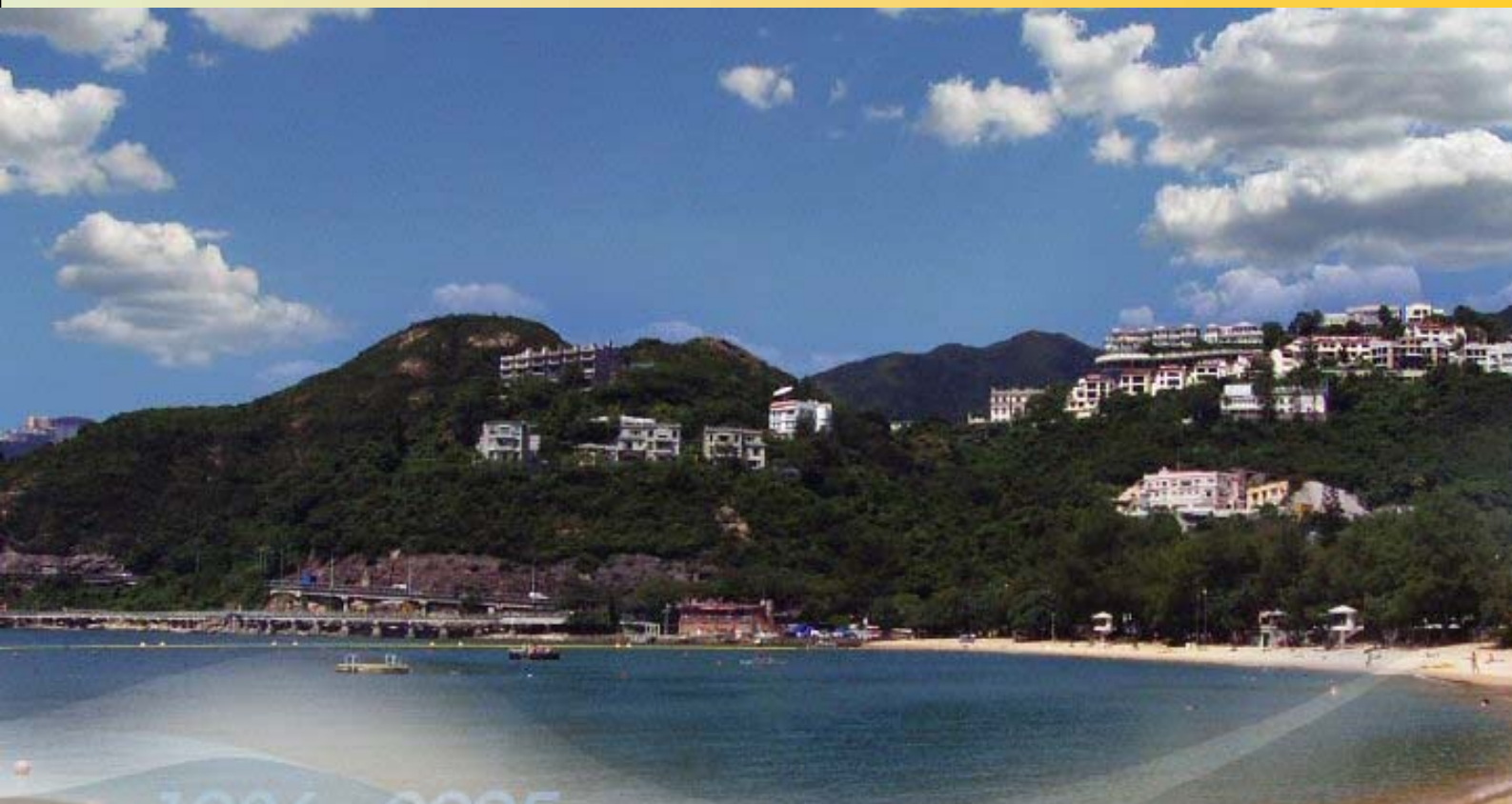


1986 - 2005

香港泳灘水質監測20年

20 Years of Beach Water Quality Monitoring in Hong Kong

環境保護署
Environmental Protection Department

Copyright Notices

CONTENT

		Page
Director's Message		1
Chapter		
1	**Overview**	3
	The situation back in 1986	4
	The situation by 2005	6
2	**The Beach Water Quality Monitoring Programme**	9
	A brief history of the monitoring programme	9
	Beaches monitored by the programme	9
	Beach monitoring frequency	11
	The Water Quality Objectives	12
3	**Monitoring of Beach Water Quality**	14
	Water sampling	14
	Laboratory analysis of samples	15
4	**Ranking and Grading Hong Kong's Beaches**	18
	The annual beach ranking system	18
	The beach grading system	19
5	**Handling Emergencies**	21
	Beach Pollution Response Plan	21
	Catchment plans	22
6	**Informing the Public about Beach Water Quality**	23
	Rainfall warning advisory notices	25

Chapter		Page
7	**An Overview of Beach Water Quality up to 2005**	26
	Hong Kong's beaches and their rankings	26
	Hong Kong South: the beaches of Southern District	26
	Southern District beaches over the past twenty years	26
	Southern District beaches in 2005	27
	Hong Kong East: the beaches of Sai Kung District	30
	Sai Kung District beaches over the past 20 years	30
	Sai Kung District beaches in 2005	31
	Hong Kong West: the beaches of Tsuen Wan and Tuen Mun Districts	33
	Tsuen Wan District	35
	Tsuen Wan District beaches: the historical background	35
	Tsuen Wan District beaches: the situation in 2005	35
	Tuen Mun District	37
	Tuen Mun District beaches: the historical background	37
	Tuen Mun District in 2005	37
	Beaches on the Outlying Islands	39
	A brief historical survey	39
	The Outlying Islands beaches in 2005	40
	Non-gazetted beaches	41
	An overview of Hong Kong's beach in 2005	42
8	**Comparing Beach Rankings**	45
	Comparing beach rankings over a twenty-year period	45

SUPPLEMENTARY MATERIAL

Appendix

A	**Annual geometric mean *E. coli* over 20 years**
B	**Summary of physicochemical water quality data of gazetted beaches, 2005**
C	**2005 visitor numbers**
D	**Trends in beach water quality over 20 years**

LIST OF TABLES and FIGURES

Title	Page
Beaches monitored by the EPD	10
Beach monitoring frequencies	11
Overview of various stages of the Beach Monitoring Programme	17
Hong Kong's annual beach ranking system	19
Hong Kong's beach grading system	20
Southern District beaches: the 2005 annual ranking	28
Southern District beaches: breakdown of grading results during the 2005 bathing season	29
Silverstrand Beach: Mean *E. coli* levels and "Grade 4" occasions in the 2002-2005 bathing seasons	31
Sai Kung beaches: the 2005 annual ranking	32
Sai Kung beaches: breakdown of grading results during the 2005 bathing season	32
Tsuen Wan and Tuen Mun beaches: the 2005 annual ranking	34
Tsuen Wan and Tuen Mun beaches: breakdown of grading results during the 2005 bathing season	34
Diagrammatic illustration of Stages 1 and 2 of the HATS Project	36
Water quality change from 1986 to 2005 - Castle Peak Beach	38
Castle Peak Beach: overview of grading results, 1986-2005	38
Beaches on the Outlying Islands: the 2005 annual ranking	40
Beaches on the Outlying Islands: breakdown of grading results during the 2005 bathing season	41
Hong Kong's gazetted beaches: the 2005 annual ranking	43
Beach grading summary by district	44
Annual beach rankings over the last 20 years	46
Annual beach rankings of 1986 and 2005 compared	47
Level of compliance with the Water Quality Objectives at gazetted beaches, 1996 -2005	48
Examples of beaches with marked improvement in water quality	49
Annual geometric mean *E. coli* levels by district, 1986 - 2005	50

Director's Message

Mr Kwok Ka-keung, JP
Permanent Secretary for the Environment, Transport and Works (Environment) / Director of Environmental Protection

Since it was first founded in 1986, the Environmental Protection Department (EPD) has been tasked with the job of monitoring and improving the quality of the water at Hong Kong's beaches. Twenty years have now passed since we first began our beach water monitoring work. It therefore seems appropriate to use this anniversary to take stock of what we have been doing, what kind of differences we have made, and what possibilities lie ahead for the future. In this Annual Report we have taken the opportunity to compare the state of Hong Kong's beaches in the 1980s, the 1990s and today, as a way of highlighting what has so far been accomplished to make Hong Kong's beach environment a better place for everyone.

Our Mission

"To safeguard the health and welfare of the community and meet conservation goals by working to achieve and maintain the water quality objective for bathing beaches"

Hong Kong's Beach Water Monitoring Programme is built on rigorous scientific studies which are well-recognised worldwide. We are proud to see the difference we have made, and are continuing to make, to the quality of Hong Kong's unique natural environment and the health of all our community. Over the years, the EPD has developed an efficient system of monitoring, protection, and action that has helped significantly to reduce the water pollution problems which once so plagued Hong Kong, and which placed many of its beautiful beaches off-limits to the community. In the summer of 2005, over a million visits were made to our beaches each month: a testimonial to the confidence the public now places in the water quality of Hong Kong's beaches, and to the usefulness of the information provided by the EPD.

I hope you enjoy reading of the transformation that Hong Kong's beaches have experienced over the past twenty years, and are fascinated by some of the old photographs we have extracted from the archives. There have been very major changes over the past two decades, it is true, but the job of improving our beach

water is not yet finished. For example, there are still a few closed beaches in Tsuen Wan. To ensure these can be reopened in the not too distant future we will need the community's support both for the on-going village sewerage programme for the area and the remaining stages of the Harbour Area Treatment Scheme, which is planned to include a disinfection system specifically to improve Tsuen Wan beach water quality. In 2005 the EPD's Beach Water Monitoring Programme is still going strong. I am confident that this mature, proven programme will continue to serve our community well and improve the quality of our beaches even further in the years to come.

Mr Kwok Ka-keung, JP
Permanent Secretary for the Environment, Transport and Works (Environment) / Director of Environmental Protection

Chapter 1. Overview

Stanley Main Beach in the early 1980s (above) and in 2005 (below)

Most of the thousands of Hong Kongers who basked on Hong Kong's beaches and swam in its clear waters in 2005 were probably unaware that, just twenty years ago, many of our beaches would have been off-limits to them. The early 1980s were a time of rapid and often unbridled urban expansion, and our environment—including the seas and beaches around Hong Kong's coastline—was suffering as a result. Faced with deteriorating beach water quality and more and more of Hong Kong's beautiful beaches becoming 'no-go' areas for recreation and exercise, in 1986 the Government first placed the Environmental Protection Department in charge of its Beach Water Quality Monitoring Programme. In this, its twentieth anniversary year, we are taking the opportunity to highlight the changes and achievements of the past two decades, placing the beach water quality of 2005 in the context of twenty years of work by the EPD.

When the EPD first took over the Beach Water Quality Monitoring Programme in 1986, it devoted much thought to defining the aims and requirements of the Programme. Two key needs were recognised. First, scientific rigour in the assessment of water quality was essential. How could the EPD know the best steps to take without hard scientific evidence of the nature and extent of beach water pollution in Hong Kong? The EPD realised it would need to develop a scientifically sound set of water quality objectives. It would need to conduct epidemiological studies that could establish clear relationships between bacteria in the water and the specific health risks associated with swimming at beaches in Hong Kong.

Secondly, the EPD recognised that substantial improvement in water quality would require concerted, long-term actions. These would involve activities as varied as tackling the discharge of pollution in beach catchment areas, providing proper sewerage facilities to areas in the hinterland of beaches, diverting or extending sewage outfalls, controlling waste disposal from livestock and other pollution sources, and taking localised remedial action wherever necessary. Some of these actions could be undertaken by the EPD itself, while others would involve collaboration with other Government Departments or authorities.

Drainage diversion work at Cheung Chau Tung Wan Beach in 1989

The EPD has been doing these key tasks for two decades now, and over that time has developed an accurate and efficient beach water quality monitoring system that utilises the latest and the best in technology and scientific knowhow. After many years of honing and improvement at many levels, the Programme has now reached maturity. The vigorous scientific work that underpins the Programme has been published in international journals and has been well recognised by organisations such as the World Health Organization (WHO). The BBC news has also reported on how the EPD's beach monitoring programme has become a leading model for South East Asia. In addition to the technical part of its job, the EPD has also taken responsibility for making information available to the Government, academics and the general public in an accessible, clear, and up-to-date way. Its Annual Reports are one of the methods used by the EPD to pass on the monitoring information it gathers over the year.

The situation back in 1986

All was not well at Hong Kong's beaches in the mid 1980s. A major problem of the time was sewage pollution, due to the fact that Hong Kong's public sewage system was underdeveloped. Many squatters or residents of villages behind beaches had no access to the public sewer, so they simply channelled untreated sewage directly into streams or stormwater drains,

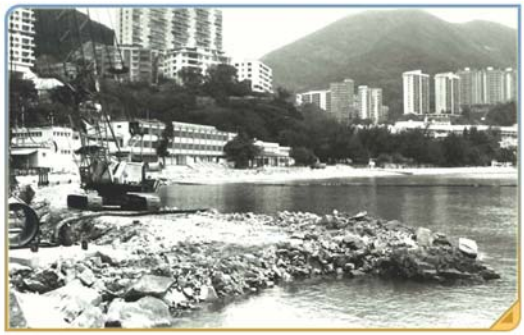
A typical storm drain directly discharging polluted water at a beach in the 1980s

which in turn emptied into the sea. Septic tank systems were not much better, while private sewage treatment facilities in residential and industrial developments were often inadequate or improperly operated. Overall, a large amount of untreated sewage was finding its way, by one means or another, into the water at or around Hong Kong's beaches. This was reflected in the water quality statistics of the time, with water assessed as 'Good' at only 11 of Hong Kong's 41 gazetted beaches in 1986.

Major Pollution Problems

- Unsewered beach hinterlands
- Inadequate sewage treatment facilities
- Livestock rearing activities
- Illegal discharges to drains

The EPD quickly initiated a number of emergency measures to bring the situation at the worst-affected beaches under control. These 'first-aid' measures included diverting polluting stormwater drains away from Repulse Bay, Middle Bay, Deep Water Bay, Shek O and Chung Hom Kok beaches, a measure that had an immediate and dramatic impact on beach water quality there. Sewage pumping facilities were installed to carry waste water to treatment plants: for example, pumping facilities at the Repulse Bay Chlorination Plant were completed in 1989, reducing bacterial levels in the waters of Repulse Bay. More generally, the EPD channelled many resources into investigating major pollution problems, planning sewage infrastructure, and instigating improvement works wherever possible.



Repulse Bay – Sewerage works carried out in the late 1980s

First-aid Measures taken to Improve Water Quality

- Pollution problems investigated and improvement plans drawn up
- Polluted discharges intercepted and diverted

The EPD also involved itself actively in introducing anti-pollution laws and related measures. The Livestock Waste Control Scheme came into force in June 1988, and the EPD made sure its provisions were widely understood and implemented by farmers, especially in areas close to beaches such as Silver Mine Bay and Angler's Beaches. It has also been enforcing the Water Pollution Control Ordinance, which has been introduced to different regions of Hong Kong in phases. This has enabled the EPD to tackle many sewage pollution problems at source, placing the liability on land and

On-going Measures to Improve Water Quality

- Enforcement of environmental legislation
- Implementation of Sewerage Master Plans by districts
- Provision of sewerage to beach hinterlands
- Improvement of sewage disposal facilities

factory-owners to stop harming the environment.

Longer term, the EPD plans and helps implement the Government's Sewerage Master Plans, a series of plans extending sewerage systems for each district and laying out proposed new sewage disposal facilities. At a local level the EPD has worked in collaboration with other Government Departments at individual beaches, leading to improvements such as the provision of new non-polluting beach facilities and toilet blocks at beaches like Kwun Yum Wan, Cheung Chau Tung Wan, and Tong Fuk.

The situation by 2005

Clean water and clear skies greet swimmers at Shek O Beach

By 2005, major changes had taken place that had transformed beach water quality for many of Hong Kong's beaches. Gone were most of the heavily polluting sewage outflows from dense residential developments, the waste from farms, and the contaminated stormwater drains. For some areas of Hong Kong, such as the beaches on the south of Hong Kong island, the difference has been especially dramatic, with beaches that were once heavily polluted now safe playgrounds for swimmers all year round. By comparison with the 11 'Good'

At the beach: fun and exercise for all ages

beaches of 1986, in 2005 a total of 23 beaches had water quality assessed as 'Good'.

Although there remains work to be done in improving our beach water quality, much has been achieved over the past twenty years. The majority of Hong Kong's beaches in 2005 offered visitors safe, enjoyable environments for swimming, playing, or just lying on the sand. The confidence the public has in our beaches was reflected in the number of visitors, with records showing that over a million visits a month were made to beaches during the 2005 bathing season.

Silverstrand Beach opens year-round to swimmers

In fact, the main problem faced by keen beachgoers in 2005 was one outside the control of the EPD—rain! The summer of 2005 was exceptionally wet, with rainfall levels 53% higher than the average rainfall for this period and almost double that of 2004. Despite this exceptional rainfall across the summer however, the year showed up the strengths of Hong Kong's beaches well. Most beaches remained open, and water quality was by and large good. Improvements in water quality at Silverstrand Beach in Sai Kung District showed the indisputable benefits of public sewerage systems. New improvements to safety were implemented: for example, all gazetted beaches now have shark nets installed, after nets were added at Cafeteria Old Beach and Lower Cheung Sha Beach midway through the swimming season in 2005. Best of all, 2005 saw the re-opening of a beach that had been closed for 24 years, Castle Peak Beach in Tuen Mun District. This beach, discussed in detail later in this report, is a splendid example of what can result from concerted efforts in pollution control, water monitoring, and a commitment to positive change in the environment.

Most of the beaches in Tsuen Wan District remained problematic and stayed closed in 2005 while steps continue to be taken to improve their water quality and prepare them for re-opening in the future. These include local sewerage schemes to ensure sewage from nearby properties can be intercepted and removed for treatment rather than polluting the nearby beaches. They also include a plan to disinfect the very large discharge from Stonecutters Island, subject to the public's willingness to meet the operating costs through increased sewage charges. Nevertheless the EPD is optimistic that provided the public is willing to pay its share of the costs of sewage treatment, further work over the next few years will see all Hong Kong's gazetted beaches once again open for swimming.

Tropical paradise? Lower Cheung Sha Beach

Chapter 2. The Beach Water Quality Monitoring Programme

Since the EPD first took over the task of monitoring Hong Kong's beaches in 1986, its Beach Water Quality Monitoring Programme has been extensively refined, improved and extended. Today, the EPD is responsible for monitoring over 40 beaches across the territory. Besides its job of monitoring and analysing beach water samples, the EPD is also responsible for making information about Hong Kong's beaches available to all who may need it.

A brief history of the monitoring programme

Before 1986, the task of monitoring Hong Kong's beach water was split between three different departments (the former Urban Services Department, Regional Services Department and Engineering Development Department). This system was neither efficient nor well-co-ordinated, and in 1986 the Government handed the responsibility for monitoring beach water quality to the newly-formed EPD. As mentioned in the Overview, the EPD devoted a great many resources to conducting the epidemiological studies that would establish a sound scientific basis for the Programme. The EPD also worked hard to ensure that monitoring was carried out efficiently and accurately, and that data about beach water quality was disseminated as widely as possible.

