1. Flood Prevention Strategy

Concept Map

This concept map shows how the situation develops since flooding occurred at Wing Lok Street in Sheung Wan. The stakeholders involved include the general public and government departments. The Drainage Services Department establishes flood prevention goals in order to enhance the quality of life of people here. These goals will be explored in detail under this theme.

Wing Lok Street in Sheung Wan

Past

Present

Future

Improved

Continual improvement

Recurring flooding

Solutions

Stormwater Storage Scheme

Intercepting drains

Enhancing

Quality of life

Causes

Natural disasters

Human factors

Stakeholders

Impacts / responsibilities

The public

Residents of the district

Shop owners

Road users / tourists

The Government

Food and Environmental Hygiene Department

Highways Department

Drainage Services Department

Hong Kong Observatory

Home Affairs Department

How much do you know about the flood prevention strategy?

Have you ever experienced floods and flooding? Or have you only seen flooding on TV or read about it in the newspapers? Either way, rain affects our daily lives. How well do you know about the stormwater drainage systems in Hong Kong? Take the quiz below and find the correct answers at the website of the Drainage Services Department (http://www.dsd.gov.hk).

1. How many levels are there in the Flooding Blackspot Scale?

   A. 3 B. 4 C. 5 D. 6

2. How many flooding blackspots were there in Hong Kong in 1995?

   A. About 30 B. About 50 C. About 70 D. About 90

3. How many flooding blackspots were there in Hong Kong in 2013?

   A. About 20 B. About 40 C. About 60 D. About 80

Quiz Was there an increase or a decrease in the number of flooding blackspots between 1995 and 2013? Why was there such a change?

4. Which of the following is **NOT** a flood prevention measure adopted by the Drainage Services Department?

   A. Blockage B. River training C. Stormwater storage
   D. Stormwater interception E. Pumping

Quiz Do you think the current measures are effective? Why? Do you have better suggestions? Consider the advantages and disadvantages of the above measures and identify the most effective flood prevention measures.

5. To reduce flood losses, the Government has put in place various warning systems to alert the public. Which of the following warning system(s) is / are adopted by the Government?

   I. Rainstorm Warning II. Thunderstorm Warning
   III. Flood Warning IV. Tropical Cyclone Warning

   A. I B. I, III C. II, III D. I, III,IV E. All of the above

6. Which of the following preventive maintenance measures are performed by the Drainage Services Department to ensure normal operation of the drainage systems?

   I. Inspection of gullies, water inlets, drains, etc.
   II. Use of closed-circuit TV for surveillance
   III. Checking flood prevention devices
   IV. Regular maintenance of drains and facilities
   V. Weather forecasts

   A. I, II B. I, II, III, IV C. I, III, IV, V D. All of the above

7. A 24-hour hotline has been set up by the Drainage Services Department. The telephone number is:

   A. 1823 B. 2300-1110
   C. 187-2288 D. No such hotline

8. Which of the following is **NOT** a major part of the rural drainage system projects?

   A. River regulation projects
   B. Construction of drainage channels
   C. Village Flood Protection Scheme for low-lying areas[1]
   D. Improvement of aging drains

Quiz The challenges facing the rural area and the urban area in carrying out drainage system projects are different. What are they?

9. Decide whether the following statement is true or false:

   When implementing flood prevention projects, the Drainage Services Department accords high priority to outcomes such as cost effectiveness, progress and impact on the community. Environmental conservation is only secondary.

   A. True B. False

10. In 2013, how many Drainage Master Plans were there in Hong Kong?

    A. 5 B. 6 C. 7 D. 8

'How much do you know about the flood prevention strategy?'

Scoring: _____ correct answers

☹ 0 – 3 Room for improvement 😐 4 – 7 Good ☺ 8 – 10 Excellent

[1] The Village Flood Protection Scheme was formerly known as 'Village Flood Pumping Scheme'.

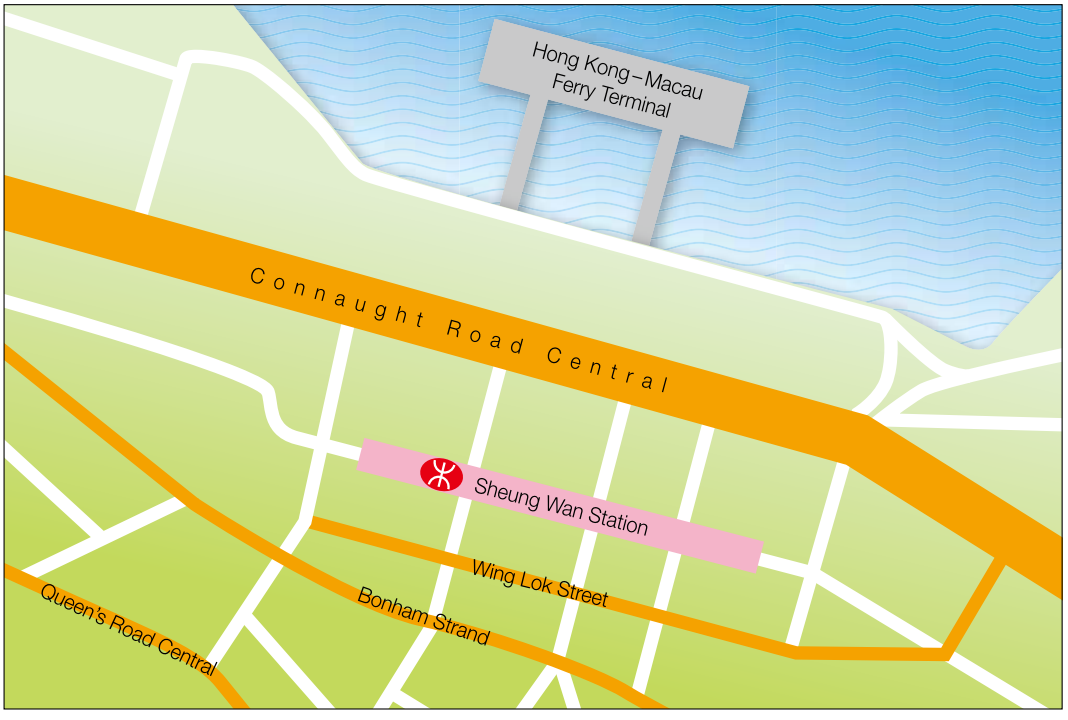
Starting with the flooding incidents at Wing Lok Street in Sheung Wan

The 'Dried Seafood Street' actually refers to the streets in the vicinity of Sheung Wan, i.e. Wing Lok Street, Bonham Strand and Des Voeux Road West. Dried food specialties and seafood are available in stalls along these streets. Many residents and tourists patronise the area on an ordinary day, and it particularly swarms with visitors and customers on the days close to the end of the lunar new year.

A flooding blackspot

Basic Knowledge

Nevertheless, Wing Lok Street is also a flooding blackspot. The area in the vicinity of Wing Lok Street and Bonham Strand was reclaimed in 1857. It is at a level lower than the surrounding area. At times of high tides, an astronomical tide[2] or a storm surge[3] in particular, this area could be affected by the backward flow of seawater through drains and road gullies, and the stormwater could not be effectively discharged into the sea as well. For example, heavy downpours on 24 June 2005, 16 July 2006 and 7 June 2008 brought severe flooding to the area. Disruption caused to businesses and residents has aroused public attention.



Location map of Wing Lok Street, Sheung Wan

[2] Astronomical tide is the tide which occurs when gravitational force exerted by the Sun and the Moon reaches a maximum level.

[3] Storm surge is caused by strong winds and change in atmospheric pressure during a typhoon.

Why flooding recurs

Basic Knowledge

To find out why the flooding in Wing Lok Street was so severe, we need to revisit the history of Hong Kong ...

