticipated climate scenario by the end of the century.

The development of climate change will be under close monitoring. If the climate change trend aligns with the anticipated scenario, the remaining reserved space can be utilized to expand the stormwater storage scheme, accommodating the additional flood risk from climate change at the end of the century. If the climate change trend exceeds the anticipated scenario, the remaining reserved space will need to be used for expanding the stormwater storage scheme, and additional measures such as constructing a drainage tunnel or further enlarging the stormwater storage scheme may be required based on actual conditions.

4.2 Integrated Flood Management Strategy

Hong Kong has made significant investments in drainage infrastructure to mitigate flood risks. In view of various unpredictable situations brought by extreme weather, the international community generally agrees that investment in infrastructure for avoiding flooding completely is not the most effective nor cost-efficient approach.

The Study formulated a territorial forward-looking Integrated Flood Management Strategy to combat the impacts brought by climate change, under the Government's strategic framework of combating extreme weather comprising the four major elements of advance emergency preparedness, enhanced early warning, decisive emergency response and speedy recovery announced in mid 2024. The Integrated Flood Management Strategy is a comprehensive and multipronged strategy to address flood risks caused by more extreme weather due to climate change and to further enhance Hong Kong's capabilities in adaptation and resilience. The integrated strategy focuses on three aspects including:

- **Adaptation** – Implementing drainage improvement works in an orderly manner by adopting the Progressive Adaptive Approach to reduce flooding impact.



Drainage Improvement – Pipe Enlargement



Drainage Improvement – River Training



Underground Storage Tank



Drainage Tunnel

Examples of Adaptation Measures

- **Resilience** – Adopting temporary or non-structural measures to control flood risks or reduce flooding impact for speedy society recovery.



Demountable Flood Barrier



Blue-Green Drainage Infrastructure

Examples of Resilience Measures

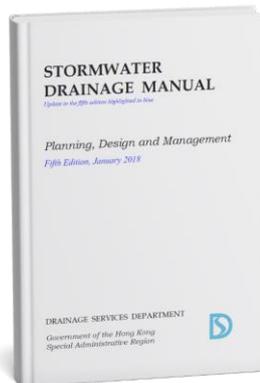
- **Management** – Strengthening emergency preparedness, leveraging innovative technologies, enhancing information dissemination, reviewing and timely updating guidelines/standards, with a view to raising public awareness of flood prevention.



“Just-in-time” Clearance



Robotic Applications



Standards and Guidelines



Public Education

Examples of Management Measures

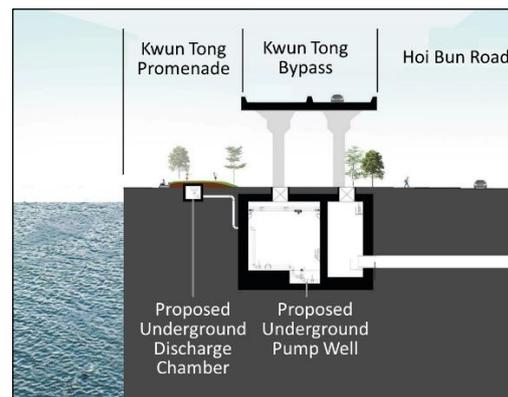
4.3 Adaptation

The Study reaffirmed the three-pronged flood prevention approach as the core strategy for adaptation. Current practice to review the performance of drainage system and implement drainage improvement projects using three-pronged flood prevention approach should be continued.

To effectively adapt to rising sea levels, smart penstocks at drainage outlets to protect inland low-lying areas from seawater infusion, barrage schemes at river channels to prevent seawater inundation due to high sea level and pumping systems for floodwater displacement can be considered depending on the size and characteristic of the catchment to be protected and cost effectiveness. These adaptation measures are essential for safeguarding urban areas against the long-term threats of climate change and sea-level rise.



Barrage Scheme



Pumping Scheme

Infrastructure for Adapting to Rising Sea Levels

In addition, considering the uncertainties in future climate change development, the Study recommended adopting Progressive Adaptive Approach as discussed in Section 4.1. Continuous monitoring of climate change development should be carried out with corresponding review and adjustment on the plans. Adaptation measures would be implemented progressively in a timely manner to cater for the increasing climate change effect according to the latest climate change development.