Beaches monitored by the programme

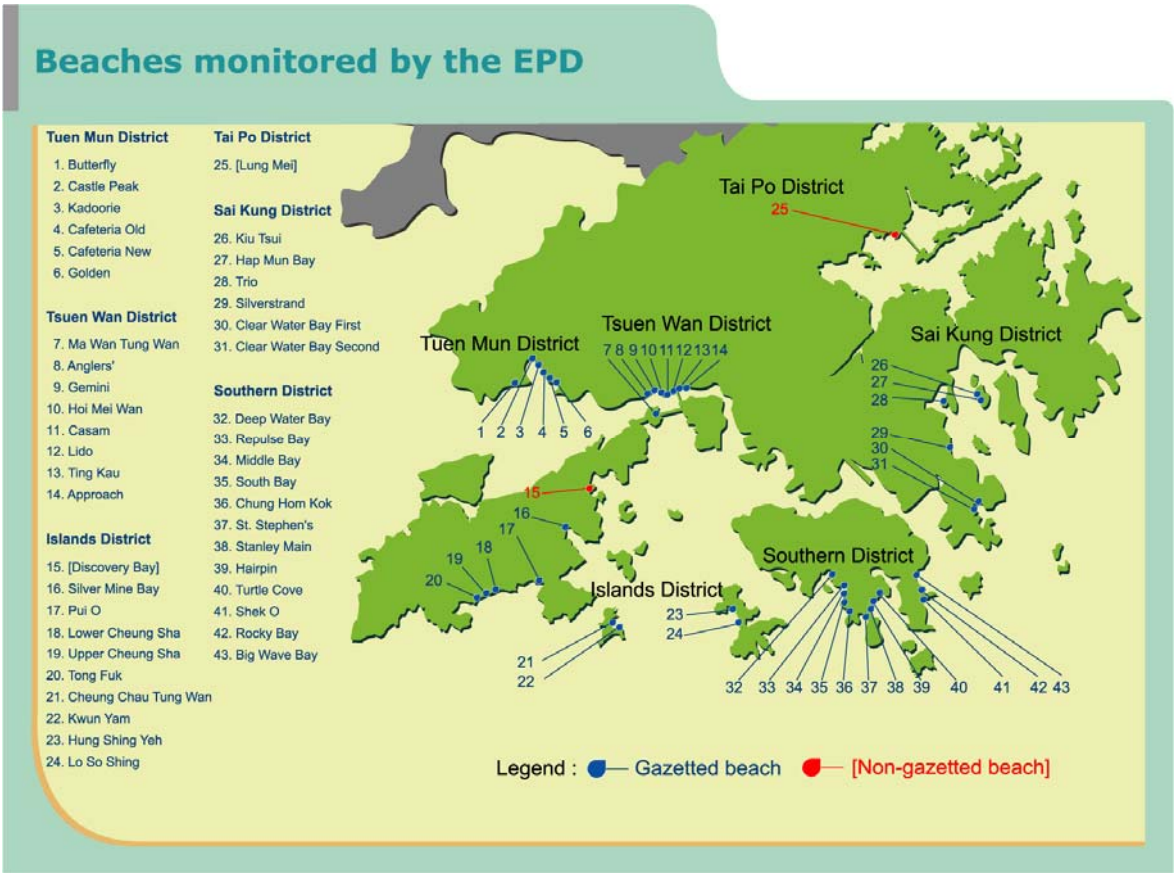
Hong Kong has a large number of beaches, some located surprisingly close to big urban centres and others accessible only by boat or a strenuous hike across the hills. All are beautiful, dramatic and ideal for relaxing on or swimming at during Hong Kong's many long, hot summer days. A number of the beaches are 'gazetted' by the Government, meaning they are maintained and managed for public use. For example, gazetted beaches have changing facilities, toilets and showers and are manned by lifeguards when they are open for swimming.

An easy-access beach next to high-density residential blocks

Back in 1986, a total of 41 of Hong Kong's beaches were gazetted. All of these were monitored by the EPD, together with a further 10 beaches that were then being considered for gazettal. Although twenty years later the number of gazetted beaches in Hong Kong remains at 41, the specific beaches making up this number have changed over time. For example, the beaches of Pak Sha Chau and Campers were de-gazetted in October 1995, while Butterfly Beach was gazetted in 1987 and Golden Beach in 1995. (The two de-gazetted beaches have been excluded from statistics and graphs in this Report).

Golden Beach, showing beach construction work in 1994

Of the 41 gazetted beaches monitored in 2005, 32 were open during the year and the other nine were closed to swimmers, seven because of poor water quality and two because of low swimmer attendance and resource considerations (a decision made by the Leisure and Cultural Services Department). The EPD monitored water quality at all these gazetted beaches. In addition, in 2005 the EPD monitored two non-gazetted beaches: Discovery Bay Beach and Lung Mei Beach.



Beach monitoring frequency

The frequency of monitoring has increased since the EPD began administering the Beach Water Quality Monitoring Programme in 1986. Originally, gazetted beaches were sampled once a fortnight during the bathing season only, while non-gazetted beaches received monthly monitoring. Over the years the EPD has adjusted the frequency of its monitoring periods at gazetted beaches to at least three times a month during the bathing season, and more frequently when a beach shows any sudden deterioration.

Across the entire year, the frequency of beach water monitoring varies depending on the season and the status of individual beaches. A few popular beaches are open all the year round: these include Clear Water Bay Second, Deep Water Bay, Golden and Silverstrand Beaches. At these beaches, the EPD takes water samples for the entire year, at least three times every month. Most other gazetted beaches are open to swimmers only for the bathing season between March and October (a few do not open until April, and a few finish their bathing season in November). During the season, the EPD takes samples from these beaches at least three times a month, while in the non-bathing season the frequency of sampling drops to once a month. The two non-gazetted beaches are monitored at least twice a month in the bathing season, and once a month outside it.

Beach monitoring frequencies

Beach	Monitoring frequency	
	Bathing season*	Non-bathing season
Gazetted beaches open all year round**	at least 3 times per month	at least 3 times per month
Other gazetted beaches	at least 3 times per month	once per month
Non-gazetted beaches	at least 2 times per month	once per month

* March to October
** Clear Water Bay Second, Deep Water Bay, Golden and Silverstrand Beaches

The Water Quality Objectives

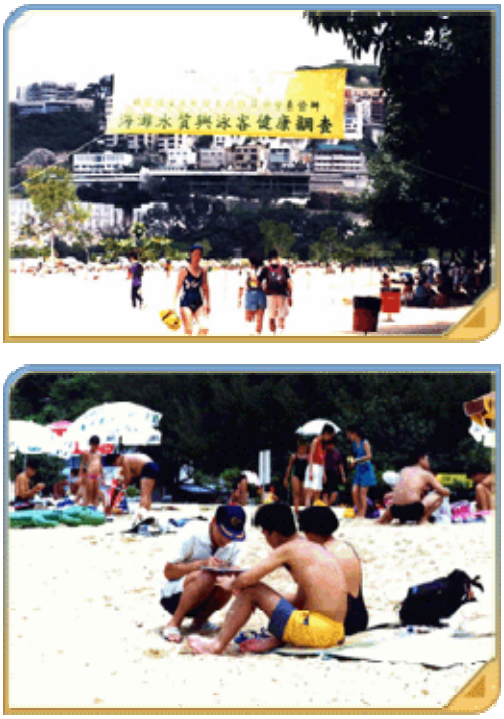
The EPD has developed simple but effective benchmark criteria for measuring environmental water quality. They are called the Water Quality Objectives (WQOs), and have been used by the EPD since the late 1980s. For bathing beaches, the WQO lays down the acceptable level of *E. coli* bacteria in beach water. *E. coli* is a good indicator of faecal pollution and levels of *E. coli* have been shown to be related to the incidence rate of swimming associated illnesses (such as skin and gastrointestinal illnesses).

The latest WQO for bathing beaches, revised in the 1990s, was based on epidemiological studies conducted on bathers at local beaches. It states that the level of *E. coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October.

Each individual beach is tested regularly, and the results across the bathing season are used to ascertain if water at the beach meets the WQO. Testing works like this. EPD staff take samples of beach water at least three times every month (sometimes more often), and these samples are collected at between three- and fourteen-day intervals. The samples are analysed for *E. coli* bacteria and the results recorded. At the end of the bathing season, the EPD calculates the geometric mean of *E. coli* bacteria across all the samples taken. The figure is then compared with the WQO level of 180 per 100 mL.

The WQO for bathing beaches has an interesting history. When the EPD first took over the Beach Water Quality Monitoring Programme in 1986, the water quality objective in use stated that "the level of *E. coli* should not exceed 1,000 per 100mL, calculated as the running median of the five most recent consecutive samples". This criterion was derived from criteria recommended by WHO in 1977, but not based on local epidemiological studies to show effects of beach water pollution on human health.

WHO had also strongly urged individual countries and regions to carry out their own scientific studies of beach water pollution, as a way of developing more accurate regionally-specific criteria for assessing water quality. The EPD initiated such research, and began a series of epidemiological studies in collaboration with scientists from local universities in the late 1980s. Its findings were clear: they confirmed that *E. coli* was the best bacterial indicator for assessing the incidence of diseases associated with swimming in the local population. They also established a significant linear relationship between the geometric mean of *E. coli* densities on the one hand, and the incidence of gastroenteritis and other illnesses associated with swimming on the other.

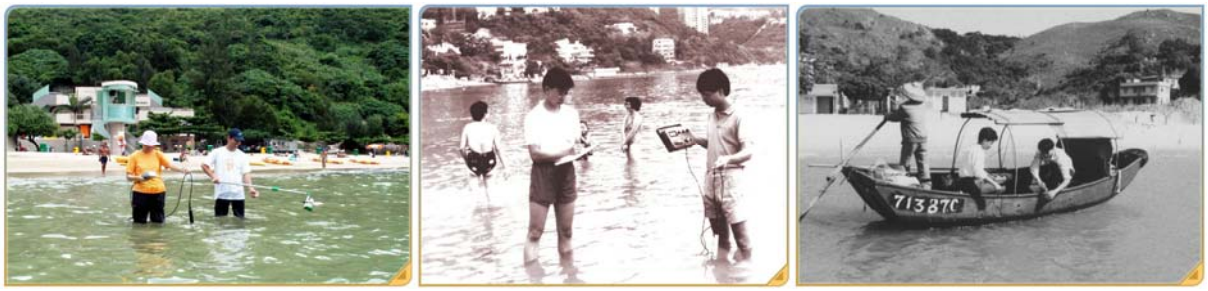


Conducting epidemiological studies at local beaches

On the basis of these studies, the previous water quality objectives were revised in the early 1990s, linking water quality classification to specific health risks. This system, still in use today, provides a much more practical and scientifically-sound system for swimmers wanting to know the health risks of swimming at a particular beach.

Chapter 3. Monitoring of Beach Water Quality

Water sampling



Current water sampling and site measurement (left), contrasted with fieldwork in the 1990s (middle) and the 1980s (right)

Water sampling is carried out frequently and regularly. At gazetted beaches, the EPD takes samples at least three times a month during the swimming season, and at least once a month outside the season. A few gazetted beaches stay open throughout the year, and at these the EPD continues to take samples at least three times a month for the whole year.

Sampling is regular but it does not conform to any rigid monitoring timetable. Instead, EPD staff select a random day during the week to take samples, including days on weekends and public holidays. The reason for this is that a rigid sampling timetable can miss important trends or events that may occur regularly on a certain days, e.g. only on weekends. Random sampling picks up on these kinds of incidents, and thus provides a more accurate picture of beach water quality over a season.

To obtain a water sample, the EPD's inspectors wade a short distance out from the shoreline, generally standing in the sea at thigh to waist level. Once taken, the samples are kept at around 4 degrees Celsius until testing. Besides taking sea water samples, inspectors also sample water from streams or drains that flow near the beach, as a way of checking and identifying possible sources of pollution.

Sampling water from a potential pollution source – an essential part of beach monitoring

Besides the actual sampling, the EPD's inspectors enter other useful information into the mobile data storage devices (PDA units) they carry. This may include information such as water temperature, the level of dissolved oxygen in the water, local weather conditions, and any other information that could be relevant to beach water quality and the environment. Once entered in their PDA, all this information can be easily uploaded directly onto EPD's office server.

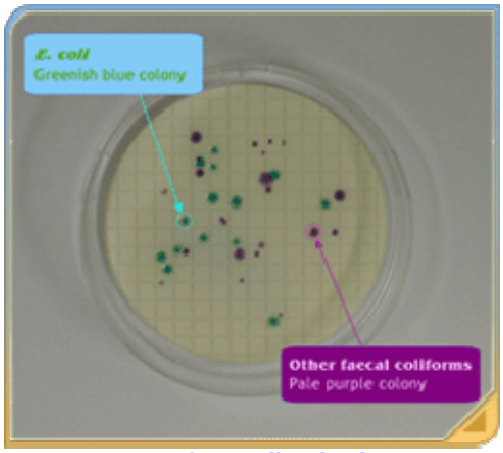
Laboratory analysis of samples

In the early days, the EPD sent all its water samples to be analysed at the Government Public Health Laboratory at the Sai Ying Pun Jockey Club Polyclinic. The testing method used to assess *E. coli* bacteria levels was known as the Multiple Tube Method (also known as the Most Probable Number Method), which suffered from a tendency to produce large errors in analysis.

In 1987, the EPD established its own Environmental Microbiology Laboratory for analysing all its beach water samples. From this date it also replaced the old Multiple Tube Method with an improved membrane filtration method, which gives much more accurate results. This system has been in use ever since, but the medium used to cultivate *E. coli* bacteria was further improved in 1997 when a chromogenic medium (CLECC) was introduced, and reporting time was shortened from three to just one and a half days.

Developing methods to speed up the testing of *E. coli* bacteria in water

The beach water samples are tested for *E. coli* bacteria at the EPD laboratory within six hours of collection. The membrane filtration method involves passing the water through a membrane filter, which retains bacteria in the water. The membrane is then placed on a special culture medium and incubated for 18 to 24 hours at 44.5 degrees Celsius, in aerobic conditions. During this time any trapped *E. coli* bacteria develop into distinctive greenish-blue spots (colonies) on the surface of the



Appearance of *E. coli* colonies

membrane. Each greenish-blue colony is recorded as an occurrence of *E. coli* in the water sample. The samples are also measured for pH, salinity and turbidity.

The sampling and testing procedures have been refined and streamlined over the years, and today the EPD system is recognised as scientifically sound and reliable.

Overview of various stages of the Beach Monitoring Programme

Water Sampling and Field Data Recording

Water sampling

On-site measurments

- Record beach conditions, dissolved oxygen and water temperature

Samples kept at 4°C and tested within 6 hours

Laboratory Testing

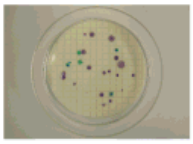
Bacteriological Analysis

Membrane filtration

Water sample is filtered to retain bacteria on membrane

Incubation

Membranes are incubated with culture medium at 44.5°C in aerobic conditions for 18 - 24 hours



Counting of bacteria

Greenish blue colonies - *E. coli*

Physical Parameter Analysis

Measurement of pH, salinity and turbidity

Data Collation

Data processing

Calculating beach gradings and annual rankings

Information Dissemination

Chapter 4. Ranking and Grading Hong Kong's Beaches

Publicity leaflets on the beach ranking and grading systems

The EPD uses two separate systems to help beach users get a wider picture about beach water quality. The first is the annual *ranking* system, which is designed to give a general summary of the water quality at every beach across the bathing season, from March to October. Beaches were ranked using an annual ranking system when the EPD first took over the monitoring programme in 1986. On the other hand, the *grading* system, which came into operation in 1987, is designed to present recent, short-term information about beach water quality, based on sampling over the past few weeks. Both systems have undergone changes and improvements over the years and gradually developed into the forms that are used today.

The annual beach ranking system

Each year, the EPD sorts Hong Kong's beaches into rankings to reflect the overall quality of beach water across the bathing season (March to October). The most important distinction is whether or not individual beaches met the WQO. The key figure here is 180 per 100 mL, the upper limit for *E. coli* bacteria in 100 mL of sea water. Beaches whose geometric mean across the swimming season is more than 180 do not meet the WQO.

Those beaches that do meet the WQO (and most of Hong Kong's beaches are in this category) are then further ranked to reflect the quality of their beach water. The best beaches are ranked as 'Good', while those beaches with a higher geometric mean are ranked 'Fair'. In the same way, beaches that have not met the WQO are also further categorized into two rankings: 'Poor' and 'Very Poor'. This fourfold ranking system is designed to help beach users know which beaches have consistently high or low water quality. It also provides the public and the Government with helpful information on trends of improvement or deterioration over the longer term.

Hong Kong's annual beach ranking system

Rank	*E. coli* count per 100 mL*	Minor illness rate** (Cases per 1,000 swimmers)	WQO Compliance
Good	≤24	Undetectable	Compliant
Fair	25-180	≤10	
Poor	181-610	11-15	Non-compliant
Very Poor	>610	>15	

* Geometric mean *E. coli* count calculated based on all data collected between March and October.
** Skin and gastrointestinal illnesses

The beach ranking system has been developed into its current form over time. In the early days, beaches were ranked into four categories: 'Good', 'Acceptable', 'Marginally acceptable', and 'Unacceptable', based on their percentage of compliance with the Hong Kong water quality standards of the day. Once the EPD's own studies were completed in the late 1980s, however, the system was revised and linked to health risks. This involved a change in the category labels, which between 1990 and 1992 evolved into those used today.

The beach grading system

The beach grading system was designed to complement the beach annual ranking system, and give beach users up-to-date information about the water quality of Hong Kong's beaches at any given time of the year. The beach grading score for any individual beach is worked out by taking the geometric mean *E. coli* levels of the five most recent samples taken from that beach. Because most gazetted beaches are sampled three times per month or more, a beach grading score provides a good snapshot of beach water quality over the current month.

When the beach grading system was first introduced in July 1987, it divided beaches into three categories: 'A' (Good), 'B' (Acceptable) and 'C' (Poor). The early criteria for grading were based on 1977 WHO criteria which, as mentioned earlier, were not based on epidemiological studies and were not specifically linked with health risks

to swimmers. Following the EPD's own studies in the late 1980s and its development of health-risk based water quality objectives, a revised four-tier grading system was introduced in 1990, numbered from 1 to 4 and labelled 'Good', 'Fair', 'Acceptable', and 'Poor'.

In 1992, the classification system was further refined into what is the current system. On the basis of their scores, beaches now fall into one of four grades: Grade 1 (Good), Grade 2 (Fair), Grade 3 (Poor), and Grade 4 (Very Poor). These labels should not be confused with those of the beach annual ranking system, which measures water quality across an entire season. For example, a beach may have some periods when it is *graded* 'Good', while still being *ranked* 'Fair' for the bathing season as a whole.

A further significant change was made in 1999. Since then, whenever a single beach water sample shows an *E. coli* level exceeding 1,600 per 100 mL, this reading overrides the geometric mean figure for the beach and instead triggers an immediate Grade 4 rating. Sudden high levels of *E. coli* indicate a potential health risk, and this system is designed to make sure they are not disguised by a low geometric mean. Such a level probably suggests a period of exceptionally heavy rainfall or an isolated pollution incident, for which immediate action needs to be taken.

Hong Kong's beach grading system

Grade	Beach water quality	*E. coli* count per 100 mL*	Minor illness rate** (Cases per 1,000 swimmers)
1	Good	≤24	Undetectable
2	Fair	25-180	≤10
3	Poor	181-610	11-15
4	Very Poor	>610 or last reading >1,600	>15

* Unless otherwise indicated, the *E.coli* count represents the geometric mean of the 5 most recent sampling occasions.
** Skin and gastrointestinal illnesses

Chapter 5. Handling Emergencies

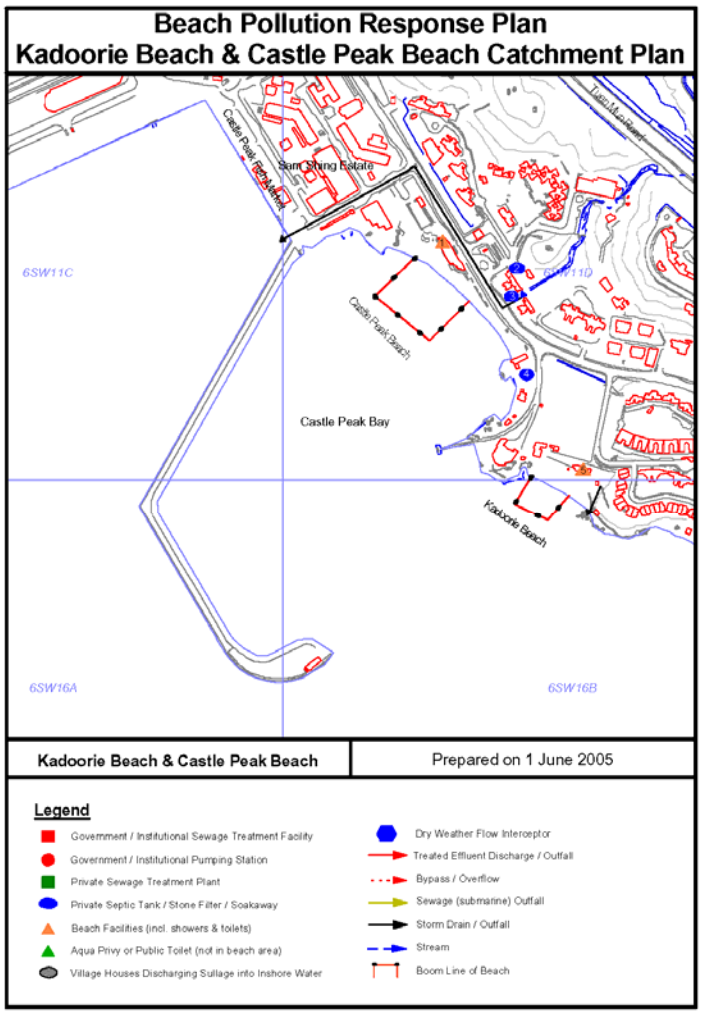
Beach Pollution Response Plan

While a major purpose of the beach water quality monitoring programme is to chart long-term trends and changes in water quality, there are times when the programme alerts the Government and the public to sudden and unexpected deterioration due to pollution incidents. In such cases, the EPD in collaboration with other Government Departments brings into operation its Beach Pollution Response Plan, which is designed to call a series of anti-pollution measures into play quickly and effectively. This Plan was first formulated in 1997, after a couple of serious pollution incidents in that year drew attention to the need for an integrated system that could respond to emergencies and unexpected events and prevent their recurrence. Fortunately, since 1997 there have been no further major pollution incidents.