In Hong Kong's early years, hundreds of thousands of people left mainland China for Hong Kong to make a living. They put up dwelling places and settled down along the shore at a section of Queen's Road at Sheung Wan and Sai Ying Pun. On 28 December 1851, a fire of unprecedented scale broke out. The affected area stretched from today's Wing Wo Street in the east to Queen's Road in the west. More than 400 dwelling places were destroyed and there were over 20 casualties. George Bonham, the British Governor at the time, sent people to clear the scene. To speed up the clean-up work of the site for reconstruction, large amounts of debris, wood and rock were dumped on a shore nearby — the north shore of Queen's Road (today's Bonham Strand). This was the first reclamation project in Hong Kong's history.

Many new streets were also built during the reclamation, including today's Bonham Strand, Jervois Street and Wing Lok Street. With the setting up of business hongs and banks, this area became a financial hub for the Chinese. Hong Kong Gold Exchange was once located on Des Voeux Road Central and Mercer Street.

Why is Sheung Wan a low-lying area?

Basic Knowledge

Reclamation work in the area around Sheung Wan kept expanding northward. With advancements in scientific development, improvement in engineering technology and higher expectations for land reclamation, the later-reclaimed waterfront land areas were constructed higher than those in the vicinity of Des Voeux Road Central, Wing Lok Street and Bonham Strand. The 10-hectare area in Sheung Wan became low-lying as a result. Wing Lok Street is situated at the lowest point and is therefore susceptible to flooding.

On 7 June 2008, Wing Lok Street was severely flooded due to heavy rain. Shops suffered huge losses.

Worksheet (1)

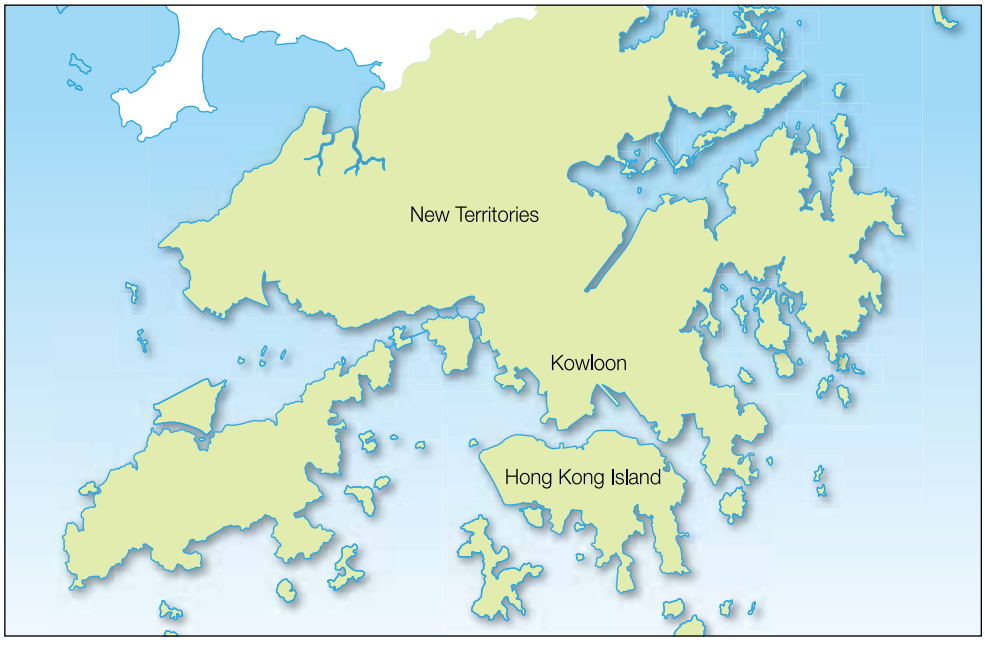
'While water can carry a boat, it can also overturn it'

Foundation

1. How does rain affect our lives and society? List the positive and negative impact of rain in the table below:

Positive impact	Negative impact

2. List the places in Hong Kong where rain has brought 'negative' impact in the past decade. Elaborate your answer with examples and mark the respective places on the map below.



Advanced

Data-response Questions

Study the information below:

Source 1

Statistics of the Hong Kong Observatory show that Hong Kong has an average annual rainfall of about 2,380 mm between 1971 and 2001. The annual rainfall in 2007 was relatively low, only around 1,707 mm. The amount of rainfall recorded was 3,066 mm in 2008 and 2,182 mm in 2009.

Source: Hong Kong Observatory

Source 2

On 7 June 2008, flooding and landslides caused by heavy rain led to two deaths and 16 injuries. In an hour between 8 a.m. and 9 a.m., 145.5 mm of rainfall was recorded at the Hong Kong Observatory Headquarters, setting a record for the highest hourly rainfall. A total of 307.1 mm of rainfall was recorded for the whole day, which was the fifth highest recorded in June in Hong Kong history.

Source: Hong Kong Observatory

Source 3

Hong Kong faced severe droughts in 1963. As the water supply was insufficient, the Government implemented water rationing territory-wide. Water was only supplied for four hours every four days. The public had to store enough water to last for four days each time. Therefore, the Government began purchasing water from the mainland. The two regions eventually signed an official agreement in 1964 and the mainland started supplying water from Dongjiang to Hong Kong in March 1965. Since then, Hong Kong has had a more stable water supply.

In the 1960s, it was common for men to work while women stayed home. During the period when the Government supplied water to the public for four hours every four days, queuing for water for cooking and laundry was an important duty of women.

1. According to Sources 1 and 2, what are the problems caused by rain?

2. According to Source 3, how did the Hong Kong Government solve the unsteady water supply in the 1960s?

3. Comparing the social problems related to rainfall in Sources 2 and 3, which situation do you think has a greater impact on Hong Kong people? Please explain.

Worksheet (2)

Sheung Wan: Worst hit by rainstorm

Read the information below and complete the activities on the next two pages.

Sheung Wan flooded in the deluge after heavy downpour

On 24 June 2005, Hong Kong witnessed several episodes of heavy rain. The Hong Kong Observatory issued the first Red Rainstorm Warning Signal of the year. The downpour coincided with a high tide and caused flooding in the Central and Western District. A 0.6 metre deep flood resulted in the vicinity of Wing Lok Street, Queen's Road and Des Voeux Road due to backward flow of seawater. Wing Lok Street in Sheung Wan was the hardest hit. Many dried seafoods (such as shark's fin, bird's nest and American ginseng) were swept away by the torrential rain. The situation was chaotic and many shops suffered severe financial losses. Like a spectacular waterfall in an urban area, stormwater kept flowing down Smithfield Road in Kennedy Town, and cars crashed as a result. It was reported that the driver and passengers in a taxi were frightened as it was tossed around by the force of the flood. Moreover, a basement supermarket nearby was inundated with goods bobbing all around. The following day, the Chief Executive, the Director of Drainage Services and the District Officer (Central and Western District) visited the area affected by the flooding to appraise the situation. It was noted that the construction of new stormwater drains and a floodwater pumping station would be expedited to relieve the flood risk.

Source: Adapted from various newspapers.

Foundation

Flooding Incident at Wing Lok Street in Sheung Wan

Date: 24 June 2005

Venue: The area around Wing Lok Street in Sheung Wan, also known as 'Dried Seafood Street'

1. Why did flooding occur?
   (Hint: Consider natural factors and human factors.)

2. What was the impact of flooding on the residents, shop owners and passers-by there?
   (Hint: The impact on daily lives, work, traffic and property.)

Advanced

Deconstructing the Flooding Incidents at Wing Lok Street in Sheung Wan

Ask questions by employing the 5Ws and 1H. Try to find the answers and you will have a better understanding of the flooding incidents in Sheung Wan.

5Ws and 1H	Questions	Answers
What		
Who		
When		
Where		
How		
Why		

Worksheet (3)

Causes of the flooding at Wing Lok Street in Sheung Wan

A. Read the following information

Source 1

Reclamation work in the area around Sheung Wan kept expanding northward. With advancements in scientific development, improvement in engineering technology and higher expectations for land reclamation, the later-reclaimed waterfront areas were constructed higher than those in the vicinity of Des Voeux Road Central, Wing Lok Street and Bonham Strand. Since the area around Wing Lok Street was an important financial and business district, it was undesirable to demolish the buildings there to raise the ground level. The 10-hectare area in Sheung Wan became low-lying as a result.