In addition to the on-going projects, proactive planning of drainage improvement works across various districts was recommended. These projects would take into account the existing topography, flood risks and impacts on surrounding areas, drainage capacity of existing drainage system, technical feasibility and cost-effectiveness, etc. The drainage improvement works would be implemented by batches in an orderly manner to mitigate the flood risk at mid-century (2050).

Given that the scenarios at the end of the century (2100) are relatively far-future and subject to uncertainties in long-term climate change, coupled with the evolving land development in Hong Kong over time, the Study recommended to monitor the latest climate change trends, review flood risk across districts and formulate appropriate measures in a timely manner.

The Study identified preliminary options for the developed areas with potential flood risks. Examples would include implementing stormwater storage schemes, barrages, stormwater pumping stations and drainage tunnels, as well as installing smart penstocks at drainage outlets in low-lying areas. For new development area, such as the Northern Metropolis, the stormwater drainage systems should be designed according to the requirements as set out in the SDM, to address mid-century climate change impacts, while implementation plan would be developed with land reserved for at the end of the century, enabling future expansion following the Progress Adaptive Approach.

4.4 Resilience

Resilience covers measures to control flood risks or reduce flooding impact for speedy society recovery. The Study recommended that blue-green drainage infrastructures and floodproofing measures would be the major measures for implementation in Hong Kong.

Blue-green Drainage Infrastructures

Some elements of the Blue-green Drainage Infrastructures such as green roof, water harvesting, bioretention system, etc, can reduce surface runoff under normal rainfall events and hence reduce the flood risks and enhance the overall flood resilience of a city under various intensities of rainfall events.



Green Roof



Rain Garden



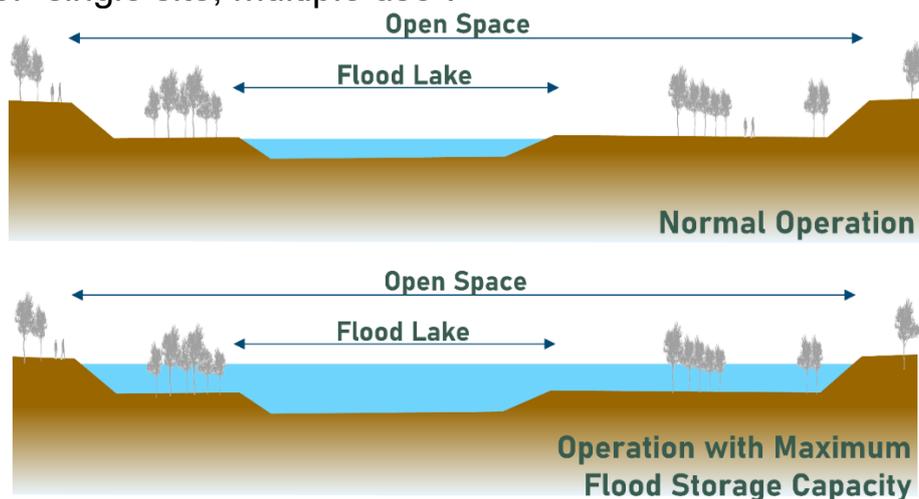
Engineered Wetland



Water Harvesting

Examples of Blue-Green Drainage Infrastructure

Floodable area (e.g. floodable open space) serves as public spaces and recreational facility during normal days and can be transformed into temporary stormwater storage facility during extreme rainfall events, leading to better utilization of land resources and land co-use, achieving benefit of “single site, multiple use”.



Floodable Open Space

Floodproofing Measures

Floodproofing measures include elevated platform, waterproof enclosure for protection of electrical equipment, and various types of flood barriers such as demountable flood barrier, electrical auto flip-up barrier, water filled tube barrier, doorway barrier, etc. DSD promulgated Practice Note “Guidelines on Flood Resilience” in 2022 to introduce various flood resilience measures and the relevant considerations for public reference. Among these measures, demountable flood barriers have been commonly used which can be easily and quickly installed.