In a nutshell, the Beach Pollution Response Plan drew up a series of formal steps to be taken in response to any beach water pollution incident involving discharge (accidental or deliberate) of polluting material, and breakdown of or damage to sewerage systems and outfalls. The plan lays out clear guidelines for the EPD and other Government Departments on their responsibilities and lines of communication in such cases, and enables action to be taken directly and quickly. For serious incidents the Plan requires the EPD to send out an emergency inspection team; but in all cases, it specifies how the EPD should handle its response and the steps it should take. The introduction of the Plan in 1997 has improved communication and response times all round, and helped minimise and control pollution incidents occurring since then.

Catchment plans

New technology has made the job of EPD officers much easier when it comes to responding to pollution incidents. For example, the EPD now maintains electronic plans of the water catchment areas for every beach that it monitors. The plans are rapidly retrievable and easy to update. Most importantly, they mark all potential pollution hazards clearly, and include detailed information about sewage treatment facilities in the area, noting their treatment methods and normal daily discharge rates. If *E. coli* levels change suddenly and unexpectedly at a beach, EPD officers can quickly call up the beach catchment plans and make systematic field checks on every potential source of pollution in the area.



Chapter 6. Informing the Public about Beach Water Quality

The EPD's role goes far beyond simply taking samples, analysing the samples in a laboratory, and maintaining detailed statistics about beach water quality. As this information is valuable to a wide range of different interest groups, from scientists and students to hikers and regular swimmers, part of the EPD's responsibility is to communicate the information it collects to the public as widely as possible. In addition, the EPD's data on beach water quality is useful to other Government Departments: for example, when major infrastructure projects are being planned, one important consideration is whether the project will affect the water quality of nearby beaches. The Leisure and Cultural Services Department, which runs the facilities at gazetted beaches, relies on EPD information for making decisions about opening or closing beaches, and letting the public know when it is not advisable to go swimming.

Over the years since its foundation the EPD has expanded its methods of getting information to the public, especially as new technology has become available. Its first means of dissemination was by fortnightly press releases, the first of which was sent out on Thursday 30 July 1987 in time for weekend publication. Several newspapers carried EPD beach grading information. The press releases have remained a basic feature of the EPD's information services, and since 1997 have been issued weekly instead of fortnightly, and on Fridays instead of Thursdays to provide weekend beach users with the most up-to-date information possible.

Beach grading noticeboards today (left) are more attractive than those used in the early days (right)

Swimmers arriving at beaches and wanting information about beach water quality have been able to get this from beach grading noticeboards, introduced at different times across Hong Kong. Beaches managed by the (then) Regional Councils put up these noticeboards as early as 1988, but swimmers at what were then Urban Council

beaches had to wait until 1999. Also in 1999, the EPD introduced its telephone beach water enquiry hotline service. This 24-hour hotline still operates today, at 2511 6666.

The EPD first began publishing comprehensive Annual Reports on its Beach Water Quality Monitoring Programme for the public in 1988, although the early reports were quite technical in nature and perhaps better suited to internal readership. Over time, these Annual Reports have been transformed into user-friendly documents that attract a wide general readership, and in recent years have been produced in electronic formats which are both convenient and environmentally friendly.

The first EPD webpage with information on beach water quality was set up in October 1998, and from April 1999 the webpage was updated daily. Over time, more information has been added to the webpage: for example, water quality trends for individual beaches have been available since 1999, and annual information about Hong Kong's beaches since 2000. The Annual Beach Report was first available for download in pdf format in this year too, and has also been available in CD-ROM format since 2001. Today, the website at http://www.epd.gov.hk is packed full of information, including up-to-date beach gradings and other useful information about all the beaches the EPD monitors, and those heading to the beach can now access this data from their mobile phone or PDA.

Four easy ways to access EPD's beach water quality information

Changes in annual beach report, from hard copies to e-files (CD ROM and Internet)

Rainfall warning advisory notices

It is a well-established fact that rainfall leads to changes in bacteriological water quality. In particular, heavy rain in conjunction with sewage overflow can result in short periods of very high bacteria levels in sea water, posing a health hazard to swimmers. Acting on advice from the EPD, the Leisure and Cultural Services Department has erected signs at many beaches warning swimmers to avoid the water after periods of heavy rain. This message has also been publicized in other ways, such as on the EPD website and in its weekly press releases.

A typical brightly-coloured rainfall advisory notice at a beach

Chapter 7. An Overview of Beach Water Quality up to 2005

Hong Kong's beaches and their rankings

For administrative and practical reasons, the EPD classifies Hong Kong's beaches into groups depending on their location. The beaches of Southern District are all those situated on the southern coast of Hong Kong island, while Sai Kung District covers the territory's eastern coastline and its beaches. The Tsuen Wan and Tuen Mun Districts are here treated together because their respective beaches run along the coastline extending from Tsuen Wan to Tuen Mun. Finally, Outlying Islands District covers the splendid beaches of Lantau, Lamma and Cheung Chau.

Hong Kong South: the beaches of Southern District

Southern District beaches over the past 20 years

Back in 1986, the beaches in Southern District —which range from the wide, safe and sweeping sands of Repulse Bay to more exposed surf beaches such as Big Wave Bay — were not in great shape, and with rapid population growth in the area they had deteriorated further by 1990. The problem was a familiar one: most of the sewage disposal facilities in the beach hinterlands had been built in the 1970s and designed to serve a relatively small population. With the rapid growth of the 1980s, pressure on the facilities increased to breaking point. Commercial premises, squatters and other residents often discharged sewage directly into stormwater channels, meaning that raw sewage made its way straight to large beaches like Repulse Bay, Deep Water Bay, Shek O and Rocky Bay. A few pig farmers around

Repulse Bay Beach in the 1980s - an open channel ran through the beach, and squatter shacks stood nearby

Squatters in the beach hinterland

Stanley added to the problem: their waste affected beaches on the Stanley peninsula including St Stephen's Beach. Despite their beautiful situations, most of the beaches in Southern District were unsafe for swimming. By 1986, it was clear that urgent restorative measures were necessary.

The Government began by implementing pollution control legislation to improve water quality. The keeping of livestock in urban areas was banned, and the pig farms on the Stanley peninsula closed down. Equally importantly, a programme was put in place to intercept and divert polluting stormwater channels away from beaches. Further measures were taken to reduce pollution from drains and watercourses. Much 'first aid' work was carried out in 1988 and 1989 involving intercepting and diverting polluting storm flows, and by 1990 improvement in water quality at the beaches was already in evidence.

By 1989, all Southern District Beaches except one complied with the WQO, and they have continued to comply ever since. That is not the end of the story however, because even after meeting the minimum WQO standard, many of these beaches have gone from strength to strength. Work continued on improvements at the beaches in the 1990s, as sewerage facilities to collect waste water from the Deep Water Bay, Shouson Hill and Repulse Bay areas were put in place between 1991 and 1995. The area around Stanley benefited from a new sewage treatment facility at Pak Sha Wan (Tweed Bay) discharging at Sheung Sze Mun, which was completed by the middle of 1995. Following this, an extensive public sewer connection programme in the area was carried out.

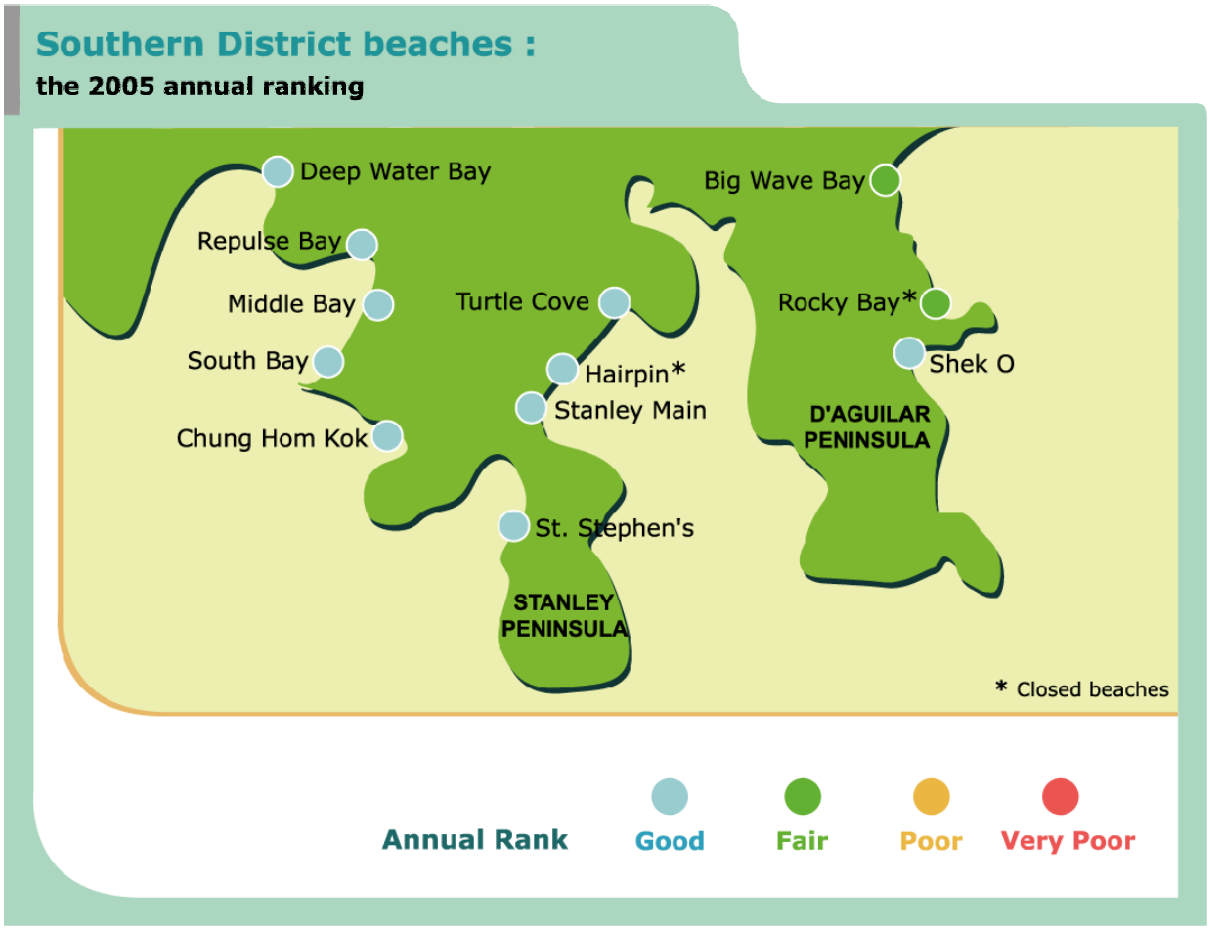
For a while, Rocky Bay was the sole exception to the trend described above, partly due to a large area of unsewered village houses close by. However, after drainage improvements diverted waste water outlets further away from the beach, it finally achieved WQO compliance in 1999 and since then has consistently met the WQO threshold.

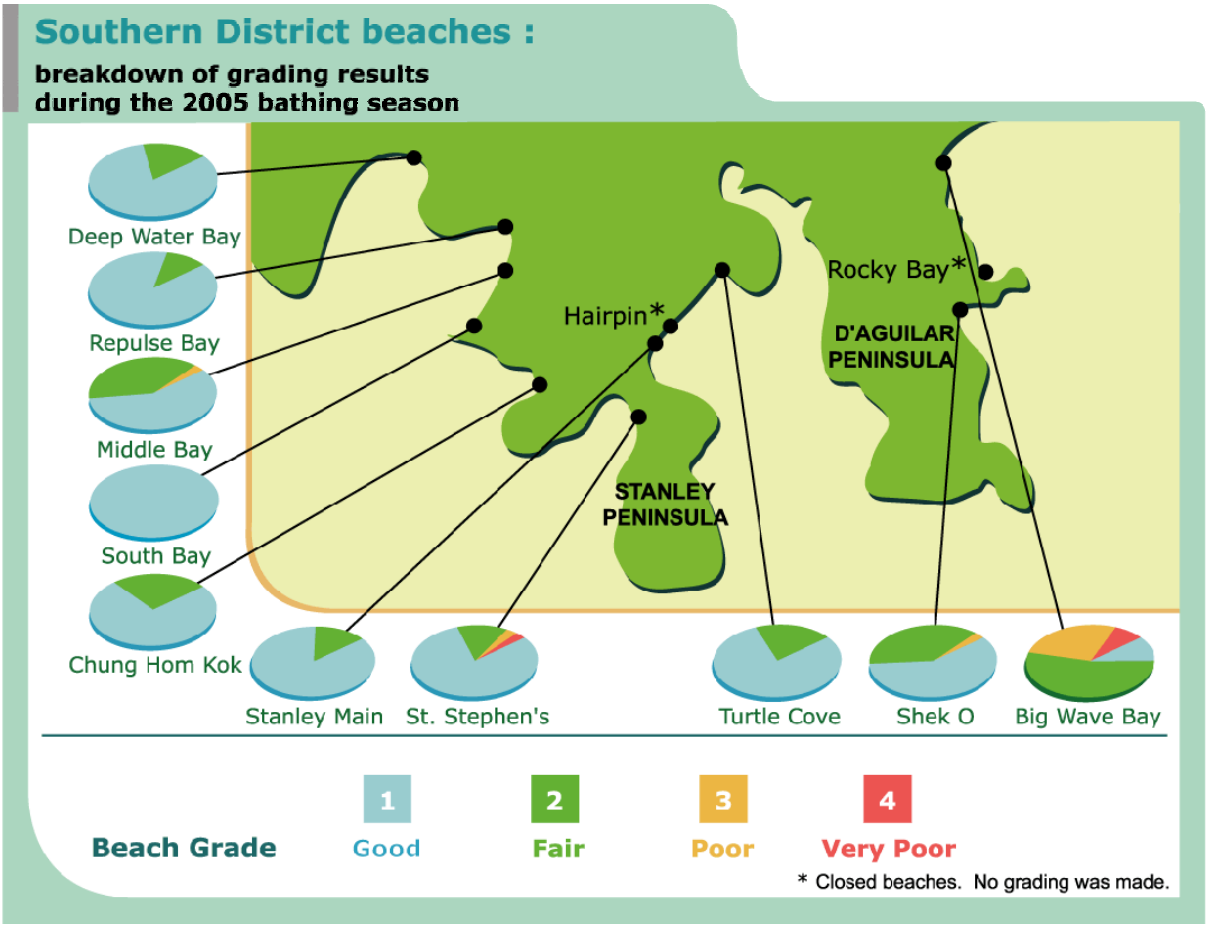
Southern District beaches in 2005

By now, the beaches of Southern District have established a long-standing tradition of good water quality, and 2005 was another good year for swimmers using these beaches. Despite the heavy rainfall, ten of the district's twelve beaches maintained annual rankings of 'Good', and just Big Wave Bay Beach and Rocky Bay

Repulse Bay Beach today

Beach registered 'Fair' rankings. Around 95% of the samples from all beaches in the district met the WQO, and 72% achieved a 'Good' grading. Not surprisingly then, these Southern District beaches are today some of the most popular and well-used in Hong Kong, and provide beautiful bathing conditions in a stunning scenic environment.





One unusual event of 2005 occurred in early July, when swimmers and visitors at Southern District beaches began to notice a constant stream of floating debris washed about in the shallows and piled up on the beaches. The EPD immediately went on alert, stepping up monitoring frequencies. This extra monitoring did not show any signs of a rise in *E. coli* levels at the beaches, but the debris was nevertheless a nuisance. After carrying out further investigations, the EPD discovered that the floating materials originated from the upper reaches of the Pearl River. Severe floods in those parts after exceptionally heavy rainfall and flooding had carried quantities of debris down the Pearl River and out to sea. Winds and tides in the Pearl River Delta region then combined to carry the floating debris across to Hong Kong. Despite the debris, the beaches on the southern coast of Hong Kong Island all managed to maintain gradings of 'Good' or 'Fair' over this period.

Hong Kong East: the beaches of Sai Kung District

Sai Kung District beaches over the past 20 years

Clear Water Bay First Beach

The beaches of Hong Kong's Sai Kung District have enjoyed a long reputation for being some of the cleanest and most unspoiled in the territory. Even in the 1980s, when many of Hong Kong's beaches were in poor shape, most of the Sai Kung District beaches managed to achieve 'Good' rankings consistently. They benefited from the fact that Hong Kong's wild and island-studded east coast, which includes the extensive Sai Kung Country Park, has never been as densely populated as other parts of the territory, and pressure from human habitation has thus been lower.

Silverstrand Beach was for a period the main exception to this rule, due to a relatively heavy population on the steep slopes above the beach, whose septic tanks regularly affected beach water quality. In 2001 the public sewer was extended to Silverstrand, and since then the EPD has been actively encouraging residents to connect to the public sewers. As each year goes by, fewer and fewer houses are using septic tanks and the beach is consequently becoming less susceptible to pollution. Currently, over 50% of Silverstrand area residents are connected to the public sewers and the trend is expected to continue in the next few years.

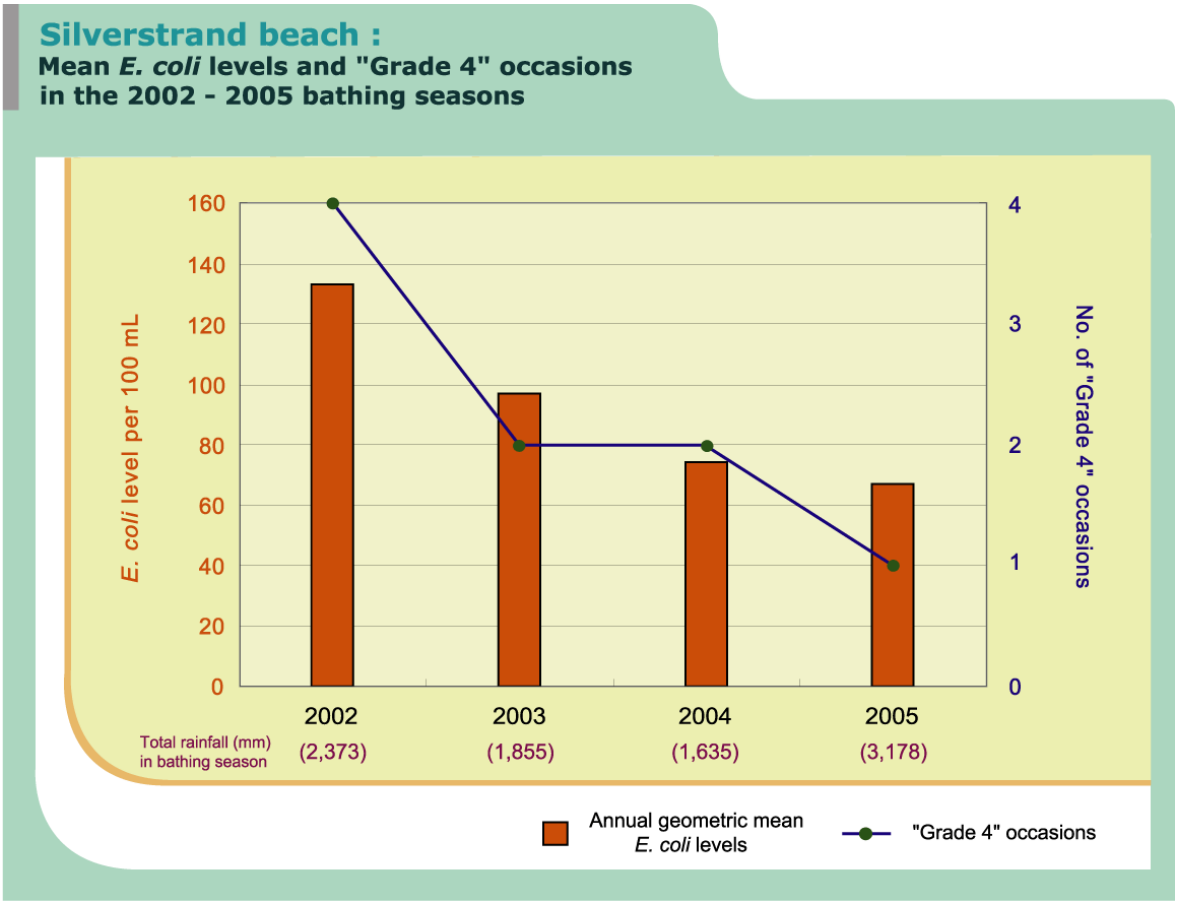
Occasional incidents have occurred at other beaches too: for example, Clear Water Bay First Beach for a while was affected by pollution from a contaminated stormwater drain in the vicinity. The EPD has carried out ongoing enforcement actions to minimise the recurrence of incidents like this. Some improvements were achieved by upgrading the beach environments, as in the building of new beach facilities and toilets for Clear Water Bay Second beach, the waste water from which was treated and discharged well away from the beach, south of the So Shi Tau promontory. The commissioning of a disinfection unit at the wastewater treatment facility for Clear Water Bay Second beach in early 2002 has also brought about improvements.