Source: Drainage Services Department

Source 2

A1 Local | Daily News | 4 February 2009

During rainy seasons, Wing Lok Street, dubbed 'Dried Seafood Street', has always suffered from flooding due to backward flow of seawater. Sheung Wan is a low-lying area and most drains were constructed many years ago. With heavy rains coinciding with high tides, the drainage system could be overloaded by rainfall from higher areas and the backward flow of seawater. Between 2000 and 2008, the Hong Kong Observatory issued eight Black Rainstorm Warnings and flooding occurred five times in the area around Wing Lok Street and Bonham Strand. The stormwater pumping station constructed by the Drainage Services Department at the waterfront of Sheung Wan started operation in 2009. The huge stormwater storage tank and diversion chambers can withstand rainstorms with a return period[4] of one in 50 years.

Sheung Wan Stormwater Pumping Station (The storage tank is built underground.)

Source: Adapted from various newspapers.

[4] 'Return period' is a statistical term to describe the average period of time between the occurrences of a certain phenomenon. The higher the severity of the rainfall, the less likely its recurrence and the longer the return period.

Source 3

Sheung Wan is one of the oldest settlements in Hong Kong. Most of the infrastructures, including the drains, were designed and constructed decades ago to meet the requirements and standards at that time. To cater for development needs, the Drainage Services Department has carried out improvement works to the drainage systems from time to time. However, the 10-hectare low-lying area including Bonham Strand, Wing Lok Street and Man Wa Lane is still susceptible to flooding during heavy rainstorms and high tides.

Source: Drainage Services Department

Source 4

The Red Rainstorm Warning Signal was issued on 24 June 2005 as the rainfall recorded in the Western District on Hong Kong Island reached a record high of 112 mm per hour. As the rainstorm happened to coincide with the high tide, large amounts of rainfall could not be effectively discharged into the sea. Flooding occurred and the floodwater reached 0.6 m in depth. During the rainstorm on 16 July 2006, a high tide coupled with strong onshore winds raised the sea level, resulting in the backward flow of seawater and wave flooding. More recent flooding incidents occurred on 19 April and 7 June 2008. Although there was no high tide or on-shore winds, heavy rainstorms caused serious flooding and the traffic came to a halt as the water depth reached 1.5 m. Many shops in the area suffered heavy economic losses as ginseng and dried seafood were soaked and damaged.

Drainage Services Department workers are clearing a blocked drain

Source: Drainage Services Department

B. Explore the causes of flooding

Read Sources 1 to 4. Identify the causes of flooding at Wing Lok Street and put them in the table below.

Causes	Description	Source(s)
Geographical situation		
Natural disasters		
Urban planning / Economic activities		
Population growth		
Drainage facilities		

C. Classify the causes of flooding

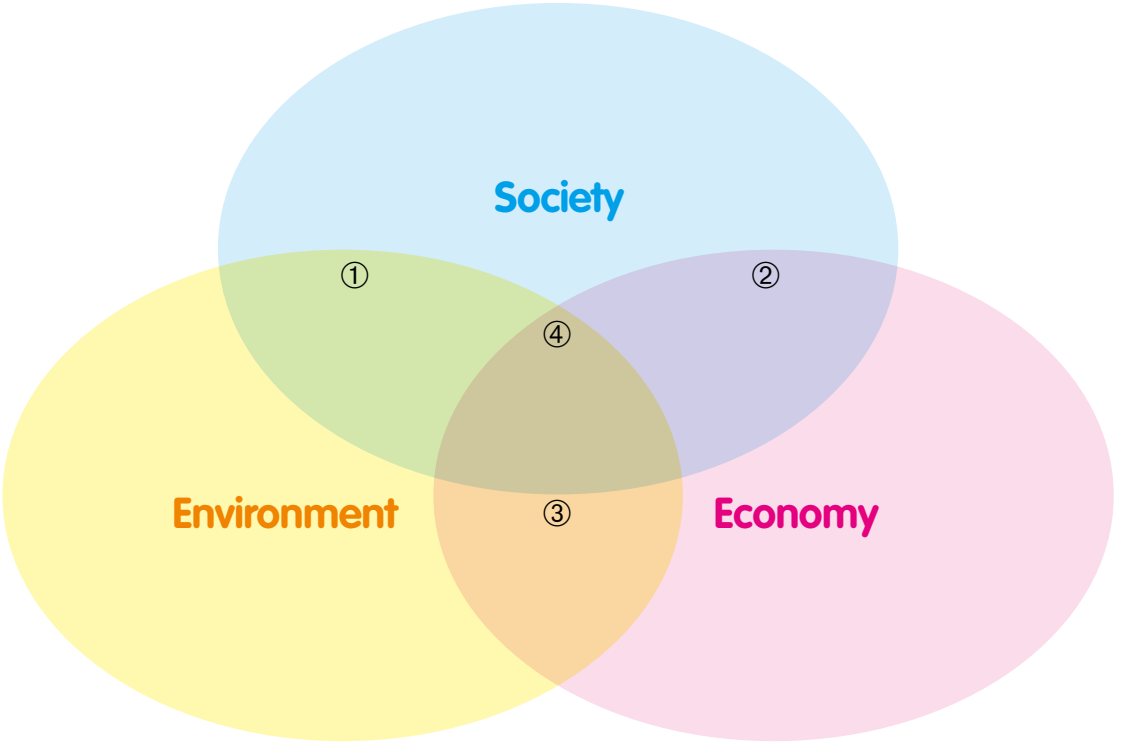
Foundation

Classify the causes of flooding at Wing Lok Street in Sheung Wan by their nature and put them in the appropriate boxes.

Natural / Non-human factors	Human factors

Advanced

Analyse the correlation between different causes of flooding at Wing Lok Street in Sheung Wan. Fill them in the appropriate spaces and explain.



	Factors involved			Causes	Explanation
	Society	Environment	Economy		
①	✓	✓			
②	✓		✓		
③		✓	✓		
④	✓	✓	✓		

Worksheet (4)

News Magazine: When will the flooding problem be solved?

A. Watch the TV programme 'News Magazine: When will the flooding problem be solved?' (「水浸何時了？」)

A brief introduction of the programme (about 15 minutes):

- ✓ It describes the impact of flooding on dried seafood business at Wing Lok Street in Sheung Wan.
- ✓ It analyses the causes of serious flooding incidents at Wing Lok Street in Sheung Wan. The topography of Wing Lok Street is the main cause.
- ✓ The Drainage Services Department has carried out improvement works in recent years, such as building a floodwater pumping station.
- ✓ Limitations of improvement works on relieving the flooding problem at Wing Lok Street. For example, rainstorms with a return period of one in 50 years and blocked drains cannot be dealt with merely by design techniques.

B. Group discussion

1. Referring to the programme 'When will the flooding problem be solved?', which group of people do you think suffered most in the flooding at Wing Lok Street? Why?

People and occupations	The impact on them is ...

2. Discuss the impact of flooding incidents at Wing Lok Street on the quality of life of different groups of people.

Definition of the quality of life:		
People and occupations	**The level of impact on their quality of life:** ('1' least impact; '5' greatest impact)	**Why?**
	1 2 3 4 5	
	1 2 3 4 5	
	1 2 3 4 5	
	1 2 3 4 5	

C. Note taking

Present the main points of the TV programme in the format of a concept map.

Flood prevention strategy of the Drainage Services Department

What is 'Flood Prevention Strategy'?

Basic Knowledge

Flood prevention standards, an integral part of the flood prevention strategy, are used for the planning and design of public stormwater drainage systems. In developing these standards, the Drainage Services Department has taken into account factors like land use, development options, socio-economic needs, consequences of flooding, along with the cost-benefit analysis of various flood mitigation measures. In this way, different flood prevention standards are adopted for different drainage systems at various areas with different land use.