To promote wider adoption of flood barriers, the Study investigated various types of new generation flood barriers including their operational principle and application and concluded that various types of flood barriers would be effective in preventing intrusion of floodwater under different settings, with advantages of convenient to use, automatic, adjustable and can be swiftly deployed. Five types of flood barriers were selected for site trial under the Study and their recommended application are summarized below:

	<u>Flood Barriers</u>	<u>Recommended Application</u>
1.	 <p>Electrical auto flip-up barrier</p>	Applicable to entrances of buildings or underground facilities e.g. underground car park
2.	 <p>Hydrodynamic auto flip-up barrier</p>	Applicable to entrances of building and underground facilities e.g. underground car park

	<u>Flood Barriers</u>	<u>Recommended Application</u>
3.	 <p style="text-align: center;">Water filled tube barrier</p>	Applicable to long defense along riverside/roadside
4.	 <p style="text-align: center;">Temporary auto flip-up barrier</p>	Applicable to long defense along riverside/roadside
5.	 <p style="text-align: center;">Doorway barrier</p>	Applicable to entrances of village houses

To foster self-protection among the public, it's essential to promote the concept of flood resilience and related measures to both the industry and the general public. Regular meetings with relevant stakeholders, department's open day, engineering conference, seminars and talks are appropriate occasions to engage the industry and the public for enhancing their knowledge on this aspect.

4.5 Management

The Study recommended to continuously enhance multi-faceted management measures which could be categorized into 4 main aspects –

- Strengthening “just-in-time” clearance
- Leveraging innovative technologies
- Reinforcing information dissemination
- Updating and formulating standards and guidelines

Strengthening “Just-in-time” Clearance

With the experiences gained from the rainstorm in September 2023, the Study revealed that increasing the number of emergency response teams and utilizing existing government’s premises to increase the number of emergency support stations was effective in strengthening the emergency preparedness. Since the implementation of the enhancements, time required for “just-in-time” clearance was minimized and operational efficiency was also improved in reaching flooding locations to conduct necessary flood relief works.



Emergency Response Teams and Emergency Control Centre

Leveraging Innovative Technologies

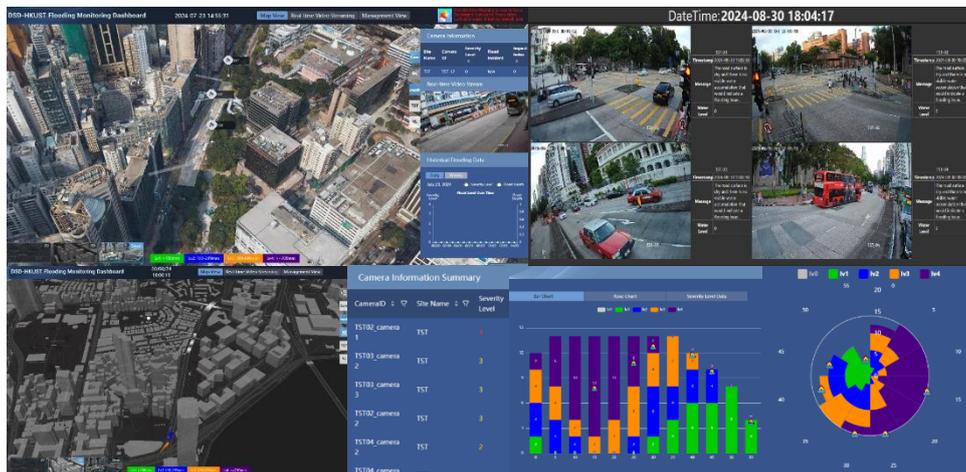
Recent rapid advancements in robotics, artificial intelligence (AI), and remote sensing present significant opportunities to enhance the capabilities of emergency response teams and improve societal resilience. The Study recommended that expanding the use of these technologies would lead to a major improvement in emergency response efforts.

Deploying pumping robots for flood response increases the efficiency of flood relief works and accelerates recovery. Pre-positioning these robots in high flood risk areas supplements the drainage system with extra capacity, thereby efficiently reducing flood risks. To be effective, the selected robots must be capable of operating in diverse environments including roads, villages, underground facilities, and low-lying regions to enable rapid deployment and pumping across various flood scenarios.



Use of Pumping Robots to Handle Flooding

With the support of AI visual recognition technology and big data, the AI can analyze real-time images to detect flooding instantly, facilitating a faster operational response.



Artificial Intelligence-based Flood Monitoring Systems

The Study identified a new type of flood monitoring sensor which was able to detect real-time flood level on the road and alert relevant parties when flood level reached the pre-set warning level. The devices were installed to support the operation of pilot scheme for Wading Line System at low-lying road sections with high flood risk to monitor the flooding situation in real time, so as to facilitate effective mobilisation and collaboration of relevant government departments to tackle flooding as early as possible.