Sai Kung District beaches in 2005

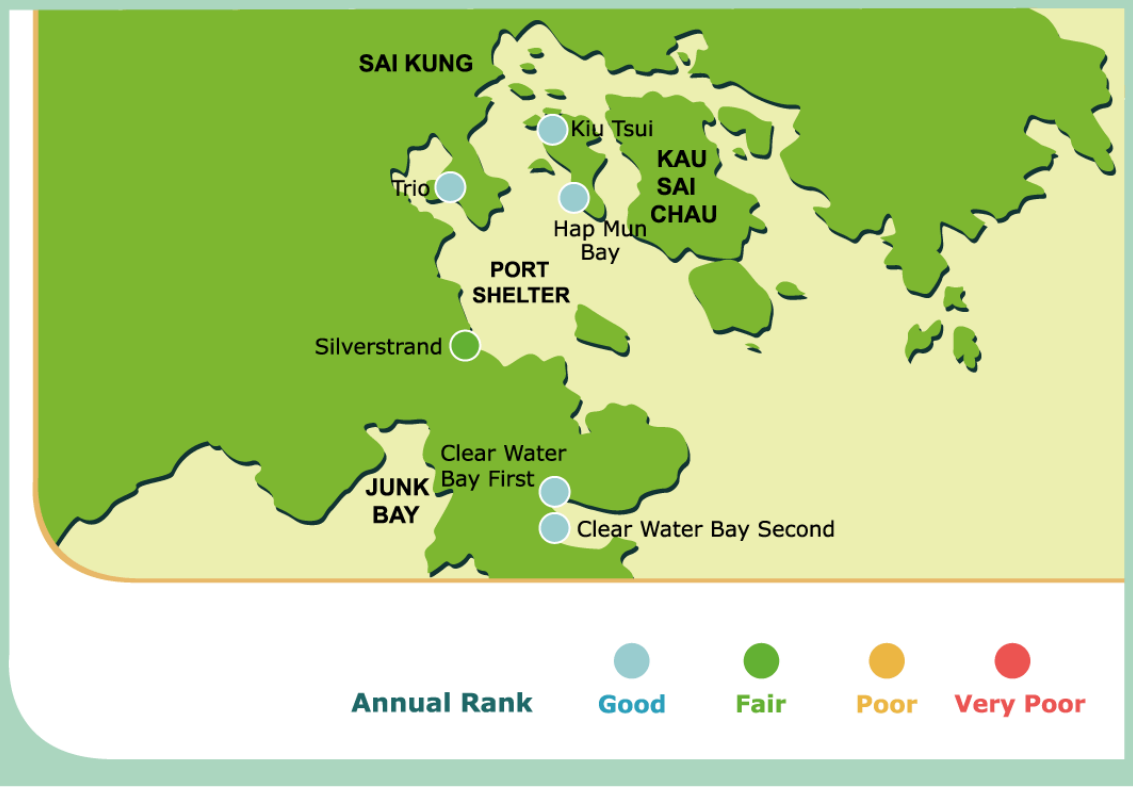
In 2005, of the six gazetted beaches in Sai Kung District, five maintained their 'Good' rankings, with Hap Mun Bay and Trio Beach both distinguishing themselves by maintaining 100% 'Good' gradings across the season. The sixth, Silverstrand Beach, remained ranked 'Fair', but the unchanged ranking disguises several improvements at the beach.

Sewerage connection works at Silverstrand Beach

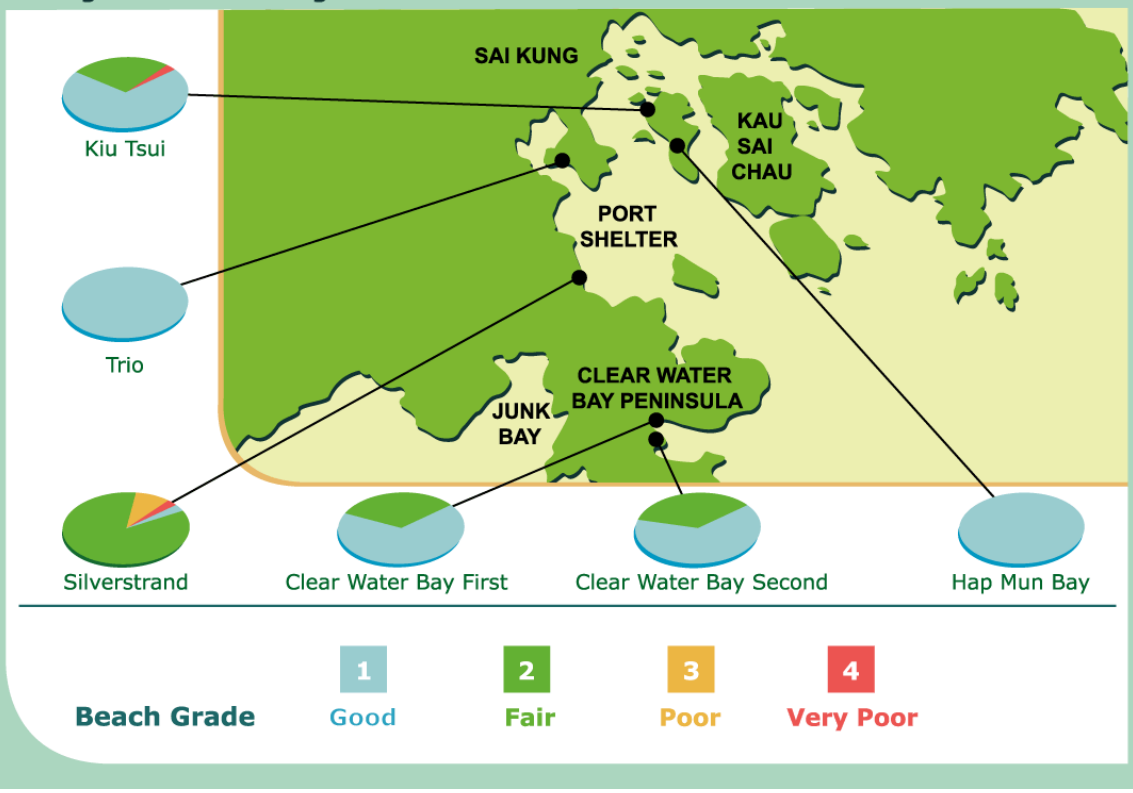
By 2005, the risk of pollution from septic tanks used in the hinterland of Silverstrand Beach had been much reduced, as more and more village houses became connected to the public sewer. The public sewer has been available in the area since 2001. Since 2002, water quality at the beach has shown gradual improvement, and this trend has continued over the past two years despite the heavy rainfall of 2005. As shown in the graph, rainfall in 2005 was around twice that of 2004, yet the annual geometric mean of *E. coli* levels at Silverstrand Beach continued to decrease in 2005, and the beach only experienced one Grade 4 occasion in 2005, compared with two in the previous year.



Sai Kung beaches :
the 2005 annual ranking



Sai Kung beaches :
breakdown of grading results during the 2005 bathing season



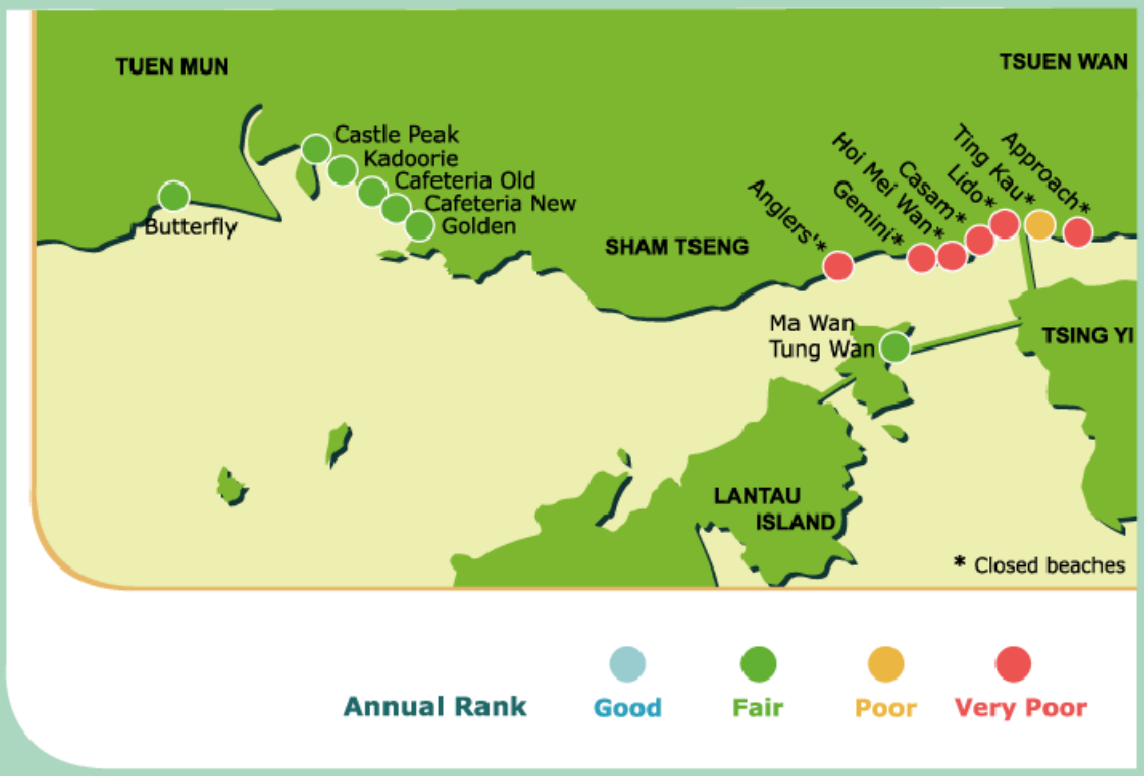
Hong Kong West: the beaches of Tsuen Wan and Tuen Mun Districts

Controlling waste discharge from a livestock farm

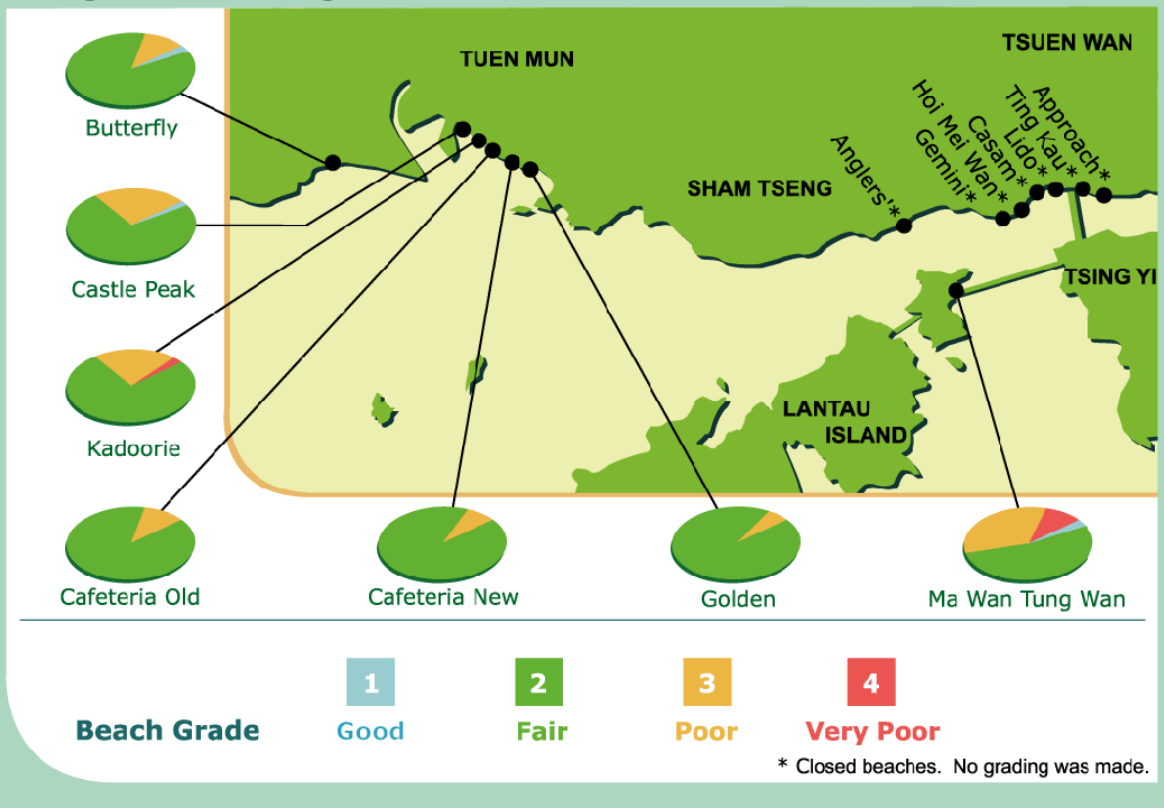
The beaches ranged along Hong Kong's western coasts are situated in the Tsuen Wan and Tuen Mun Districts. Located close to two of Hong Kong's densely-populated towns, Tsuen Wan and Tuen Mun, these beaches have all been characterised over the years by a struggle to deal with pollution from intensive development in the vicinity. In the early years, pig farming was another major contributor to poor water quality, but this source of pollution has largely been controlled since the implementation of the revised Livestock Waste Control Scheme in 1994.

As can be seen from the charts, the annual ranking statistics clearly divide the beaches of Tuen Mun from those of Tsuen Wan District and indicate a distinct divergence in the historical development of the beaches of each district. The cluster of Tuen Mun beaches to the west have shown gradual improvement over the past twenty years, and by 2005 all managed to maintain 'Fair' rankings for the year. Within the *gradings* for these beaches across 2005, Grade 2 ('Fair') dominated, with a couple of beaches even managing to achieve the occasional Grade 1, and only one beach experiencing any Grade 4 incidents. By contrast, the Tsuen Wan beaches have yet to show forward momentum in the battle against pollution, for reasons that are discussed below. Most were closed to swimmers in 2005, though Ma Wan Tung Wan bucked the trend of its location and managed to achieve an annual ranking of 'Fair'. Overall, it is worth noting that in 2005 the combined beaches of the Tuen Mun and Tsuen Wan Districts met the WQO 81% of the time, and the non-WQO compliant occasions were mostly generated by a small group of Tsuen Wan beaches.

Tsuen Wan and Tuen Mun beaches :
the 2005 annual ranking

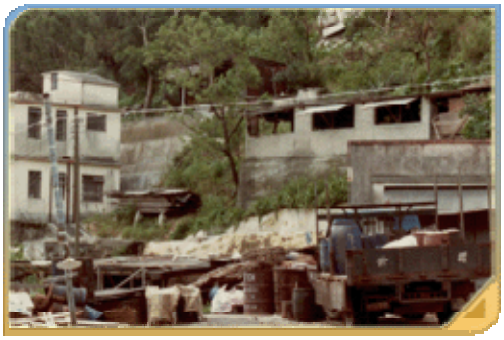


Tsuen Wan and Tuen Mun beaches :
breakdown of grading results during the 2005 bathing season



Tsuen Wan District

Tsuen Wan District beaches: the historical background



A pig shed (upper right) behind Anglers' Beach

Back in the 1980s, Tsuen Wan beaches had to deal with at least three major pollution challenges. Two were faced in common with other areas around Hong Kong: namely, waste runoff from pig farms in the vicinity and extensive discharge of raw sewage from squatter areas and other developments lacking adequate sewage facilities. The third, however, related to the specific geography of the Tsuen Wan coastline. Tides frequently brought polluted marine water from the Rambler Channel (between Tsuen Wan and Tsing Yi) north-west along the line of coast where the gazetted beaches are located.

The problem of animal waste was largely solved in the 1980s with the clampdown on the siting of farms in and around urban areas. The pollution generated from sewage, however, has been more persistent and continues to compromise beach water quality in the district. The extension of the public sewer and connection of unsewered villages along Castle Peak Road (behind many of the Tsuen Wan beaches) is still on-going. This has been further complicated by undisinfected effluent discharged from Stage 1 of the Harbour Area Treatment Scheme (HATS) since late 2001. Though the Scheme has brought about general improvement in the harbour's water quality, particularly the eastern side, the discharge is released from a tunnelled outfall from the Stonecutters Island Sewage Treatment Works, situated around eight kilometers from many of the beaches. Tides and currents have resulted in the HATS discharge affecting beach water quality in the Tsuen Wan District.

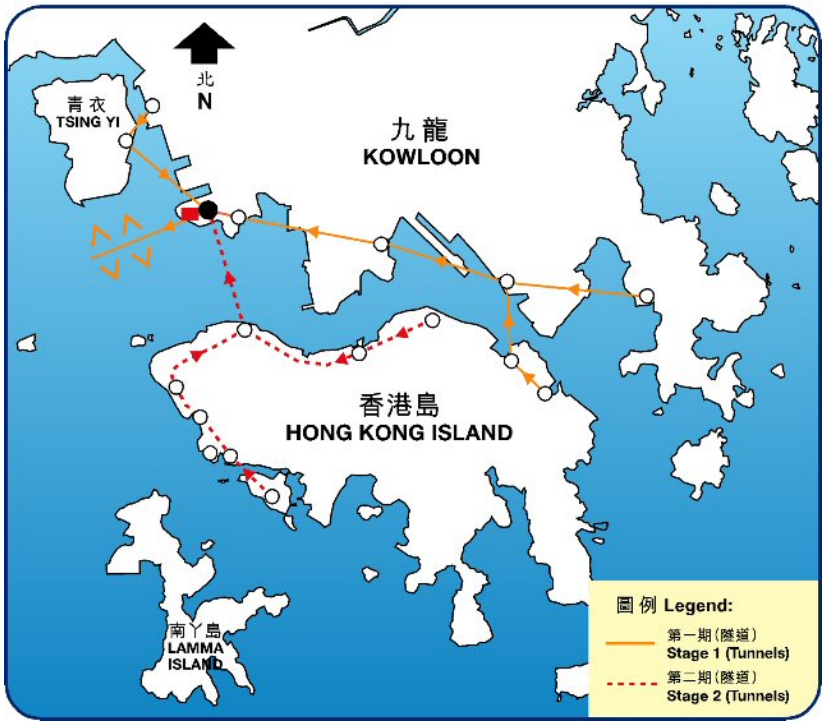
Tsuen Wan District beaches: the situation in 2005

Ma Wan Tung Wan Beach

Of the eight beaches in the Tsuen Wan District, seven did not meet the WQO for bathing beaches in 2005 and remained closed during the bathing season, as they were in 2004. The water quality at Tsuen Wan District beaches was also affected by the year's high rainfall. Four of the closed beaches saw their ranking fall from 'Poor' to 'Very Poor' for the year. The exception

to the list of closed Tsuen Wan beaches was Ma Wan Tung Wan Beach on Park Island, which maintained its 'Fair' ranking for the year and was kept open for swimmers. Ma Wan Tung Wan Beach did experience occasional Grade 4 periods after heavy rainfall, but overall its water quality was much better than the other Tsuen Wan beaches, partly as a result of its location.