In formulating the flood prevention strategy, the Drainage Services Department has to consider environmental constraints and cost effectiveness. Factors unrelated to the works, such as social and economic pressures, finance and legislation, geographical environment and organisational management, are also taken into account as a whole in addition to the objectives of development plans.

Various drainage improvement works

While conducting Drainage Master Plan studies, the Drainage Services Department has drawn up a number of improvement works for the existing drainage systems. They are categorised as follows:

Flood Storage Tank in Tai Hang Tung

Flood storage

In general, urban development expands from a coastal area (downstream). By the time the inland areas (upstream) begin to develop, the downstream areas have already been urbanised. Upgrading the drainage networks in downstream areas will cause severe disturbance and is technically difficult due to inadequate working space.

A stormwater storage tank is a common way to reduce flood risk in urban areas. The flood storage approach is often used when the capacity of downstream drainage network is insufficient to cope with increased surface runoff[5] following upstream urban development.

A stormwater storage tank or pool is built to store the stormwater from upland to downstream areas, so that the peak runoff[6] to the downstream drainage system can be reduced.

[5] As more land is cemented over for urban development, stormwater cannot penetrate into the soil, thus leading to an increase in surface runoff.

[6] Runoff is the surface water flowing, from different catchment paths, downhill to rivers, lakes and the sea.

The stormwater storage approach is commonly used in Hong Kong because there is a need to improve the standard of flood prevention in urbanised downstream area. For example, a large underground storage tank has been built under a sports ground in Mong Kok to lower the flood risk.

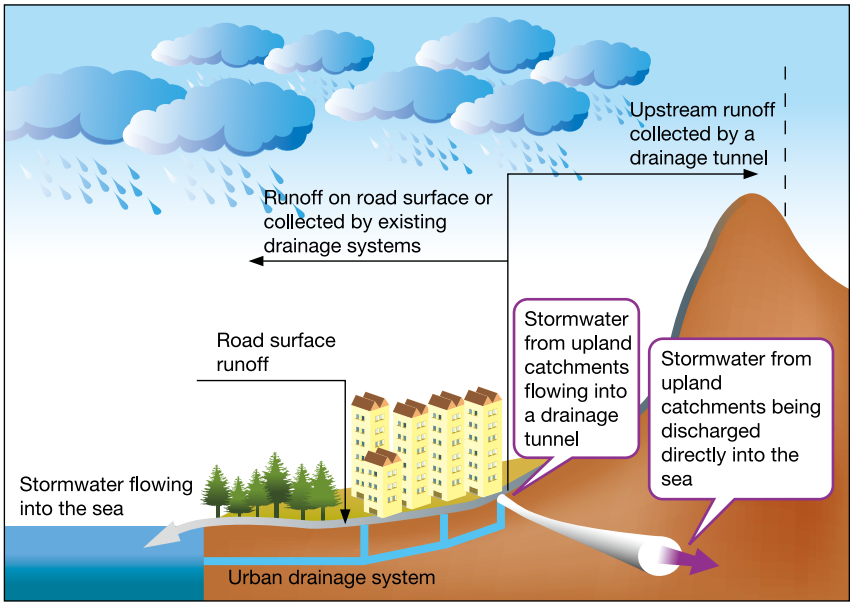


Diagram of the mechanism of a drainage tunnel

Drainage tunnel

Stormwater from an upland catchment area is intercepted by the drainage tunnel system for direct discharging into the sea. As some of the stormwater is intercepted at upland catchments, there will be less stormwater flowing into the existing drainage system in the urban areas. In this way, the flood prevention capacity of the drainage system downstream is improved because its discharge load has been reduced.

Pumping

Pumping can lower the water level in flood-prone areas, and stormwater can be discharged directly into the sea through rising mains.

Upgrade of existing drainage system

This option involves widening, enlargement or replacement works to drainage pipelines, rivers, nullahs or culverts of the existing drainage system.

Village flood protection schemes

Weirs and pumping schemes are designed to provide flood protection to villages in low-lying areas. The weirs can prevent stormwater from flowing into the village area whereas pumps can pump stormwater out of it.

A pumping station in Chuk Yuen Tsuen, Yuen Long

Legislation and management measures

In the past, flooding very often occurred in low-lying areas of northwestern and northern New Territories. The chance of flooding could have been reduced had the watercourses within these areas been adequately maintained and kept unblocked. At present, a number of main watercourses run through, or are surrounded by, private land. Access to these areas is a must to carry out maintenance work. However, some of the necessary maintenance works could not be carried out because Drainage Services Department staff were denied access to these private land areas.

Drainage Services Department workers are clearing the blocked drains.

Under the *Land Drainage Ordinance*, the Drainage Authority is empowered to carry out maintenance works and exercise control within certain watercourses to keep them unblocked for the purpose of protecting lives and property in flood-prone areas.

About the *Land Drainage Ordinance*

Powers conferred on the Drainage Authority

The *Ordinance* establishes a Drainage Authority (DA). The Director of Drainage Services shall be the DA, who may:

1. prepare draft Drainage Authority Area plans (draft plan) which shows watercourses that are designated as main watercourses.
2. enter private land to carry out inspection and drainage works in any main watercourses;
3. order the removal of obstructions or structures in any main watercourse; and
4. control the erection of obstructions or structures within any main watercourse.

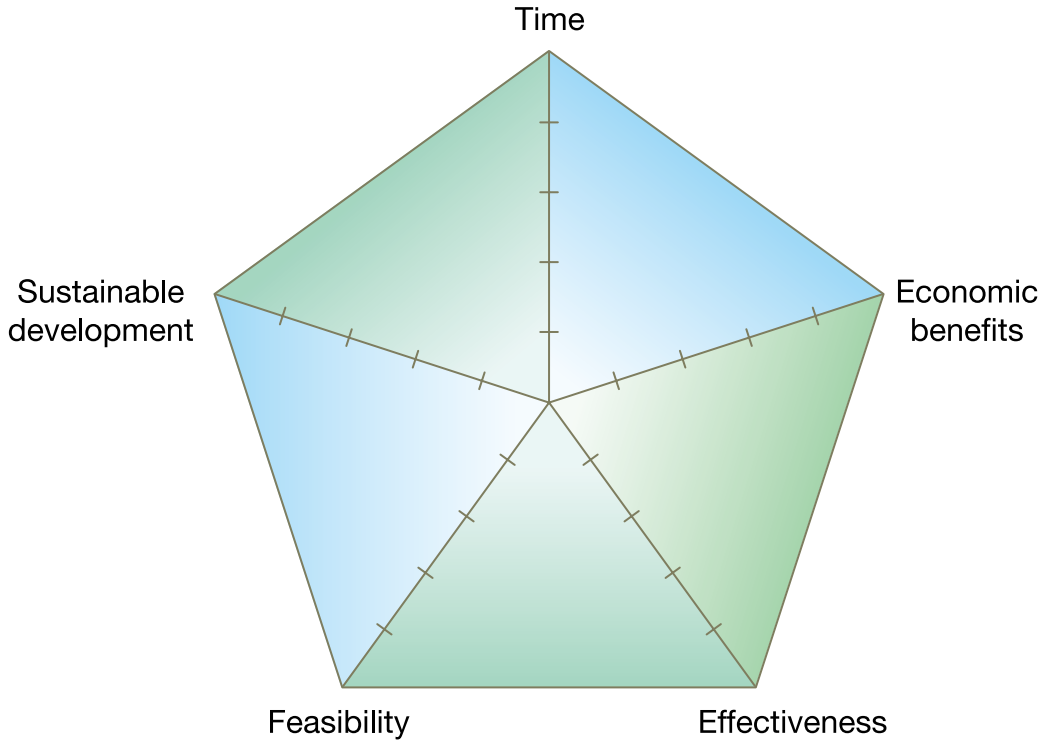
Worksheet (5)

Foundation

Is the flooding problem in Sheung Wan hard to tackle?

1. Identify five concerns that you think the Government should take into account when formulating measures to solve serious flooding problems.

   (Hint: Which of the following concerns are most important? Please rank by order of importance.)