Wading Line and Flood Monitoring Device

Reinforcing Information Dissemination

Effective communication by providing clear and accessible information is vital in flood risk management to enhance community preparedness and build trust in government initiatives. By proactively sharing data, it will enable public to aware of flood risks and take appropriate precaution, ultimately safeguarding lives and property. The Study recommended to provide real-time river water level warning in DSD's website.

The Study reviewed the flooding blackspots mechanism and concluded that the mechanism might no longer reflect the current situation. With over three decades of dedicated effort by the DSD to improve the drainage systems over the territory, the number of flooding blackspots has been substantially reduced, and occurrence of large-scale flooding cases have been significantly decreased. The Study observed that most flooding cases in recent years were caused by other reasons rather than insufficient drainage capacity and flooding could occur due to various factors, including blocked drainage inlets, insufficiency of local drainage systems due to more extreme rainstorm or low-lying topography of the coastal areas. To improve public awareness and preparedness, the Study recommended publishing lists of flood-prone areas in DSD's website to

replace the flooding blackspots, categorized into three groups: "Locations Prone to Blockage", "Locations with Drainage Improvement Works in Progress" and "Coastal Low-lying or Windy Areas".

Updating and formulating Standards and Guidelines

In addition to the update of design rainfall intensities in the SDM in response to the extreme rainstorm in September 2023, the Study also reviewed the DSD Practice Note "Guidelines on Flood Resilience" and recommended update to reflect findings from the Study, in particular for the new types of flood barriers investigated.

Furthermore, in conjunction with the recommendations of CEDD's Study on Shoreline Management Plan, the Study proposed the inclusion of a new section for climate resilience of engineering infrastructure in the Hong Kong Planning Standards and Guidelines (HKPSG), aiming to raise public awareness of possible flood risks induced by climate change, to highlight flood management proposals from these two studies, to encourage the use of blue-green drainage infrastructure, and to promote the concept of flood resilience.

5 FUTURE VISION

5.1 Collaboration with Public

As our city faces increasingly challenges due to more frequent extreme weather events, it is clear that no single entity can tackle these issues alone. It cannot solely rely on government's effort. It is crucial to engage the community and stakeholders in order to fully embrace the Integrated Flood Management Strategy.

A coordinated effort can reduce the overall flood impact on the community. To further enhance the resilience of the city, DSD would continue to engage the public and private sectors, on regular basis, to raise awareness and preparedness for extreme weather events, such as stakeholders engagement meetings before every rainy season to enhance their preparedness.

DSD would also continue to enhance the public education through engagement activities, such as international conferences, open days, meeting with relevant stakeholders (including utility providers, professional bodies, etc.), and other outreach education programs, etc, thereby strengthening their vigilance in face of extreme weather and climate change.

5.2 Interdepartmental, Cross-border and International Collaboration

A robust collaborative framework across government, regional, and international lines is essential for a comprehensive flood resilience strategy. Domestically, DSD would continue its active participation in inter-departmental bodies such as the Climate Change Working Group on Infrastructure. Regionally, DSD has deepened cross-border collaboration with Greater Bay Area counterparts through the Joint Working Group for the Shenzhen River and Cooperation Agreement with Pearl River Water Resources Commission of the Ministry of Water Resources. Globally, DSD has engaged in international forums to share Hong Kong's experience and keep abreast of cutting-edge technologies and global best practices, ensuring Hong Kong's resilience planning remains at the forefront of international standards.

5.3 Long-term Strategy

Whilst the Progressive Adaptive Approach was recommended by the Study to cater for the uncertainties in future climate change development, the Study considered that continuous monitoring and review of the climate change projections on sea level rise and rainfall increase would be necessary. Holistic drainage system review studies should be conducted from time to time (aligning with the updating cycle of IPCC Assessment Report or whenever in need) with updated climate change projections to adjust the plan for appropriate measures. Relevant design standards and practices should be reviewed and updated taking into consideration the latest climate change development.

5.4 Further Studies

With the breakthrough in technology, the Study revealed that the current method to define flood level in the SDM could be refined. International practices were reviewed under the Study, advanced countries such as UK, US and the Netherlands have shifted to use probabilistic method to define the flood level. The Study recommended that further studies would be conducted to investigate the cost benefit and application of the new approach.

In addition, the Study recommended to conduct new study to enhance the overall application for resilience and management measures. The new study could focus on refining resilience and management measures for further enhancing robustness on district scale; developing a comprehensive publicity plan to elevate public awareness of flood risks and resilience measures; and exploring possible management plan to deal with worse-than-anticipated climate change impact.