Although beach water quality remains poor in the district, there are reasons for optimism concerning the future. HATS has not yet begun to disinfect the effluent which it discharges and, as noted, this discharge does affect beach water quality. The Government is working on the next stage of the treatment project (HATS Stage 2A), and hopes to be in a position to disinfect discharges from the Stonecutters Island Sewage Treatment Works by 2009, subject to community support for its plan to recover operating costs through sewage charges. This should result in an improvement in the bacteriological quality of the surrounding seawater, and would be a significant milestone in the EPD's attempts to prepare the seven closed Tsuen Wan beaches for re-opening.



Diagrammatic illustration of Stages 1 and 2 of the HATS Project

Over the year the EPD has been active in encouraging residents to play their part in improving beach water quality. In a joint effort of the EPD, the Drainage Services Department and the public, many village houses, residential blocks and commercial complexes in the Sham Tseng area have been connected to the public sewers. Currently some sewerage works along Castle Peak Road are in progress. Once the main sewer trunks are completed in 2009, the EPD will ask owners of village houses and other buildings to connect to the public sewer as soon as possible. Tackling local pollution at source will further enhance the benefits arising from effluent disinfection at Stage 2A of the HATS programme.

Tuen Mun District

Tuen Mun District beaches: the historical background

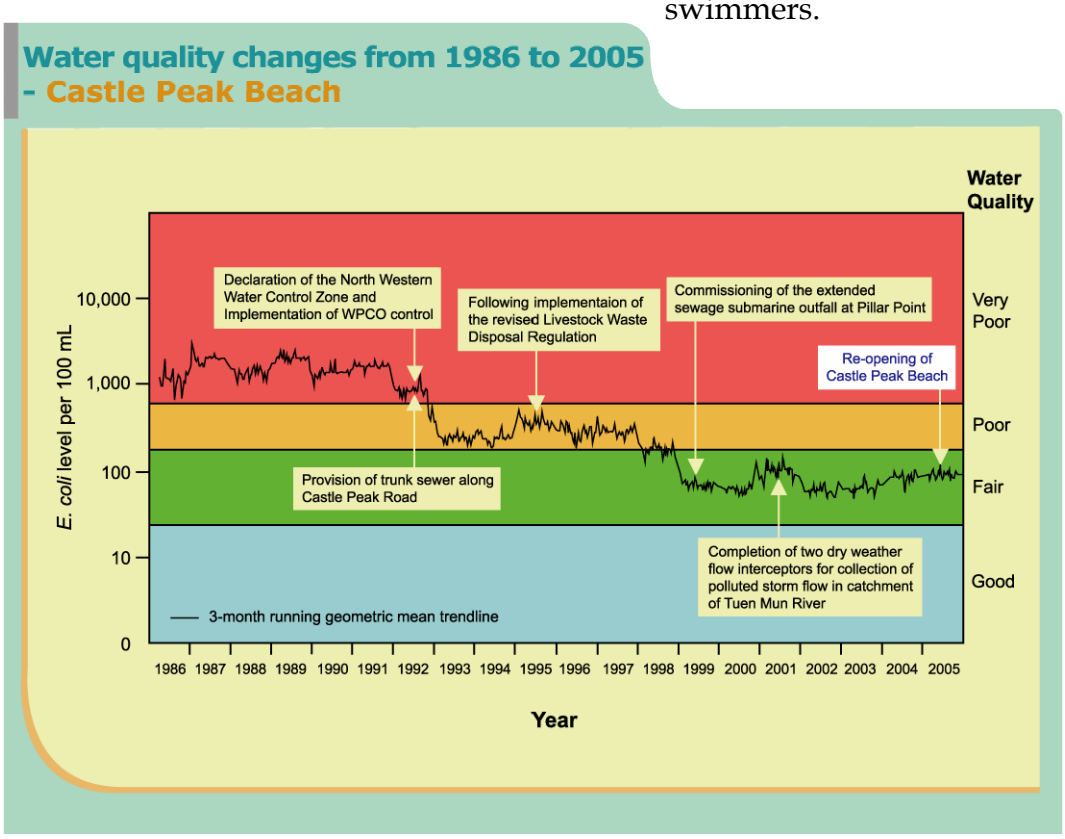
Although in the 1980s Tuen Mun beaches shared with those of Tsuen Wan an unenviable reputation for poor water quality, concerted work by the EPD and other Government Departments over recent years has managed to reverse this trend. Almost all the Tuen Mun beaches recorded very high *E. coli* counts in 1986, particularly those closest to Tuen Mun town itself. A major problem at the time was the Tuen Mun Nullah, a foul stretch of water the discharges from which consistently contaminated beaches in its vicinity. The Tuen Mun Sewerage Master Plan (SMP), drafted in 1993, was aimed at improving beach water quality in the district. Stage 1 of the SMP began in 1994 and involved increasing sewer capacities and networks. Stage 2 of the project was initiated in 1997, and the trunk sewer further extended in range so that public sewer connection became available for many more village communities. The results of this work were marked when it came to beach water quality. Beaches that for years had been unsafe for swimming became 'user-friendly' once more. Perhaps the best single example of this is the story of Castle Peak Beach, opened to the public again in 2005.

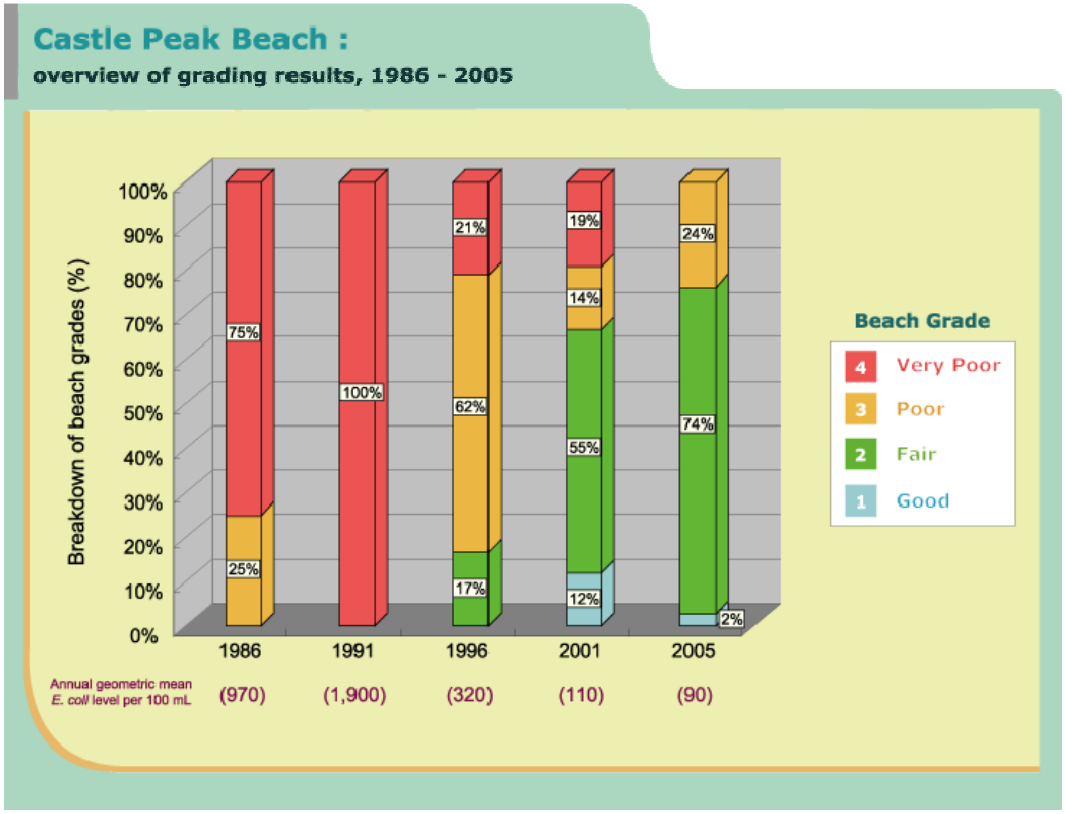
Tuen Mun District in 2005

The continued improvement to sewer facilities over the years saw the situation in Tuen Mun District turn around in the 1990s. The six Tuen Mun District beaches all managed to meet the WQO in 2005, and have each maintained a 'Fair' ranking since 1999, but this does not tell the full story. Symbolic of the change in the District's fortunes is the case of Castle Peak Beach. The beach was closed back in 1981 when water quality hit alarmingly low levels. After a long period, sewerage enhancements in the district along with pollution control programmes began to have a positive effect on water quality, and in the 1990s the water quality at Castle Peak Beach improved steadily. The beach was first ranked 'Fair' in 1999, and has maintained this ranking ever since. In fact, Castle Peak Beach was a good

Castle Peak Beach in 1981 with a drain at the far end (above), and re-opened in 2005 (below)

candidate for re-opening earlier than 2005, but the condition of the seabed proved to be poor and potentially unsafe for swimmers. Once improvement work was carried out to improve the seabed and new beach facilities were installed, Castle Peak Beach was officially opened on 1 June 2005 and has quickly become a popular destination for swimmers.





Beaches on Outlying Islands

A brief historical survey

Cheung Chau Tung Wan Beach

The Outlying Islands beaches are scattered on the islands of Lantau, Lamma, and Cheung Chau. Their distance from Hong Kong's main urban centres means they generally enjoy good clean water. In the years since 1986, a few have suffered on occasions from pollution caused by septic tank overflow, but the EPD has worked continuously to locate and remove these pollution sources. On Cheung Chau island, the water quality at Cheung Chau Tung Wan and Kwun Yam improved significantly after works in the mid 1990s in which wastewater was diverted away from the surface drains into which it had previously been flowing. Earlier, in 1989, a submarine sewage outfall was installed at the Cheung Chau Sewage Treatment Works, which proved effective in dispersing discharged effluent away from beaches. Further improvements occurred once the outfall was replaced by a new one utilising more effective diffusers in 2003, at which time other enhancements to the Treatment Works were also made.

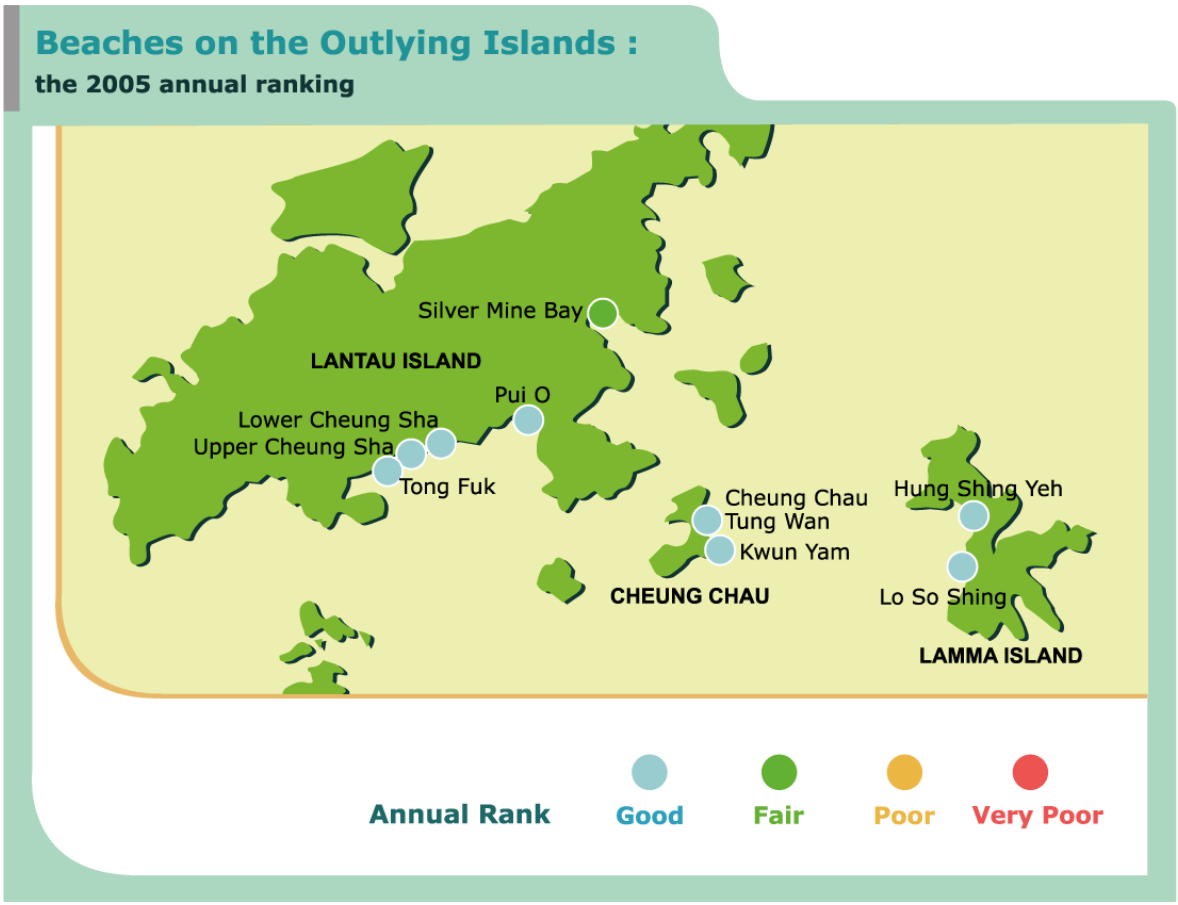
Perhaps the biggest challenge of all the beaches in the Outlying Islands District was Silver Mine Bay Beach. It has a somewhat complex history, due largely to the existence of a number of livestock farms in the hinterland for many years. Their discharges went into the rivers in Mui Wo area and were responsible for most of the pollution at the beach in the 1980s, to the extent that the beach was closed for the three years from 1987 to 1989. Once the Livestock Waste Control Scheme began to be implemented however, water quality rapidly improved, with noticeable changes evident by 1989. By the end of 1992 the five livestock farms in the area were completely closed down, resulting in further improved water quality. However, Silver Mine Bay continued to experience occasional problems on a smaller scale for some years.

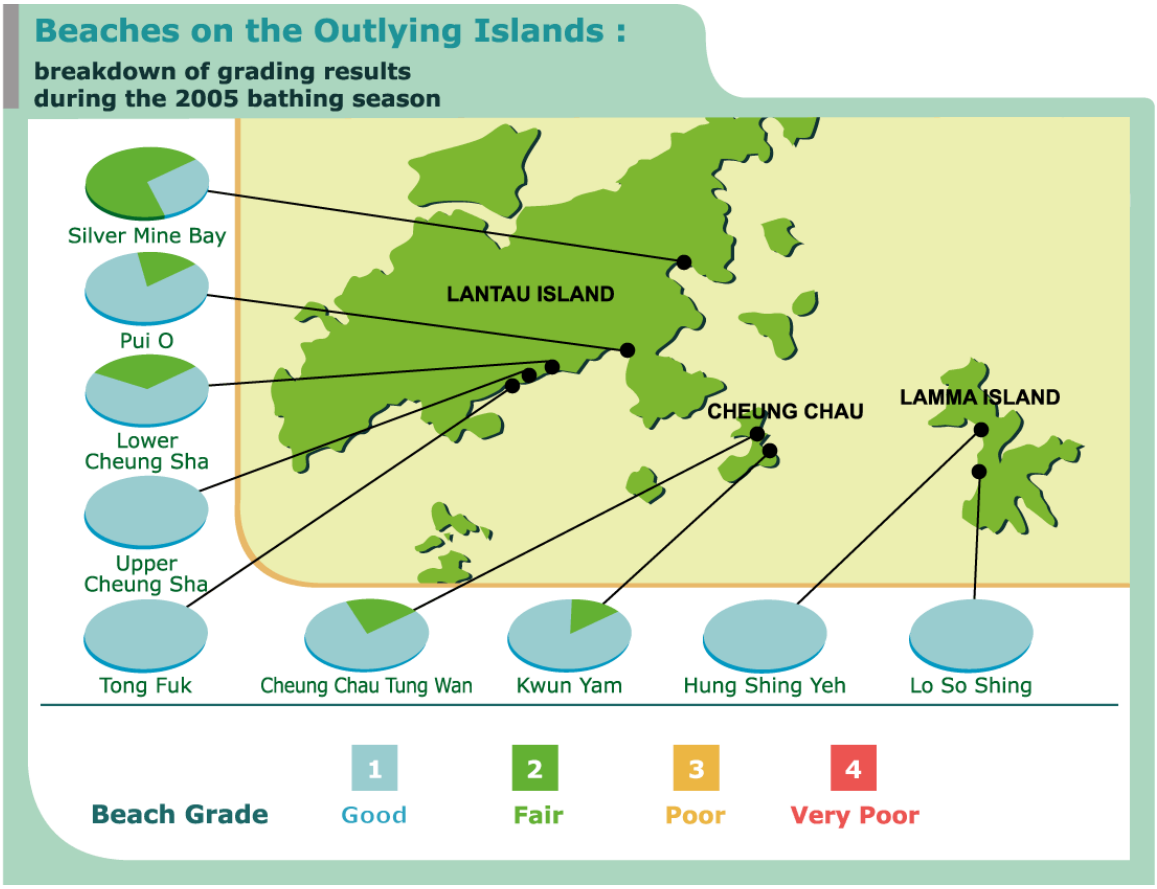
The outlying islands beaches in 2005

In 2005 all but one of the nine beaches in the Outlying Islands District maintained an annual ranking of 'Good'. Four of the Outlying Islands beaches maintained Grade 1 ('Good') 100% of the time throughout the season, and none experienced any Grade 3 or Grade 4 periods.

Silver Mine Bay Beach, Lantau

Unlike the other beaches in the district, Silver Mine Bay achieved only a "Fair" ranking in 2005, but its story is encouraging. The Government is making plans to upgrade the sewerage network and the treatment works in Silver Mine Bay. In addition, the EPD has been continuing its role of monitoring and controlling the effectiveness of septic tanks and soakaway pits, making sure that residents know their responsibilities when it comes to maintaining efficient working sewage systems and repairing leakages.





Non-gazetted Beaches

Of the many non-gazetted beaches scattered around Hong Kong's shores, the EPD monitored two over 2005: the beaches of Discovery Bay on Lantau, and Lung Mei on the northern edge of Tolo Harbour east of Tai Po. Discovery Bay is a beautiful and popular beach, situated in the Discovery Bay residential development and maintained a 'Good' ranking for 2005. By contrast, Lung Mei is a beach 'in the making', as the Government plans to turn this originally rocky shore into an artificial bathing beach to complement the popular leisure facilities of nearby Tai Mei Tuk. Its annual ranking also remained the same as in 2004, at 'Fair'.