Importance ('1' as the most important)	Concerns
1	
2	
3	
4	
5	

2. In deciding which measures are most effective in solving flooding problem, I believe _____ and _____ as mentioned above are the most important. This is because:

_____

_____

_____

_____

_____

_____

Flood prevention works of the Drainage Services Department

The Drainage Services Department adopts different strategies to tackle flooding problems in the rural New Territories and urban areas. In the rural areas, with low population density and more water courses for draining stormwater, village flood protection schemes, stormwater drains and river improvement works are the major flood prevention measures. In contrast, underground stormwater drains or drainage tunnels are used in urban areas as intense commercial activities and limited space have made construction of pumping stations at ground level difficult. In this section, we will use Yuen Long and Tsuen Wan as examples to explore the flood prevention works in the rural New Territories and urban areas.

Case 1: Flood prevention works in the rural New Territories (Yuen Long)

Basic Knowledge

Progress of flood prevention works

1. 19 village flood protection schemes

   Between 1989 and 2010, the construction of drainage channels of 40 km in total length was carried out in Yuen Long, Kam Tin and Ngau Tam Mei (牛潭尾). In the northwestern New Territories, 19 village flood protection schemes are in progress to protect 26 low-lying villages against flooding.

2. Yuen Long Bypass Floodway

   The construction of the 3.8 km Yuen Long Bypass Floodway was completed in November 2006. The risk of flooding at Yuen Long Town has been greatly reduced as a result.

3. Construction of stormwater drains

   The construction of stormwater drains of a total length of 7.5 km at Yuen Long Town, Ping Shan (屏山) and Hung Shui Kiu (洪水橋) has been completed.

A stormwater pumping station in Pok Wai, Yuen Long

4. River training works

Moreover, a number of river training projects covering a total length of 8 km over the upper streams of Kam Tin River, the San Tin Eastern Main Drainage Channel and some smaller channels in Kam Tin, Ngau Tam Mei and San Tin have been completed. These works began in 2006 and were completed in 2009.

5. Tributary improvement works

Improvement works on the upper streams and tributaries of channels in Ngau Tam Mei and Kam Tin were completed in June 2007. Improvement works on the tributaries of the main drainage channels in Kam Tin and Pak Heung have already commenced, and the construction was completed in 2011.

Ongoing improvement and management measures adopted by of the Drainage Services Department

1. Carry out preventive maintenance measures

The Department also carries out preventive maintenance measures to alleviate flooding problems while the long-term improvement works are in progress.

2. Strengthen the inspection of flooding blackspots

Every year before the rainy season, officers and workers are deployed to inspect and clear the channels at flooding blackspots. The Department continues to monitor the situation of these blackspots during the rainy season and carry out immediate flood relief measures during adverse weather.

3. Inspect stormwater pumping stations and flood warning systems regularly

The Department regularly inspects stormwater pumping stations and flood warning systems to ensure their effective operation during rainstorms.

Case 2: Flood prevention works in urban areas (Tsuen Wan)

Basic Knowledge

Objectives

The Tsuen Wan Drainage Tunnel aims to improve the flood protection level in Tsuen Wan and Kwai Chung by intercepting the runoff in the upland catchments for discharging into the sea. It can help alleviate the load on the existing drainage system and raise the flood conveyance capacity within Tsuen Wan and Kwai Chung to withstand rainstorms with a return period of one in 50 years.

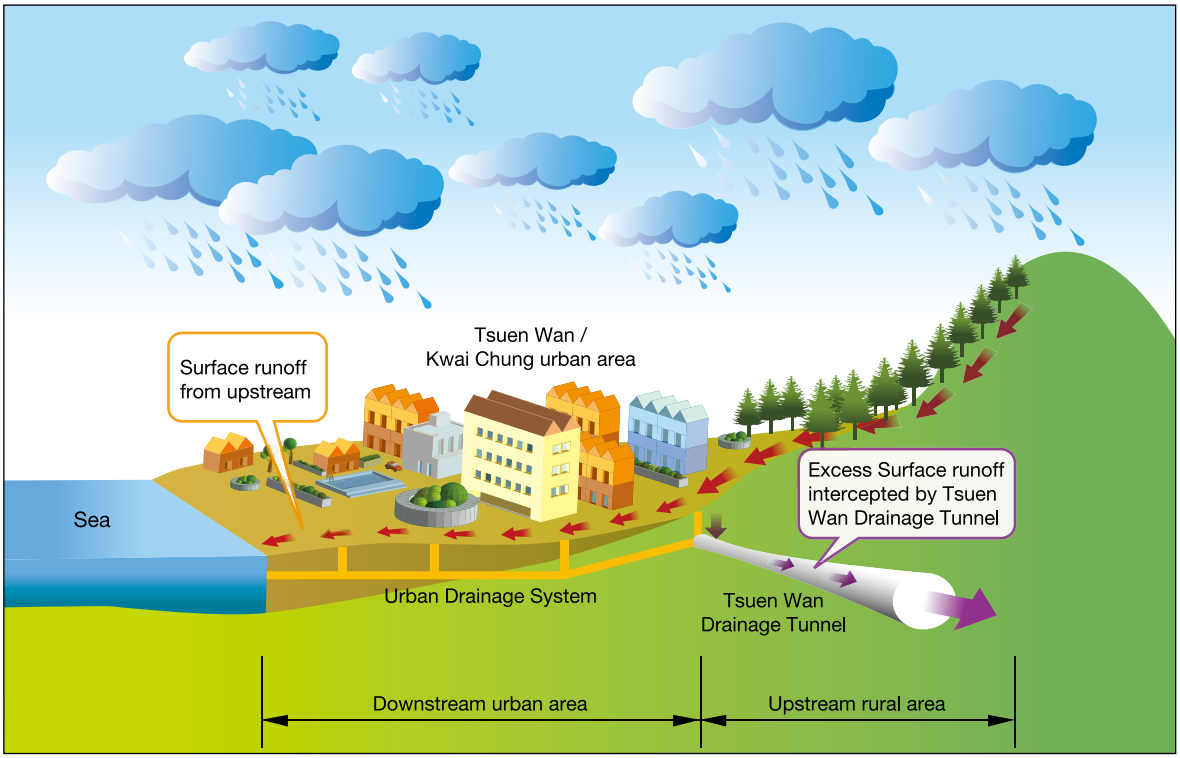


Diagram of the Tsuen Wan Drainage Tunnel under construction

Background

The existing drainage systems in Tsuen Wan and Kwai Chung were constructed over 30 years ago. Continuous urbanisation increases surface runoff which affects the conveyance capacities of the drains and overloads the existing urban drainage system. Hence, flooding often occurs during rainstorms. For example, in 1997, several rainstorms caused flooding in many developed areas in Tsuen Wan and Kwai Chung.

To address the flooding problem, the Drainage Services Department carried out a Drainage Master Plan study on the stormwater drainage systems of Tsuen Wan, Kwai Chung and Tsing Yi. Completed in July 1999, the study concluded that the stormwater drainage systems of Tsuen Wan and Kwai Chung could not meet the flood protection standards. The study recommended the construction of the Tsuen Wan Drainage Tunnel, as a vital part of the overall drainage improvement strategy for these districts.

Why select the drainage tunnel option?

Tsuen Wan and Kwai Chung are districts with busy traffic and congested underground utilities. The use of conventional open-cut method to improve the stormwater drainage systems would cause severe traffic congestions, while the use of trenchless construction method would seriously affect underground utilities. Therefore, the Drainage Services Department decided to construct a tunnel in the mid-hill far off Tsuen Wan and Kwai Chung.

Scope of the Tsuen Wan Drainage Tunnel (TWDT)

The TWDT project comprises the following:

(1) a tunnel of about 5.1 km in length and 6.5 m in diameter;

(2) three intakes at Wo Yi Hop (和宜合), Lo Wai (老圍) and Tso Kung Tam (曹公潭);

(3) an outfall portal at Yau Kom Tau (油柑頭); and

(4) associated landscaping and civil works.