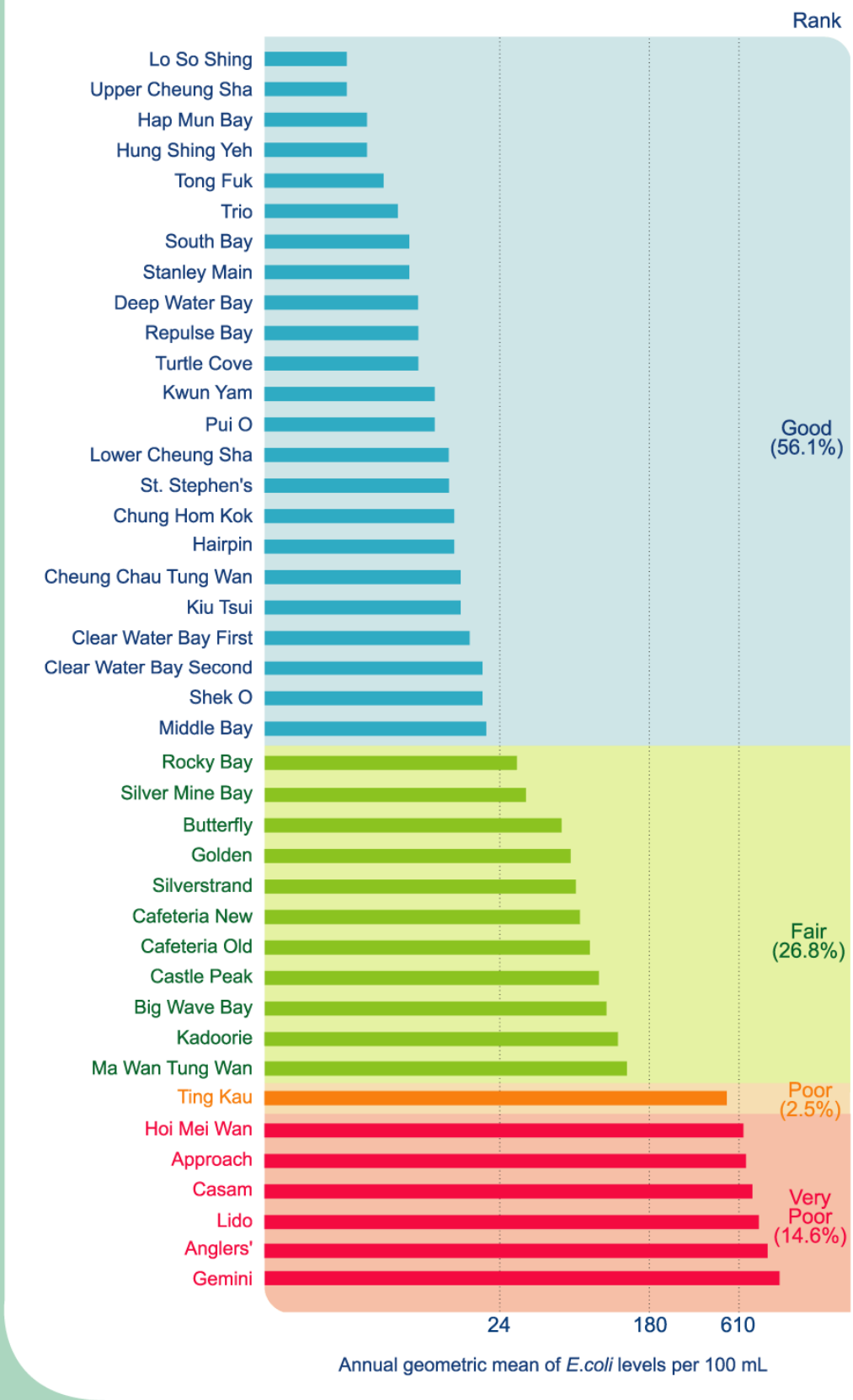
Discovery Bay and its backdrop

The proposed Lung Mei Beach

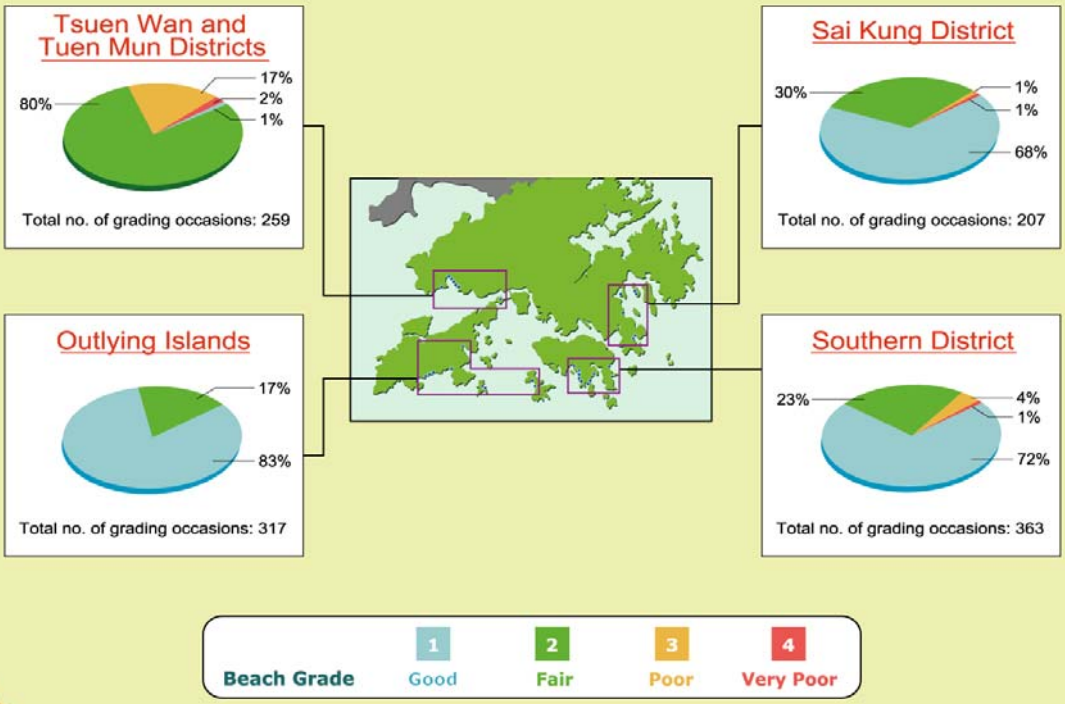
An Overview of Hong Kong's beaches in 2005

In summary, the situation after twenty years of hard work is one the EPD can take satisfaction from, especially by comparison with the situation it faced when it first began operations. Of Hong Kong's 41 gazetted beaches, 34 (or 83%) were WQO compliant in 2005, being ranked either 'Good' (23) or 'Fair' (11). These beaches are located in the Southern, Sai Kung, Outlying Islands and Tuen Mun Districts. Seven beaches were not WQO compliant: one was ranked 'Poor' and the other six 'Very Poor': all these seven beaches were located in the Tsuen Wan District, and the Government is taking actions to improve the water quality at these beaches. The 2005 charts published here are a testimony to the effectiveness of the Beach Water Monitoring Programme. They also testify to the commitment and determination of the Government, and of course the general public, in their efforts to improve our beach environment for current and future generations.

Hong Kong's gazetted beaches :
the 2005 annual ranking



Beach grading summary by district in 2005



Chapter 8. Comparing Beach Rankings

Comparing beach rankings over a twenty-year period

Established in 1986, the EPD has now been monitoring water quality at Hong Kong's beaches for twenty years. During that time, it has undertaken a number of important initiatives to improve and safeguard the health and safety of beach users. These initiatives include:

Key Achievements of the Beach Water Monitoring Programme

- Local scientific studies conducted to establish beach water quality objectives
- Rank and grade beaches
- Provide up-to-date information to the public
- Safeguard health of swimmers

- developing a comprehensive scientific programme for monitoring beach water quality;
- providing regular, reliable and up-to-date water quality information to the general public;
- working in collaboration with other departments to extend the sewer network and improve sewage facilities, with a particular emphasis on reducing pollution from beach hinterlands;
- enforcing environmental legislation designed to reduce pollution and help safeguard beach water quality.

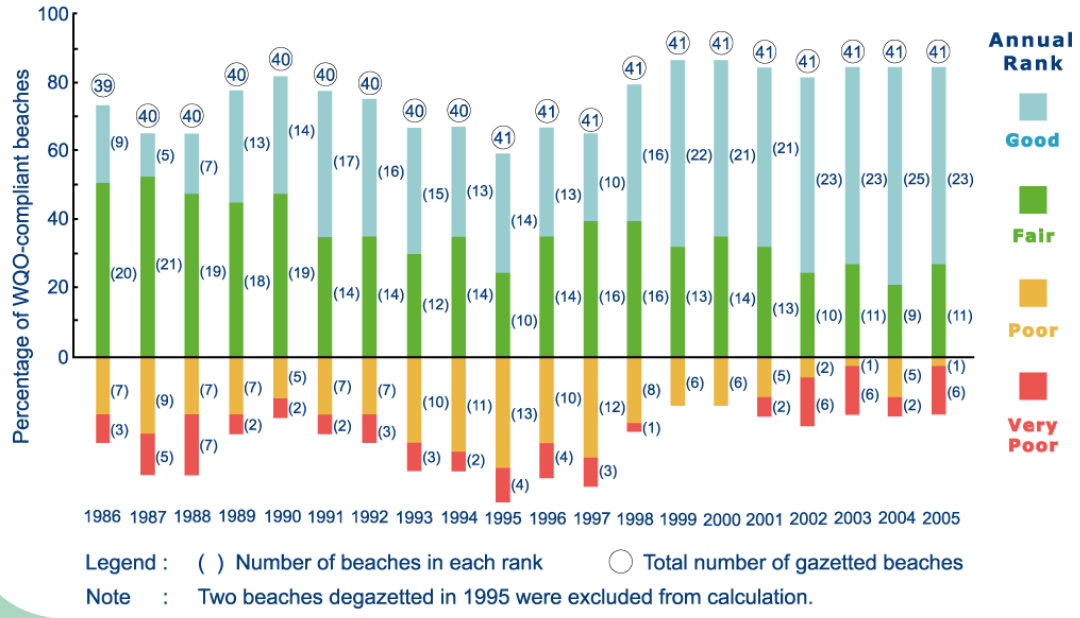
Over the twenty years of its operations, the EPD has seen a great many changes that have affected beach water quality, for better and, sometimes, for worse. One of the most obvious is population growth: Hong Kong's population has grown from 5.5 million two decades ago to around 6.9 million in 2005. Such growth has brought with it rapid commercial and residential development, particularly in new towns such as Tsuen Wan and Tuen Mun. While Hong Kong's new towns were applauded as successful models of urban development, initially at least they placed severe stress on an overloaded drainage and sewerage network. Beaches suffered as a result, with sewage frequently finding its way into the sea. The result was that, for the first ten years or

so of its existence, the EPD observed some signs of deterioration in beach water quality.

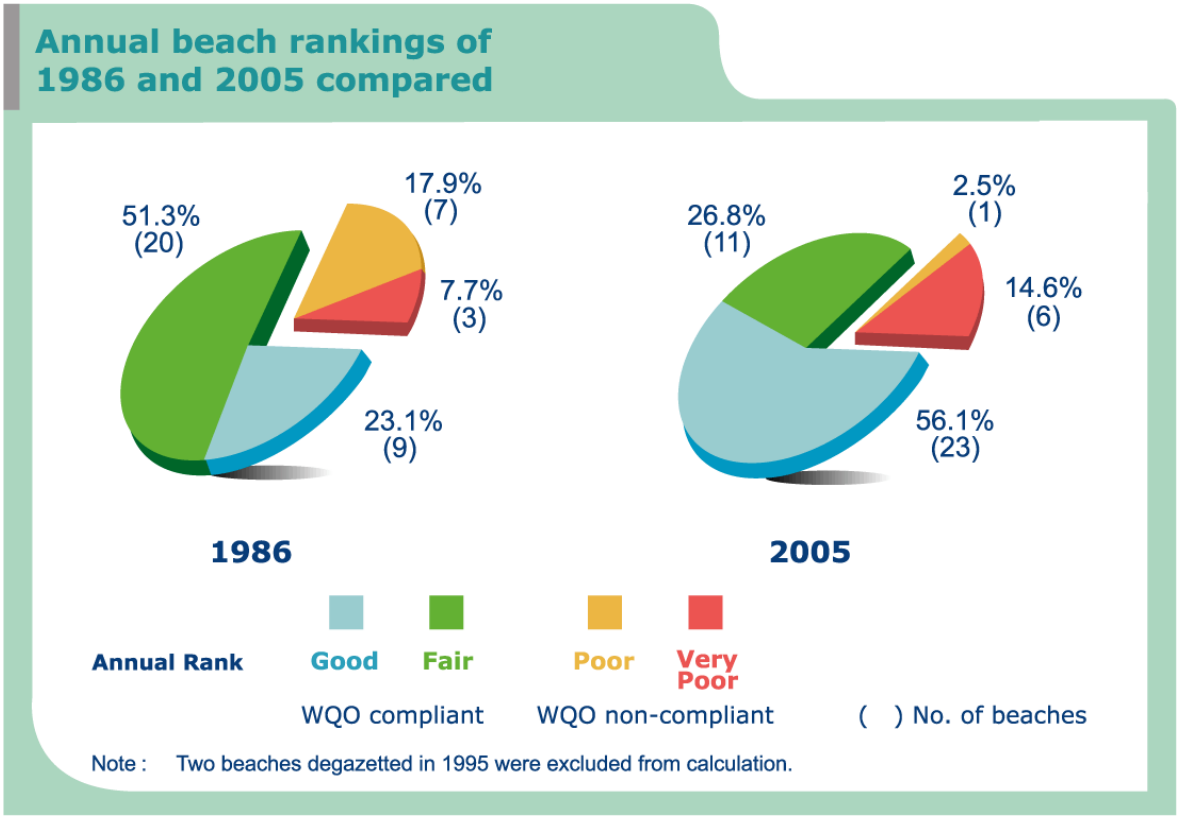
Tracking down a source of pollution in the beach hinterland

To improve beach water quality over the last two decades, the EPD has implemented a whole series of environmental protection measures designed to minimise the environmental impact associated with the pressure of development and rising population. Amongst these, perhaps the most significant was the implementation of Sewerage Master Plans drawn up for districts, a process of extending the public sewerage network right across Hong Kong. The EPD was also heavily involved in enforcing environmental legislation, most of it becoming effective in the late 1980s. Legislation controlling disposal of waste and water pollution was vigorously enforced, helping create a change of attitude amongst residents and leading to a significant improvement in water quality at most beaches. Pollution incidents were tackled and prevented effectively by the actions established in the Beach Pollution Response Plan.

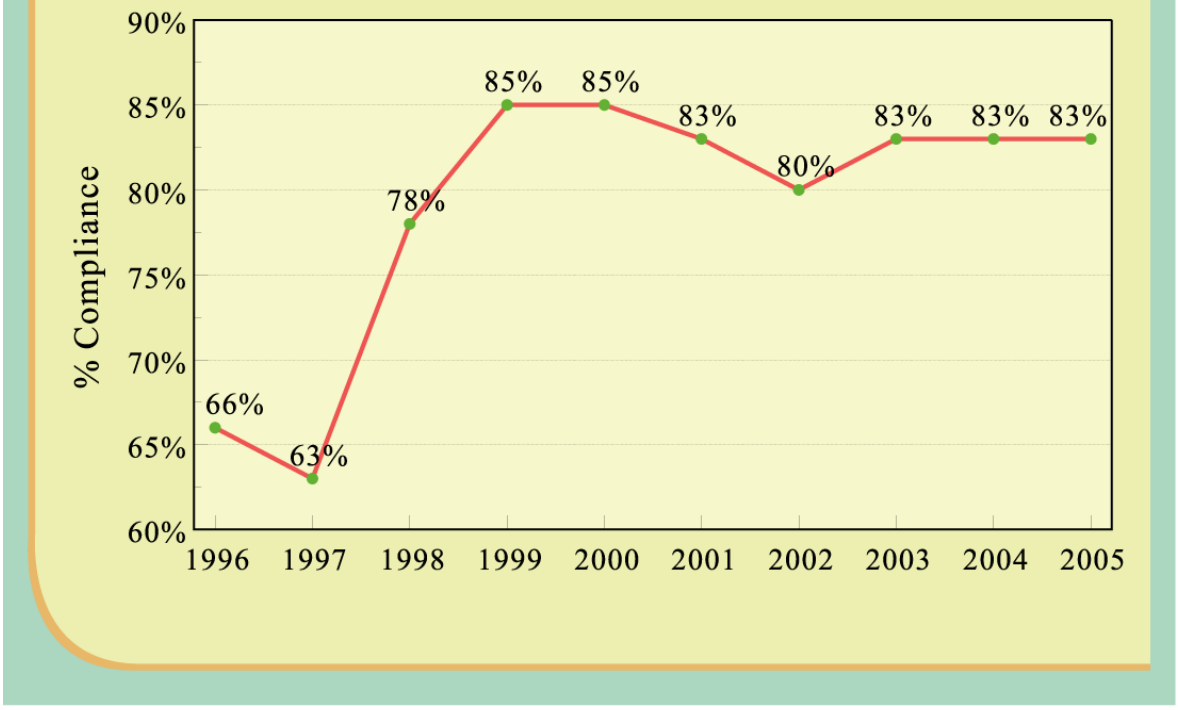
Annual beach rankings over the last 20 years



The positive achievements over the last twenty years have been reflected in the statistics. For example, the percentage of beaches complying with the WQO has risen from 74% in 1986 (29 of 39 beaches recorded in the statistics) to 83% in 2005 (34 of 41 beaches), after dipping dramatically low in the mid 1990s. Significantly fewer beaches now fail to meet the WQO: in 1987 fourteen beaches did not comply with the WQO, but in 2005 the number had been halved to seven. In addition, the percentage of beaches ranked 'Good' has more than doubled over the period, soaring from just 23% in 1986 to 56% in 2005. Since 1999, the WQO compliance rate has been steady at over 80%, a clear indication of a genuine long-term improvement in water quality.



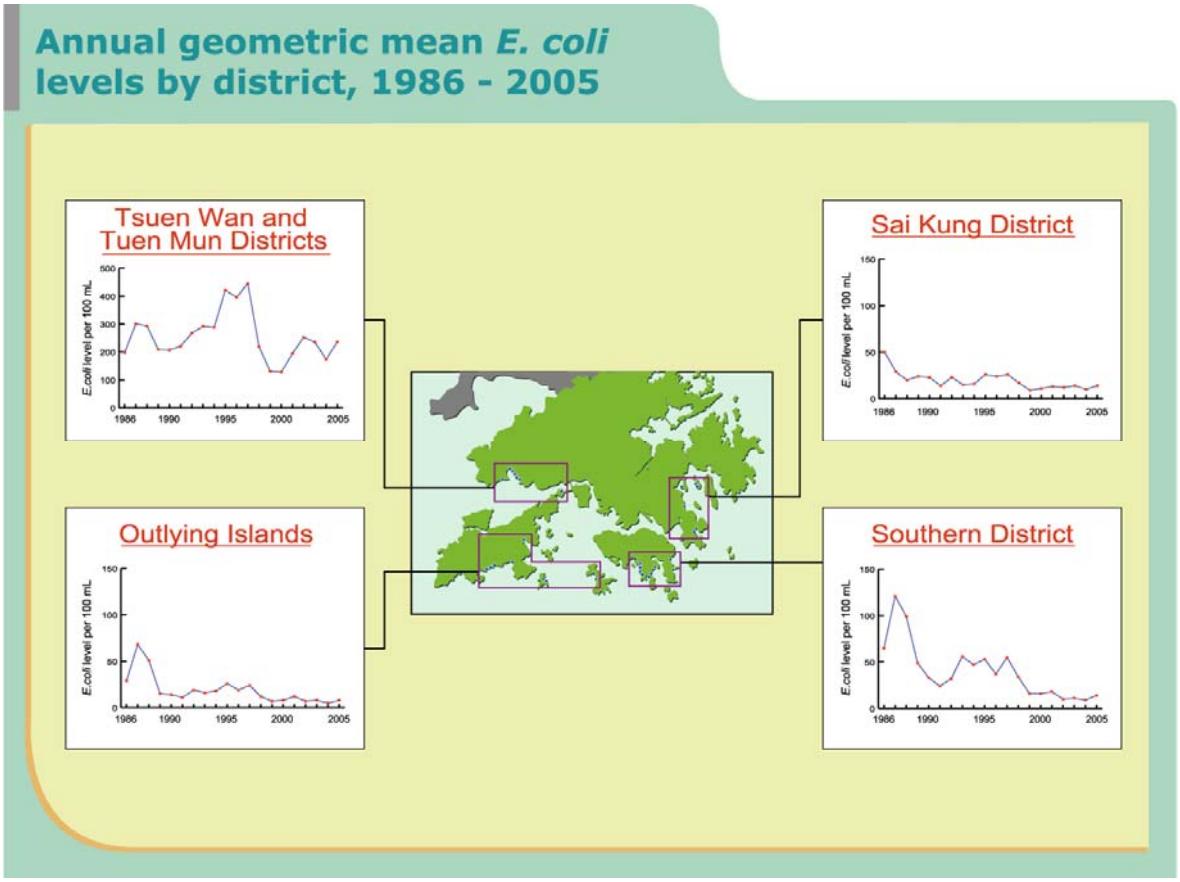
Level of compliance with the Water Quality Objectives at gazetted beaches, 1996 - 2005



As mentioned in chapter seven, back in 1986 some beaches (including Cafeteria Old, Castle Peak, Middle Bay, Repulse Bay and Silver Mine Bay Beaches) were either closed or on the verge of being closed because of their poor water quality. Over the past twenty years they have been transformed into popular, safe, and enjoyable places at which to swim. Almost all Hong Kong's beaches have benefited from the long-term trend of water quality improvement.

Bathers enjoying the broad clean sands at Repulse Bay

There is, unfortunately, still a small group of beaches which are WQO non-compliant, all of which are located in Tsuen Wan District. To a certain extent the water quality of these beaches is affected by the HATS discharge. The future holds promise here, though. With a view to opening the beaches again, the Government is pushing forward with the introduction of effluent disinfection. This development, part of HATS Stage 2A, is planned for commissioning at the Stonecutters Island Sewage Treatment Works in 2009, subject to acceptance by the community of the need for the full operating costs to be recovered from sewage charges.



The chart above, which shows district *E. coli* levels (annual geometric mean) over a twenty-year period, is an encouraging one. The drop in *E. coli* levels has been particularly marked for Hong Kong South and, less dramatically, for the beaches of Sai Kung and the Outlying Islands, which had already achieved relatively good water quality by the early 90s. The EPD is confident that what has been achieved at the once-polluted beaches of Hong Kong South can, with time, also be achieved for Hong Kong's western beaches.

In conclusion, Hong Kong swimmers have reaped the benefits of improvements over the past twenty years that have significantly improved their opportunities all round Hong Kong to fully enjoy the territory's beautiful beaches. The EPD's rigorous sampling, testing and monitoring programme means that today, beach users in Hong Kong can be confident about their health and safety every time they go swimming. And the details of Hong Kong beaches in 2005 also reinforce the story we have seen unfold over the last few years: Hong Kong's water is getting better, and as a city we are successfully reclaiming our wonderful beach resources for all to use.

Supplementary Material

Appendix A
Annual geometric mean *E. coli* over 20 years

Appendix B
Summary of physicochemical water quality data of gazetted beaches, 2005

Appendix C
2005 visitor numbers

Appendix D
Trends in beach water quality over 20 years

Appendix A - Annual geometric mean *E .coli* levels over 20 years

Southern District :

annual geometric mean *E. coli* levels over 20 years

E.coli level per 100 mL

Beach	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Big Wave Bay	39	96	47	58	135	57	79	114	115	163	112	179	114	77	98	106	23	33	26	101
Chung Hom Kok	58	94	92	37	31	21	21	38	26	16	11	22	40	14	8	15	13	14	9	13
Deep Water Bay	35	48	41	30	15	11	18	66	40	48	12	55	46	14	16	18	9	9	7	8
Hairpin	30	56	58	43	38	22	16	54	46	48	26	44	72	17	18	10	6	7	7	13
Middle Bay	137	292	620	29	9	26	17	22	22	40	31	40	16	11	11	8	9	14	12	20
Repulse Bay	175	472	414	85	7	6	13	21	18	22	15	23	11	8	9	13	9	12	4	8
Rocky Bay	491	675	647	435	510	447	637	1582	1418	726	925	399	223	72	80	118	43	28	19	30
Shek O	88	132	108	126	94	66	75	105	71	97	76	102	70	32	29	31	13	11	16	19
South Bay	18	31	81	10	6	4	5	10	5	9	7	17	6	4	7	5	5	11	9	7
St. Stephen's	50	92	64	22	22	14	25	23	23	22	30	40	26	11	6	7	5	9	4	12
Stanley Main	125	225	75	128	27	37	22	58	91	131	50	72	24	13	12	9	8	6	5	7
Turtle Cove	19	40	19	17	26	5	24	17	14	23	16	40	14	12	11	15	8	4	5	8

Note: Figure in red indicates that the beach was closed in that year

Sai Kung District :

annual geometric mean *E. coli* levels over 20 years

E.coli level per 100 mL

Beach	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Clear Water Bay First	102	133	39	80	51	30	52	31	30	55	34	62	41	11	16	28	28	17	9	16
Clear Water Bay Second	69	52	35	38	42	14	42	16	35	39	43	66	44	12	26	22	14	21	10	19
Hap Mun Bay	9	6	4	3	4	2	2	3	3	6	5	3	2	2	2	1	2	4	3	4
Kiu Tsui	18	9	3	5	5	4	5	4	3	3	5	5	4	4	5	5	4	5	17	14
Silverstrand	255	62	129	192	89	106	94	56	72	226	126	148	99	32	61	100	133	97	74	67
Trio	49	32	35	23	31	14	32	20	14	16	29	30	21	17	10	12	6	10	2	6

Tsuen Wan District :

annual geometric mean *E. coli* levels over 20 years

E.coli level per 100 mL

Beach	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Anglers'	856	924	655	329	285	315	531	633	829	895	636	691	502	442	326	621	1,169	693	619	895
Approach	153	337	261	123	293	192	259	384	509	977	1,164	1,009	435	387	316	411	696	762	470	663
Casam	90	241	90	85	97	129	160	284	242	442	483	609	239	231	209	233	741	702	594	716
Gemini	47	128	155	61	75	166	248	254	246	320	512	458	399	350	258	323	1,155	875	1,102	1,042
Hoi Mei Wan	97	378	278	130	127	199	194	286	276	322	373	471	280	109	177	199	547	442	287	641
Lido	121	154	128	71	132	131	147	211	198	444	537	600	262	231	181	269	683	734	523	782
Ma Wan Tung Wan	28	38	33	21	18	27	56	82	73	108	59	110	92	51	39	133	201	159	101	132
Ting Kau	381	473	675	491	562	433	352	464	464	1,644	2,096	1,583	1,045	515	593	739	742	831	412	512

Note: Figure in red indicates that the beach was closed in that year

Tuen Mun District :

annual geometric mean *E. coli* levels over 20 years

E.coli level per 100 mL

Beach	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Butterfly	200	175	304	376	148	191	237	260	317	383	298	259	121	44	61	74	60	74	55	55
Cafeteria New	303	220	240	220	165	202	175	225	229	254	230	309	100	60	51	104	62	80	54	70
Cafeteria Old	614	862	716	743	664	632	731	669	301	387	260	435	138	58	57	125	74	76	61	81
Castle Peak	965	2,162	1,525	2,547	1,782	1,847	1,187	246	243	430	318	332	199	57	58	105	58	64	80	90
Golden	-	-	-	-	-	-	-	-	206	252	225	352	98	44	50	87	66	84	46	62
Kadoorie	187	142	233	314	291	172	267	230	210	246	231	290	130	109	68	120	114	160	98	117

Note: Figure in red indicates that the beach was closed in that year

Outlying Islands :

annual geometric mean *E. coli* levels over 20 years

E.coli level per 100 mL

Beach	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cheung Chau Tung Wan	73	104	57	27	26	29	49	29	36	19	24	24	19	11	12	16	17	11	12	14
Hung Shing Yeh	10	8	8	3	5	4	9	7	8	6	4	5	3	3	5	6	2	5	4	4
Kwun Yam	29	66	26	15	15	11	23	16	26	20	21	32	21	6	10	11	9	7	5	10
Lo So Shing	6	5	4	2	3	2	5	3	3	5	3	3	2	4	2	5	2	3	2	3
Lower Cheung Sha	253	260	215	76	38	48	39	83	80	186	137	85	23	10	12	22	10	14	7	12
Pui O	12	52	30	12	14	12	16	20	18	38	25	36	16	10	10	17	10	15	9	10
Silver Mine Bay	317	2,432	1,038	150	167	67	132	128	83	371	155	481	123	39	50	67	42	50	14	34
Tong Fuk	14	37	16	9	7	5	12	8	8	15	11	14	10	4	5	6	4	3	4	5
Upper Cheung Sha	7	11	16	4	4	2	3	2	4	6	6	8	3	2	3	5	3	3	3	3

Note: Figure in red indicates that the beach was closed in that year

Appendix B - 2005 visitor numbers

Southern District :
2005 visitor numbers

Beach	Daily average: Weekdays	Daily average: Weekends & public holidays	Peak day	Peak month	Total
Big Wave Bay	276	1,164	4,000	34,975	136,851
Chung Hom Kok	203	1,019	4,500	23,702	113,331
Deep Water Bay	1,733	4,796	37,000	157,150	663,593
Hairpin	84	477	1,500	13,950	51,255
Middle Bay	177	511	2,140	17,710	69,416
Repulse Bay	6,460	11,563	39,000	285,100	1,980,761
Rocky Bay	-	-	-	-	-
Shek O	1,033	4,976	30,000	162,300	560,570
South Bay	164	1,109	2,500	25,100	113,820
St. Stephen's	207	544	1,500	15,130	76,969
Stanley Main	643	3,886	18,500	129,090	410,544
Turtle Cove	79	308	1,200	7,205	37,182

Note: Information provided by the Leisure and Cultural Services Department

Sai Kung District :
2005 visitor numbers

Beach	Daily average: Weekdays	Daily average: Weekends & public holidays	Peak day	Peak month	Total
Clear Water Bay First	124	353	1,680	11,795	48,284
Clear Water Bay Second	1,693	6,873	65,500	168,478	818,778
Hap Mun Bay	169	793	12,950	29,432	90,001
Kiu Tsui	36	298	1,865	6,548	29,298
Silverstrand	118	545	3,850	11,999	62,282
Trio	261	973	9,800	40,930	119,401

Note: Information provided by the Leisure and Cultural Services Department

Tsuen Wan District :

2005 visitor numbers

Beach	Daily average: Weekdays	Daily average: Weekends & public holidays	Peak day	Peak month	Total
Anglers'	39	80	220	2,020	12,655
Approach	56	89	140	2,740	16,375
Casam	14	20	65	550	3,850
Gemini	4	5	5	155	1,120
Hoi Mei Wan	5	9	20	225	1,560
Lido	88	119	380	3,330	24,025
Ma Wan Tung Wan	206	1,242	8,450	30,750	131,298
Ting Kau	12	30	50	775	4,300

Note: Information provided by the Leisure and Cultural Services Department

Tuen Mun District :

2005 visitor numbers

Beach	Daily average: Weekdays	Daily average: Weekends & public holidays	Peak day	Peak month	Total
Butterfly	1,031	2,814	14,300	68,880	391,780
Cafeteria New	821	1,797	5,800	62,870	277,260
Cafeteria Old	653	1,717	5,020	41,980	243,000
Castle Peak	506	968	1,800	25,600	160,050
Golden	1,247	4,748	11,000	111,900	578,640
Kadoorie	536	949	3,000	33,400	163,440

Note: Information provided by the Leisure and Cultural Services Department

Outlying Islands :

2005 visitor numbers

Beach	Daily average: Weekdays	Daily average: Weekends & public holidays	Peak day	Peak month	Total
Cheung Chau Tung Wan	168	753	4,000	25,870	86,845
Hung Shing Yeh	170	550	1,470	12,410	71,260
Kwun Yam	136	392	990	9,440	53,210
Lo So Shing	47	150	1,470	2,980	19,520
Lower Cheung Sha	61	269	1,100	6,820	31,240
Pui O	91	257	650	8,710	35,230
Silver Mine Bay	179	418	3,150	12,670	62,475
Tong Fuk	82	176	570	6,840	27,420
Upper Cheung Sha	83	167	470	5,260	26,860

Note: Information provided by the Leisure and Cultural Services Department

Appendix C - Summary of physicochemical water quality data of gazatted beaches, 2005

Southern District : summary of physicochemical water quality data of gazetted beaches, 2005

Beach	pH	Salinity (psu)[1]	Turbidity (NTU)[2]	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Deep Water Bay	8.2 (7.9 - 8.7)	29.1 (15.7 - 33.9)	4.8 (1.5 - 11.9)	25.7 (15.7 - 31.8)	6.6 (5.2 - 8.0)	92 (76 - 112)
Repulse Bay	8.2 (8.0 - 8.7)	29.7 (16.3 - 34.5)	3.7 (1.3 - 8.9)	25.3 (15.6 - 30.4)	6.7 (5.7 - 8.0)	95 (84 - 118)
Middle Bay	8.2 (8.0 - 8.7)	29.3 (15.8 - 34.4)	3.7 (1.0 - 10.6)	25.5 (15.1 - 31.4)	6.7 (5.2 - 8.9)	95 (73 - 130)
South Bay	8.2 (8.0 - 8.7)	29.5 (15.3 - 34.3)	2.9 (0.7 - 7.2)	25.4 (14.7 - 31.1)	6.6 (5.1 - 8.3)	93 (74 - 108)
Chung Hom Kok	8.2 (8.0 - 8.7)	29.5 (16.0 - 33.8)	3.4 (1.0 - 7.6)	25.4 (14.5 - 31.5)	6.6 (5.3 - 8.1)	93 (80 - 117)
St. Stephen's	8.2 (8.0 - 8.7)	29.1 (15.9 - 33.7)	3.3 (0.9 - 15.0)	25.4 (14.8 - 31.0)	6.6 (5.4 - 8.2)	92 (75 - 108)
Big Wave Bay	8.2 (7.9 - 8.7)	29.3 (18.3 - 35.0)	3.2 (1.1 - 10.6)	25.4 (14.7 - 29.9)	6.6 (5.7 - 8.2)	94 (81 - 104)
Shek O	8.2 (7.9 - 8.6)	30.7 (20.1 - 33.8)	3.5 (0.9 - 17.9)	25.4 (14.6 - 31.0)	6.6 (5.6 - 8.1)	94 (83 - 106)
Turtle Cove	8.2 (7.7 - 8.7)	29.1 (15.1 - 33.9)	5.0 (0.7 - 15.7)	26.0 (15.1 - 30.8)	6.5 (4.9 - 8.2)	94 (80 - 115)
Stanley Main	8.3 (8.0 - 8.8)	28.6 (14.4 - 33.5)	2.8 (1.0 - 8.5)	26.2 (14.8 - 31.3)	6.8 (5.6 - 8.2)	97 (82 - 127)
Hairpin [Closed]	8.3 (8.0 - 8.7)	28.9 (14.9 - 33.7)	2.1 (0.6 - 6.4)	26.1 (14.8 - 31.0)	6.8 (5.3 - 8.1)	96 (78 - 114)
Rocky Bay [Closed]	8.2 (7.9 - 8.6)	30.0 (17.9 - 34.6)	2.5 (0.7 - 9.2)	25.1 (14.7 - 30.1)	6.7 (5.1 - 8.2)	93 (76 - 106)

1. Practical Salinity Unit ; 2. Nephelometric Turbidity Unit

Note: Data presented are arithmetic means; figures in brackets are ranges.

Sai Kung District : summary of physicochemical water quality data of gazetted beaches, 2005

Beach	pH	Salinity (psu)[1]	Turbidity (NTU)[2]	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Clear Water Bay First	8.2 (8.0 - 8.6)	29.9 (17.3 - 33.7)	4.6 (1.0 - 22.3)	26.0 (16.1 - 31.0)	6.5 (5.6 - 8.8)	94 (69 - 105)
Clear Water Bay Second	8.2 (8.0 - 8.6)	30.4 (23.0 - 33.8)	4.3 (1.1 - 16.6)	26.2 (16.5 - 31.9)	6.4 (5.3 - 8.5)	93 (78 - 106)
Hap Mun Bay	8.2 (8.0 - 8.6)	30.1 (18.2 - 33.7)	2.1 (0.4 - 5.2)	25.9 (14.6 - 32.0)	6.6 (5.6 - 8.3)	94 (86 - 103)
Kiu Tsui	8.2 (8.0 - 8.7)	29.8 (16.9 - 34.1)	1.9 (0.7 - 5.4)	25.9 (14.5 - 31.7)	6.8 (5.8 - 8.5)	97 (84 - 114)
Silverstrand	8.2 (8.0 - 8.7)	29.0 (18.2 - 33.0)	4.3 (0.7 - 38.1)	26.0 (16.2 - 31.3)	6.7 (5.4 - 8.7)	95 (76 - 106)
Trio	8.2 (7.9 - 8.6)	28.2 (9.1 - 33.0)	2.0 (1.0 - 7.1)	26.1 (14.8 - 32.0)	6.6 (5.5 - 8.2)	94 (83 - 109)

1. Practical Salinity Unit ; 2. Nephelometric Turbidity Unit

Note: Data presented are arithmetic means; figures in brackets are ranges.

Tsuen Wan District :
summary of physicochemical water quality data of gazetted beaches, 2005

Beach	pH	Salinity (psu) [1]	Turbidity (NTU) [2]	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Anglers' [Closed]	8.1 (7.9 - 8.3)	28.1 (11.4 - 32.6)	5.4 (1.5 - 13.7)	24.7 (15.5 - 28.8)	6.3 (5.2 - 7.6)	88 (75 - 106)
Approach [Closed]	8.1 (7.8 - 8.3)	27.6 (14.4 - 32.9)	5.6 (1.6 - 13.0)	24.7 (15.4 - 29.7)	6.2 (5.1 - 7.9)	87 (70 - 111)
Casam [Closed]	8.1 (7.9 - 8.3)	27.8 (16.0 - 32.3)	5.2 (1.1 - 18.6)	24.9 (15.7 - 29.3)	6.5 (5.3 - 8.6)	91 (80 - 114)
Gemini [Closed]	8.1 (7.9 - 8.4)	28.3 (12.6 - 32.6)	6.2 (1.2 - 26.2)	24.6 (15.7 - 28.6)	6.2 (4.9 - 7.4)	87 (60 - 108)
Hoi Mei Wan [Closed]	8.1 (7.9 - 8.3)	27.9 (15.6 - 32.4)	3.9 (1.1 - 10.6)	24.9 (15.3 - 29.7)	6.2 (5.0 - 7.8)	87 (74 - 109)
Lido [Closed]	8.1 (7.9 - 8.3)	28.0 (15.9 - 32.5)	4.4 (1.2 - 10.9)	24.8 (15.5 - 29.2)	6.4 (5.5 - 7.6)	89 (78 - 106)
Ma Wan Tung Wan	8.1 (7.9 - 8.4)	28.6 (13.4 - 32.5)	6.5 (1.5 - 26.1)	25.0 (15.3 - 31.0)	6.2 (4.6 - 7.8)	89 (65 - 108)
Ting Kau [Closed]	8.1 (7.9 - 8.4)	27.1 (15.5 - 33.3)	4.7 (1.0 - 26.3)	24.8 (15.7 - 29.7)	6.4 (5.0 - 7.9)	89 (74 - 106)

1. Practical Salinity Unit ; 2. Nephelometric Turbidity Unit

Note: Data presented are arithmetic means; figures in brackets are ranges.

Tuen Mun District :
summary of physicochemical water quality data of gazetted beaches, 2005

Beach	pH	Salinity (psu) [1]	Turbidity (NTU) [2]	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Bufferfly	8.1 (7.8 - 8.5)	24.6 (6.8 - 32.3)	8.1 (1.9 - 31.9)	26.2 (14.9 - 30.6)	6.3 (4.9 - 7.5)	88 (75 - 101)
Cafeteria New	8.1 (7.9 - 8.5)	24.3 (6.7 - 32.1)	10.8 (2.9 - 55.7)	25.9 (14.7 - 30.7)	6.5 (5.1 - 7.8)	90 (76 - 106)
Cafeteria Old	8.1 (7.9 - 8.4)	24.1 (6.6 - 32.1)	8.8 (1.6 - 25.4)	25.9 (14.9 - 30.9)	6.5 (5.1 - 8.1)	90 (73 - 108)
Castle Peak	8.1 (7.8 - 8.7)	23.1 (6.7 - 32.3)	6.4 (1.5 - 26.4)	26.5 (14.8 - 31.6)	6.7 (5.1 - 10.0)	95 (72 - 130)
Golden	8.1 (7.9 - 8.5)	24.4 (6.9 - 32.2)	12.5 (3.2 - 47.1)	25.9 (14.8 - 31.5)	6.5 (4.8 - 8.0)	90 (70 - 105)
Kadoorie	8.1 (7.9 - 8.5)	24.4 (6.7 - 32.2)	6.1 (2.1 - 15.8)	26.1 (15.1 - 30.8)	6.6 (5.4 - 8.1)	92 (75 - 114)

1. Practical Salinity Unit ; 2. Nephelometric Turbidity Unit

Note: Data presented are arithmetic means; figures in brackets are ranges.