A sketch of the Tsuen Wan Drainage Tunnel

Benefits

The completion of the TWDT has raised the flood conveyance capacity within Tsuen Wan and Kwai Chung to withstand rainstorms with a return period of 50 years. The construction of the TWDT also created over 200 job opportunities in Hong Kong.

Cost and timetable

The construction of the HK$1,100 million TWDT commenced in December 2007. It was completed in March 2013.

Worksheet (6)

Advanced

Exploring solutions to the flooding problem in Sheung Wan by making reference to the flood prevention measures in other districts

Please answer the following questions by making reference to the two cases above.

1. Identify the strategies adopted by the Drainage Services Department to solve the flooding problems in the two cases above.

2. What are the differences and similarities of the strategies adopted by the Drainage Services Department to solve flooding problems in different areas?

3. Regarding the above questions, what are the reasons for such differences?

4. Summarise the major concerns of the Drainage Services Department in solving flooding problems and compare them with the five concerns that you listed in Worksheet (5). Which factors are also given priorities by the Drainage Services Department? Why are these factors particularly important in dealing with the problems of flooding?

5. Role playing and group discussion: Divide students into groups of four. Each student in the group is required to assume a specific role (office workers, owners of ginseng and dried seafood shops, engineers of the Drainage Services Department and District Councillors) and express his / her views on the strategies for solving the flooding problem in Sheung Wan and analyse the advantages and disadvantages.

   Flood prevention works of the Drainage Services Department include the following: (Go back to the 'Flood prevention strategy of the Drainage Services Department' at pages 45–47 for details.)

   1. Stormwater storage system
   2. Drainage tunnel
   3. Upgrade of existing drainage system
   4. Weirs and pumping stations
   5. Legislation and management measures

What decisions were made after the group discussion? Fill in the table below and pick two of the strategies. Rank them according to their economic benefits, feasibility, effectiveness, time and sustainable development. '1' represents the worst and '5' represents the best.

Strategies for dealing with the flooding of Wing Lok Street in Sheung Wan						
Strategy	**Economic benefits**	**Feasibility**	**Effectiveness**	**Time**	**Sustainable development**	**Agree / Disagree**
Flood storage system						Stance: Reason:
Drainage tunnel						Stance: Reason:
Upgrade of existing drainage system						Stance: Reason:
Weirs and pumping stations						Stance: Reason:
Legislation and management measures						Stance: Reason:

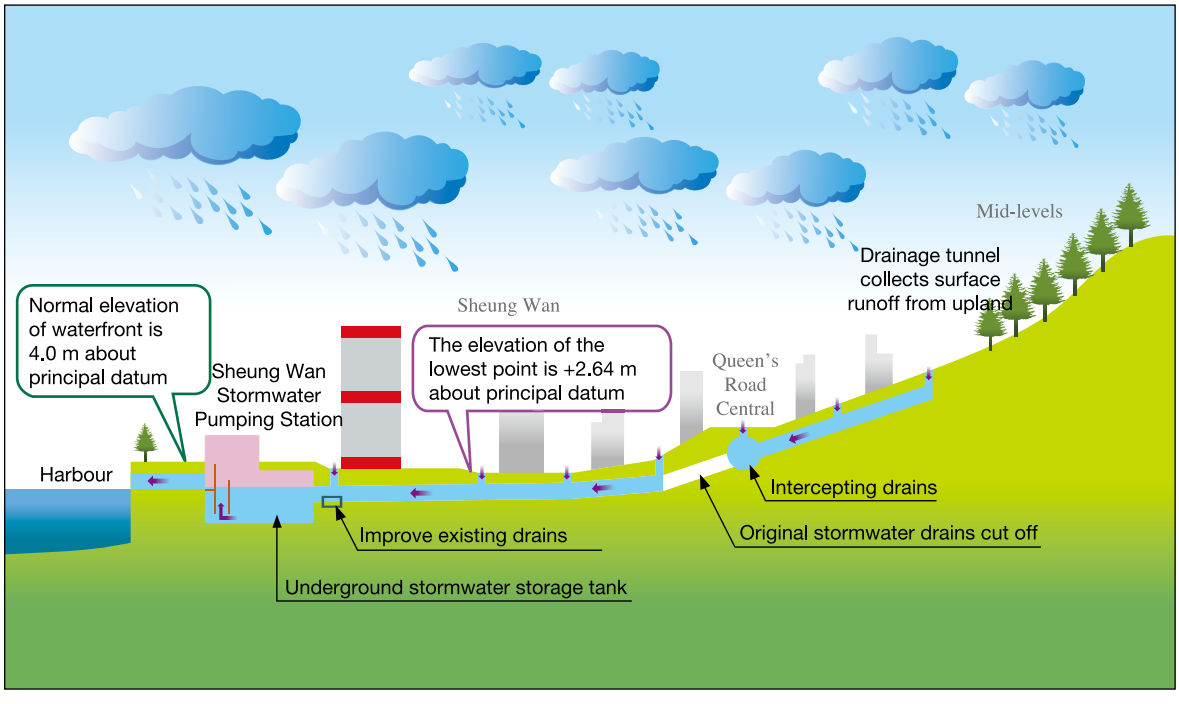
Solutions to the flooding problem at Wing Lok Street in Sheung Wan

Flooding problem in Sheung Wan and the role of the Government

Basic Knowledge

The area around Wing Lok Street in Sheung Wan is a low-lying area. During high tide, the sea level is close to the ground level and the underground stormwater drains are filled with seawater. In the event of a rainstorm, the stormwater becomes runoff. As a result, the area is particularly susceptible to flooding when there is a concurrence of high tides and rainstorms.

To solve the flooding problem in Sheung Wan, the Drainage Services Department commenced the construction of stormwater intercepting drains in Queen's Road Central and the Sheung Wan Stormwater Pumping Station and associated drainage works in March and June 2006 respectively. The goal was to intercept runoff in upland catchments for direct discharging into the sea, as well as to collect and convey stormwater in Sheung Wan to the sea. (See the diagram below for details.) Both works, now completed, have upgraded the level of flood prevention to withstand rainstorms with a return period of one in 50 years. This meant that the flooding problem in the low-lying areas of Sheung Wan is basically solved.



Schematic diagram of Sheung Wan stormwater drainage system

Major flood prevention works and measures implemented in Sheung Wan

Project	Remarks
1. Stormwater drains along Queen's Road Central Construction of a 660-metre long intercepting drain along Queen's Road Central to intercept about 30% of the surface runoff from upland and divert it away from the low-lying areas.	• Completed in end of April 2008.
2. Sheung Wan Stormwater Pumping Station Construction of a pumping station with an underground storage tank to store stormwater in the low-lying areas in Sheung Wan. • Underground storage tank with a capacity of 9,000 cubic metres (about four Olympic-sized swimming pools). • The pumping station can pump stormwater at the rate of six cubic metres per second (filling a swimming pool in seven minutes). • The deck of the storage tank is used as a recreation area.	• Commenced in June 2006. • Pumping station began operation before the rainy season in 2009. • The whole project was completed in September 2009.
3. Drainage improvement in northern Hong Kong Island • Drainage improvement works in Wan Chai, Causeway Bay, Central, Sheung Wan and Sai Wan were implemented. Among them, Wing Lok Street and Bonham Strand were the key improvement projects in Sheung Wan. • The works mostly adopted trenchless method to minimise the impact of the projects on the public and traffic. The proposed 660-metre long drains in Wing Lok Street, Bonham Strand and Western Fire Services Street vary from 1,200 – 1,350 mm in diameter.	• Works commenced in July 2008. • Improvement works in Wing Lok Street, Bonham Strand and Western Fire Services Street began in November 2008. • The drainage projects were completed in June 2010.
4. Sheung Wan 'Flood Watch' • When flooding is expected to occur due to high tide, storm surges or heavy rain, the Drainage Services Department will send flood warning by SMS or voice messages. • The system can send 250 SMS messages and 250 voice messages within 15 minutes.	• Launched between April 2006 and March 2011. • Target: Residents, shop owners and management offices in the area around Wing Lok Street / Ko Shing Street in Sheung Wan and other government departments.

5. Other preventive works • Increase the frequency of inspection and drainage clearing works. • In adverse weather, for example, when Amber Rainstorm Warning or messages of 'Sheung Wan Flood Watch'are issued, emergency teams will be deployed by the Drainage Services Department to clear blocked drains and gullies to reduce flooding risk.	• Carry out regularly.

Worksheet (7)

Who are affected by drainage works?

Examine the picture below. Evaluate the impact of drainage works on different stakeholders.

Stakeholders (e.g., Sheung Wan residents, office workers, shop owners, road users)	Impact	Level of impact ('1' most affected, '2' second most affected, and so on)	Explanation

Worksheet (8)

Write a reply to a complaint letter

The Drainage Services Department received a complaint letter (mock) from a resident when the drainage works were carried out at Wing Lok Street in Sheung Wan. Please write a reply as an officer of the Drainage Services Department to explain the work of the department and the difficulties it faces.

8 March 2008

Dear Director of Drainage Services,

I am a resident of Wing Lok Street in Sheung Wan. I am writing to lodge a complaint on the drainage works carried out by your department. Your prompt action will be highly appreciated.

Firstly, the drainage works have occupied the footpaths and roads and caused serious traffic congestion in the area. Pedestrians and cars compete for space and seriously inconvenience the residents there.

Secondly, businesses of the shops are greatly affected. I have a dried seafood shop on Wing Lok Street. The construction works are being carried out right in front of my shop. This has seriously affected the pedestrian flow and adversely affected my business.

Furthermore, the drainage works have raised a lot of dust, exhaust fumes and rubble and have polluted the environment. The noise nuisance has further worsened the residents' quality of life too.

I hope your department can arrange an inspection and make improvements accordingly. Moreover, I hope that the works can be completed as soon as possible, so that the pleasant environment in the area can be restored.

Yours sincerely,
Butt Ping Ming
A resident of Wing Lok Street

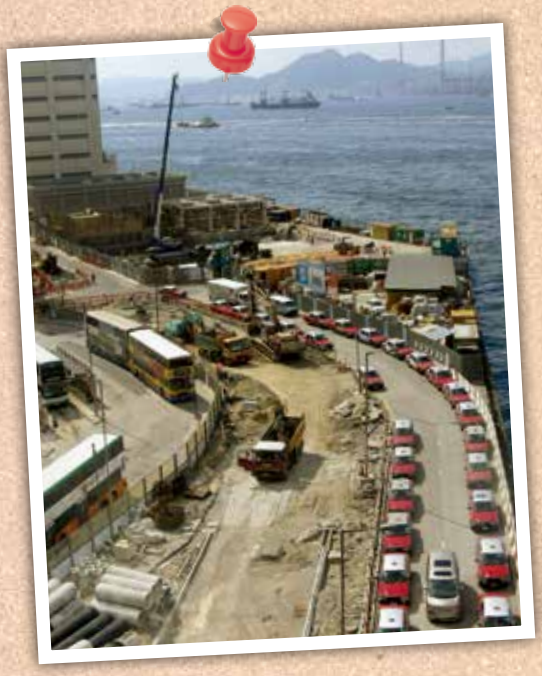
Worksheet (9)

Data-response Questions

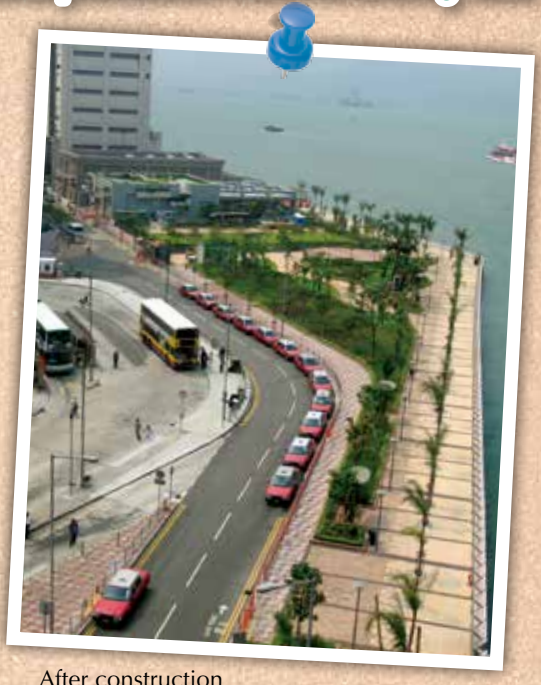
Looking into the present situation —— Are these policies effective?

Source 1

Site conditions before and after the flood prevention works in Sheung Wan



During construction



After construction

The outlook of Sheung Wan Stormwater Pumping Station upon completion

Source 2

Flood risk in low-lying areas in Sheung Wan greatly reduced

The spokesperson of the Drainage Services Department said, 'Upon completion of the flood prevention works in October 2009, the flood protection level of the low-lying area in Sheung Wan will be raised to withstand rainstorms with a return period of one in 50 years. The current level is one in two years.'

He said, 'The first drainage improvement contract in Sheung Wan involves the construction of intercepting drains of 660 metres long in Queen's Road Central. It is likely that the intercepting drains can be completed by June 2008, four months ahead of schedule, and they will lower the flood risk in the vulnerable areas.'

'The second drainage improvement contract involves the works for the Sheung Wan Stormwater Pumping Station and the construction is on schedule. It is expected that the underground stormwater storage tank will start operation in the rainy season of 2009, to further lower the flood risk in those areas.'

Before the completion of the Sheung Wan Stormwater Pumping Station, the Drainage Services Department will continue to step up the inspection and clearing of drains in the area.

A 'Flood Watch' SMS will be sent to residents and shop operators when it is predicted that flooding is likely to occur. An emergency team will also be mobilised to clear blocked drains in adverse weather.

17 September 2007

1. Referring to Source 1, what changes in the environment of Sheung Wan are found upon completion of the flood prevention works?

2. Referring to Sources 1 and 2, how does the completion of flood prevention projects affect the quality of life of the following people?

	Improved or not?	Reasons
Residents in Sheung Wan		
Shop owners in Sheung Wan		
Office workers in Sheung Wan		

3. Do you think the above changes are conducive to sustainable development in Hong Kong? Elaborate your views from the social and environmental perspectives.

Worksheet (10)

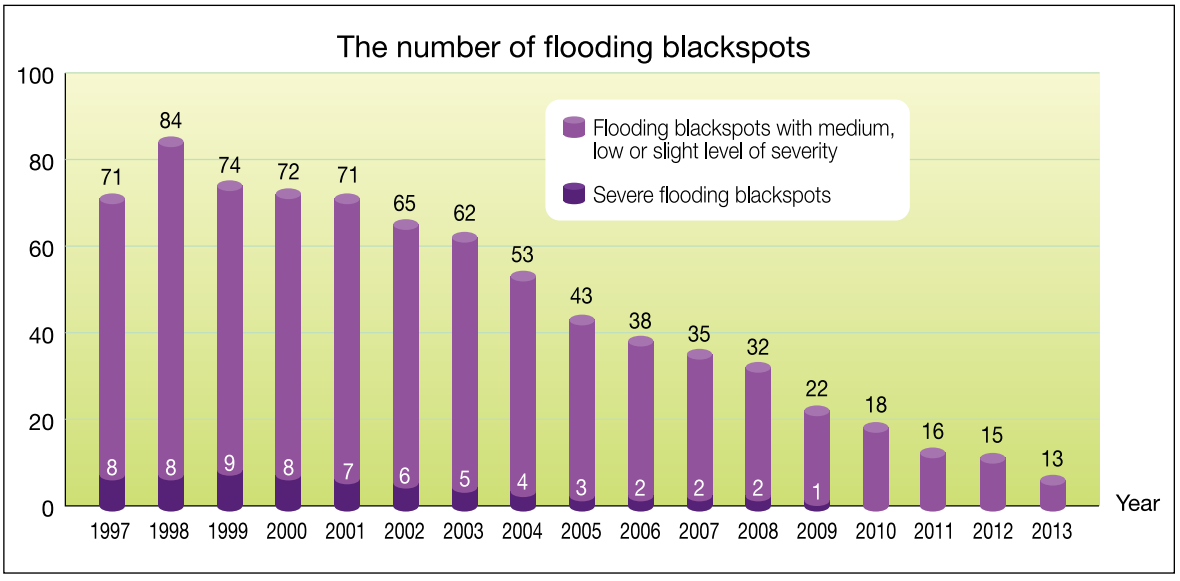
Data-response Questions

Reflect and look into the future

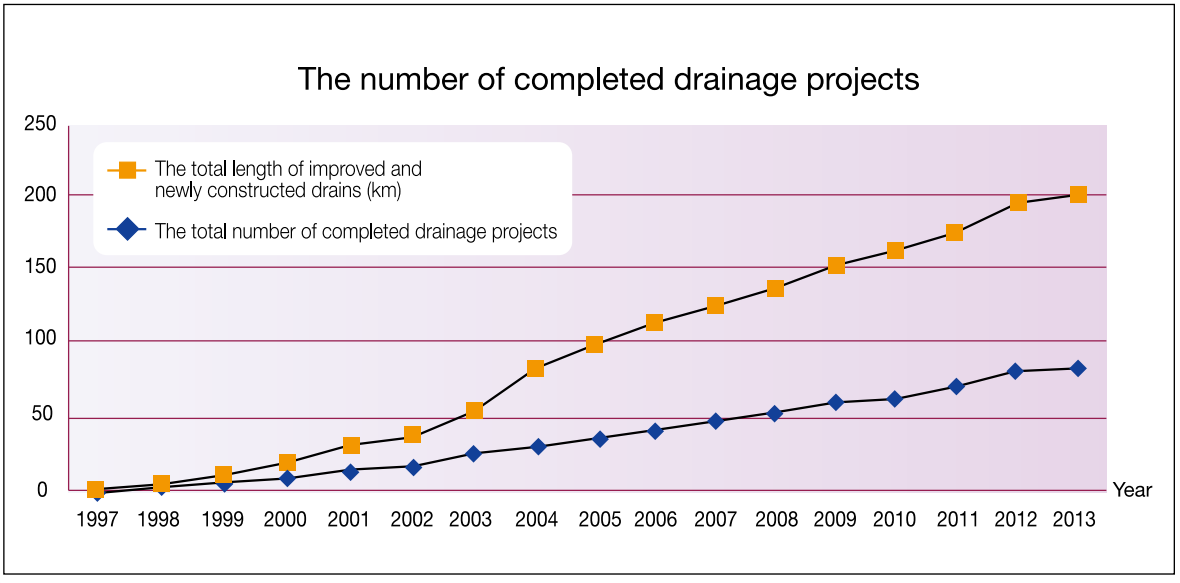
The Drainage Services Department has continued to introduce advanced engineering technology during the last few decades to reduce the risk of flooding. Nevertheless, can flooding be totally prevented?

Read the following information

Source 1



Source 2



Source 3

At present, different stormwater drainage facilities in Hong Kong adopt different flood prevention standards to withstand severe rainstorms. The standards as shown below are comparable to those adopted by other developed countries.

Types of Drainage Systems	Flood Prevention Standards (Return Period)
Urban drainage trunk systems	200
Urban drainage branch systems	50
Main rural catchment drainage channels	50
Village drainage system	10
Intensively used agricultural land	2 – 5

Source: Drainage Services Department

1. What is the relationship between the data shown in Sources 1 and 2?

2. Many developed countries often encounter serious flooding during rainy season. Find an incident on the Internet and explain the cause of flooding.

3. Can 'zero flooding' be achieved in Hong Kong with the current flood prevention facilities? Explain with reference to Sources 1, 2 and 3.

4. Different flood prevention strategies and standards are adopted in different areas in Hong Kong. Do you know the reasons for such differences?

Worksheet (11)

We all have a part in flood prevention

Foundation

Discuss the responsibilities of the Government and the public in preventing the recurrence of flooding in Sheung Wan. Making use of the suggestions below, put the proper answer in the appropriate space in the chart next page.

(A) Dispose of rubbish properly to avoid blockage of drains.

(B) Support the drainage works of the Drainage Services Department.

(C) Inform relevant government departments if there are blocked drains.

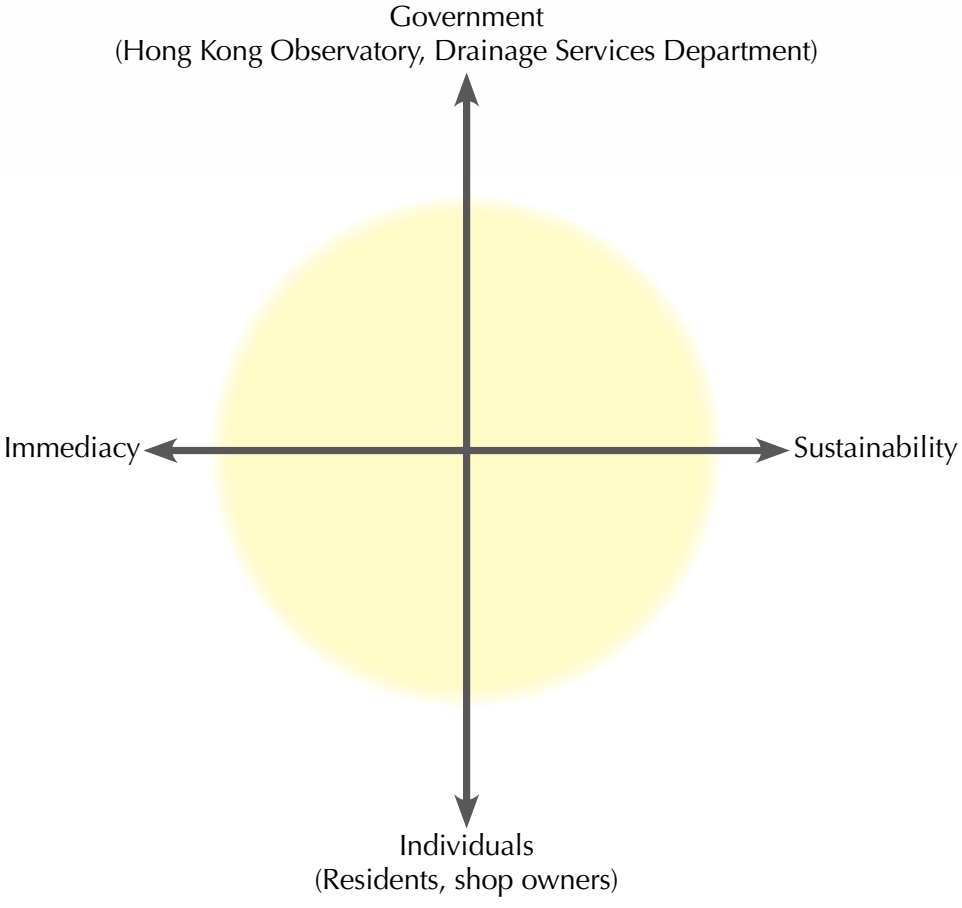
(D) Inspect low-lying areas and clear drains.

(E) In the event of Red or Black Rainstorm Warnings, send SMS to registered users for precautionary measures.

(F) Construct intercepting drains of 660 metres long in Queen's Road Central to intercept and divert 30% of the surface runoff away from the low-lying area in Sheung Wan.

(G) Issue accurate warnings during heavy rain.

(H) Construct a pumping station with an underground storage tank in the waterfront area in Sheung Wan.


Government
(Hong Kong Observatory, Drainage Services Department)
Immediacy
Sustainability
Individuals
(Residents, shop owners)

Advanced

Discuss the responsibilities of the Government and the public in preventing the recurrence of flooding in Sheung Wan. Write your suggestions in the appropriate space in the chart below.