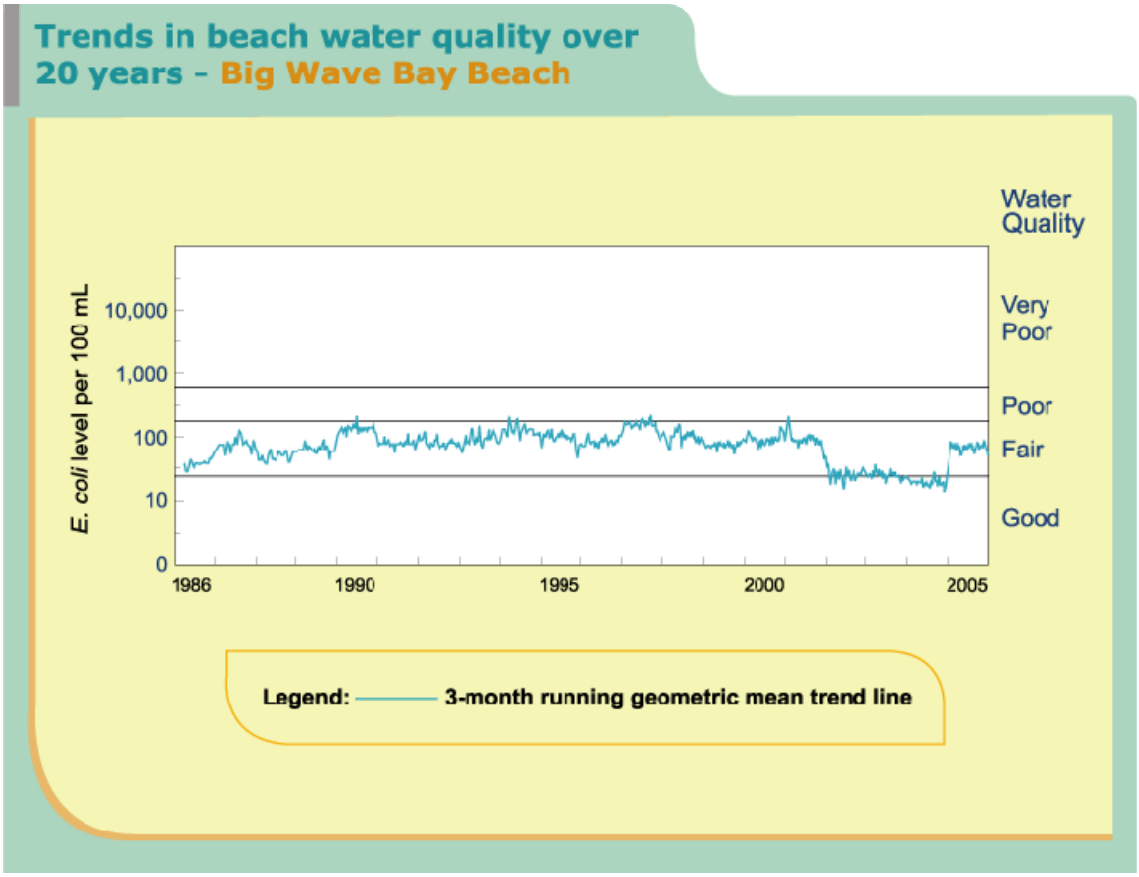
Outlying Islands :
summary of physicochemical water quality data of gazetted beaches, 2005

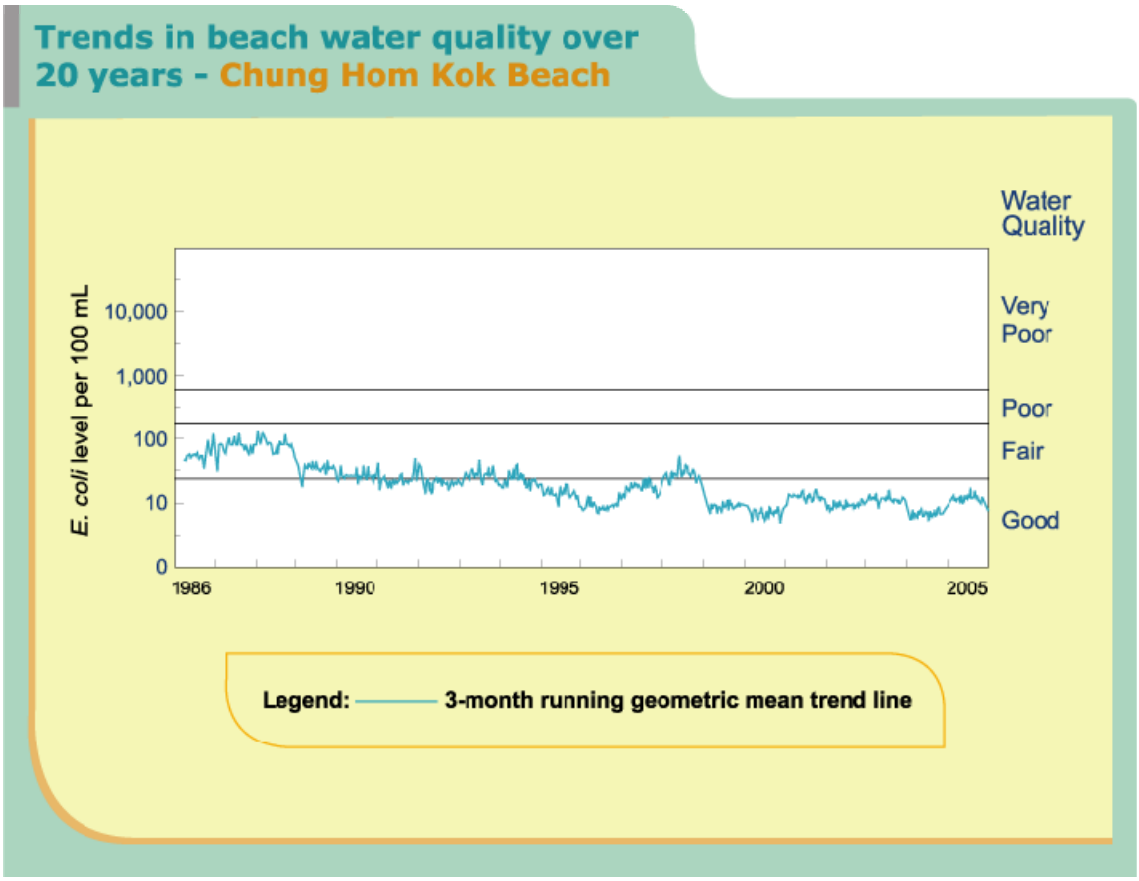
Beach	pH	Salinity (psu) [1]	Turbidity (NTU) [2]	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Cheung Chau Tung Wan	8.2 (7.9 - 8.6)	28.7 (17.2 - 33.2)	4.4 (1.3 - 11.7)	25.6 (14.4 - 29.8)	6.8 (4.6 - 8.7)	95 (68 - 112)
Hung Shing Yeh	8.2 (7.9 - 9.0)	27.7 (8.5 - 33.9)	5.8 (0.9 - 32.4)	25.8 (15.5 - 30.4)	6.6 (5.4 - 8.1)	94 (81 - 105)
Kwun Yam	8.2 (7.9 - 8.6)	28.2 (18.9 - 32.6)	4.0 (1.4 - 9.6)	25.6 (14.5 - 30.0)	6.7 (4.8 - 8.5)	93 (69 - 122)
Lo So Shing	8.3 (8.0 - 9.6)	28.7 (8.6 - 33.9)	3.5 (1.1 - 8.0)	25.5 (15.7 - 30.3)	6.7 (5.4 - 8.0)	94 (81 - 108)
Lower Cheung Sha	8.3 (7.9 - 8.8)	27.6 (10.6 - 32.8)	9.2 (2.0 - 27.7)	26.2 (15.6 - 32.4)	6.8 (5.5 - 8.5)	96 (86 - 105)
Pui O	8.2 (7.9 - 8.7)	27.4 (10.4 - 32.9)	15.7 (3.3 - 40.0)	26.8 (15.3 - 34.0)	6.6 (5.4 - 7.8)	95 (83 - 116)
Silver Mine Bay	8.2 (7.8 - 8.6)	24.8 (11.0 - 31.9)	8.4 (1.4 - 22.0)	26.6 (15.4 - 32.0)	6.5 (5.1 - 8.2)	93 (75 - 112)
Tong Fuk	8.3 (7.9 - 8.7)	27.9 (11.7 - 33.0)	7.0 (1.1 - 20.3)	26.1 (15.5 - 32.5)	6.8 (5.8 - 8.1)	96 (86 - 108)
Upper Cheung Sha	8.3 (7.9 - 8.7)	27.9 (11.4 - 33.6)	8.3 1.1 - 23.1)	26.0 (15.4 - 31.8)	6.9 (5.9 - 8.5)	97 (88 - 109)

1. Practical Salinity Unit ; 2. Nephelometric Turbidity Unit

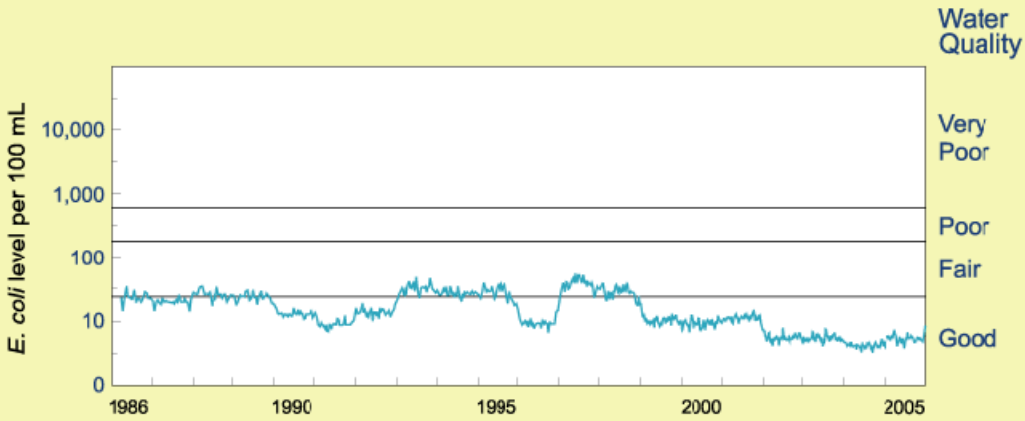
Note: Data presented are arithmetic means; figures in brackets are ranges.

Appendix D - Trends in beach water quality over 20 years Southern District

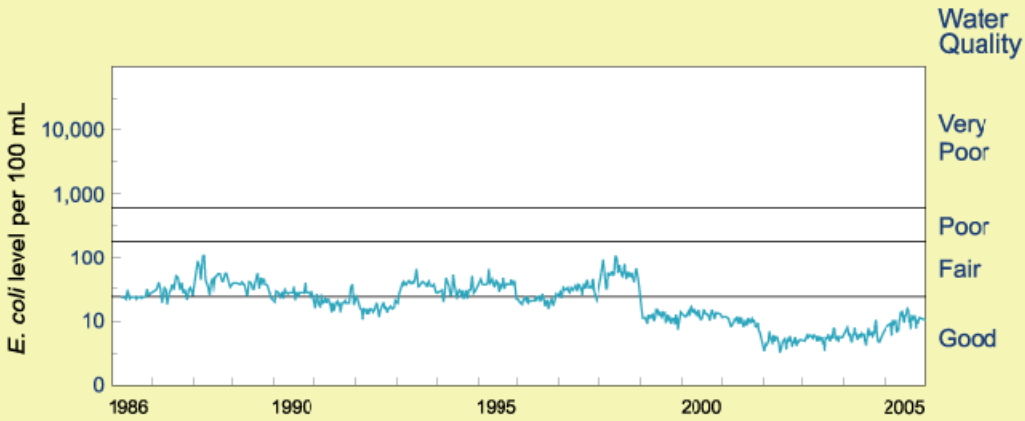




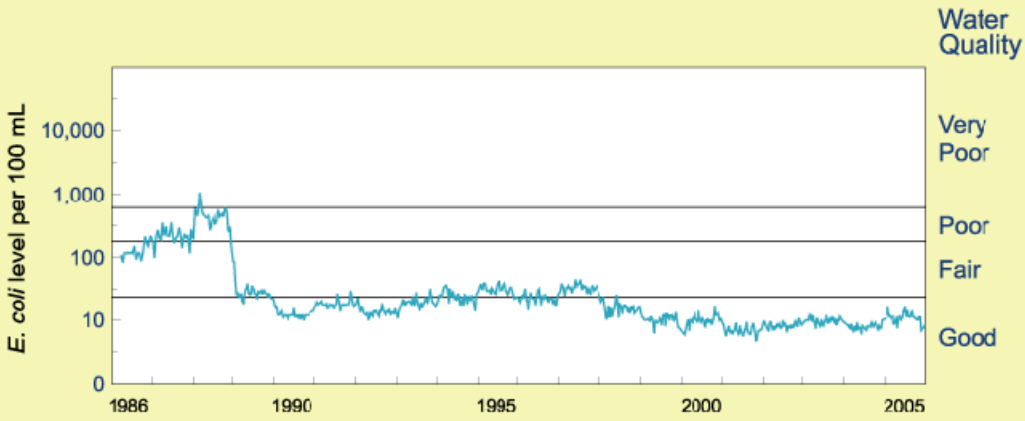
Trends in beach water quality over 20 years - Deep Water Bay Beach



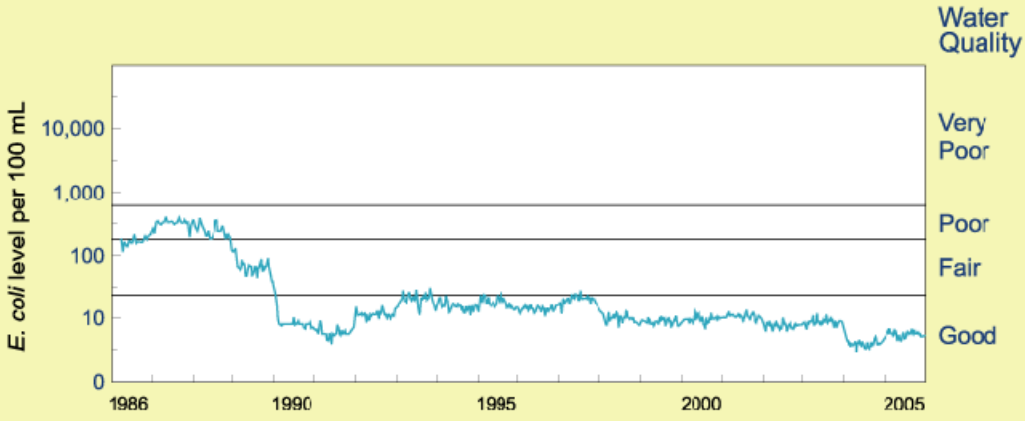
Trends in beach water quality over 20 years - Hairpin Beach



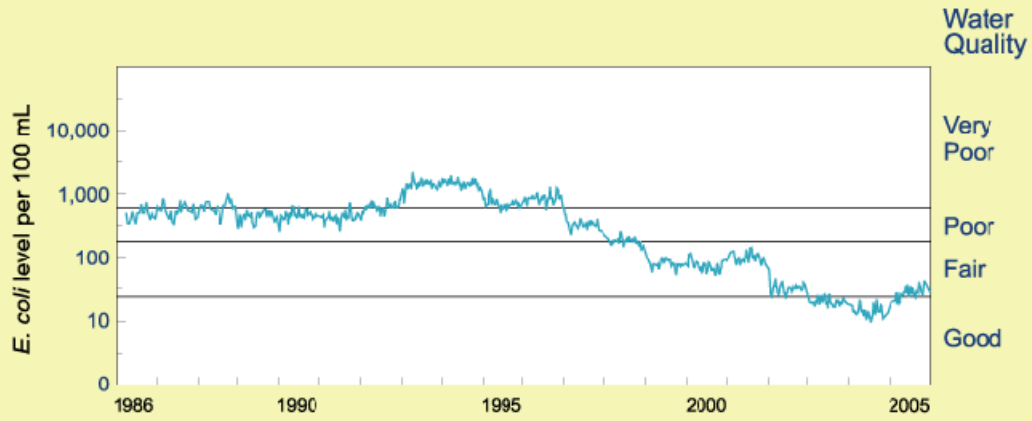
Trends in beach water quality over 20 years - Middle Bay Beach



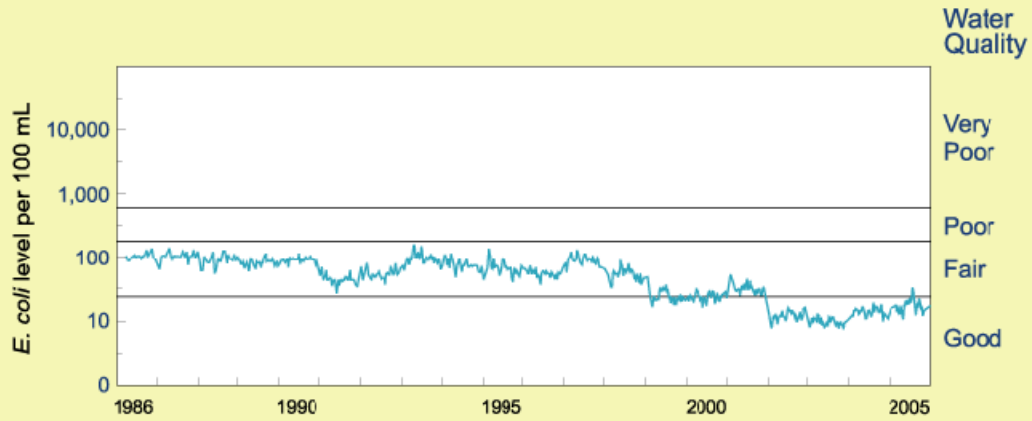
Trends in beach water quality over 20 years - Repulse Bay Beach



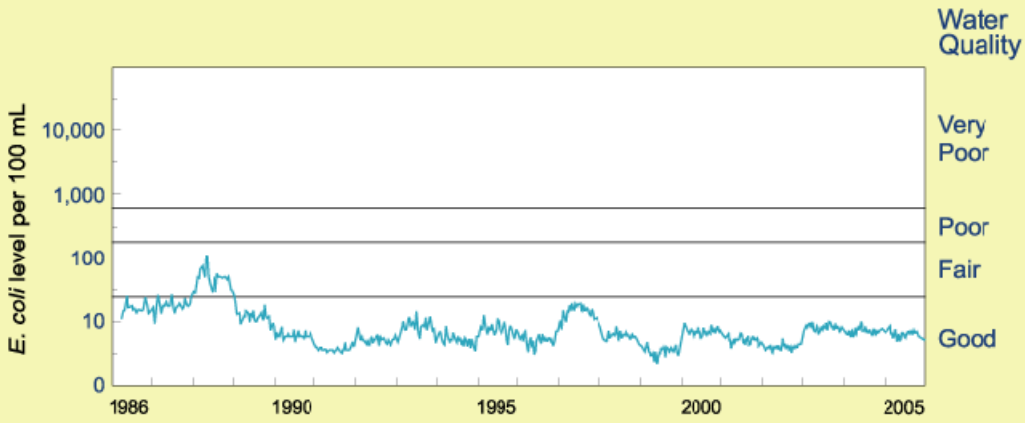
Trends in beach water quality over 20 years - Rocky Bay Beach



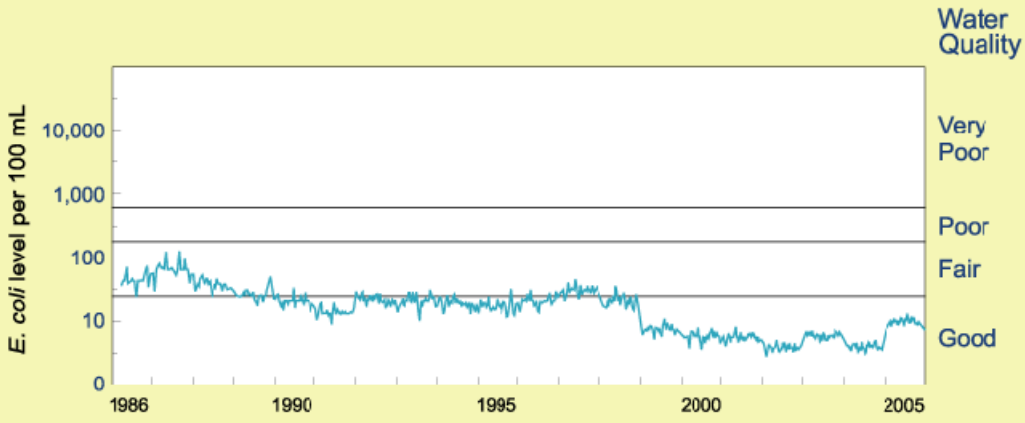
Trends in beach water quality over 20 years - Shek O Beach



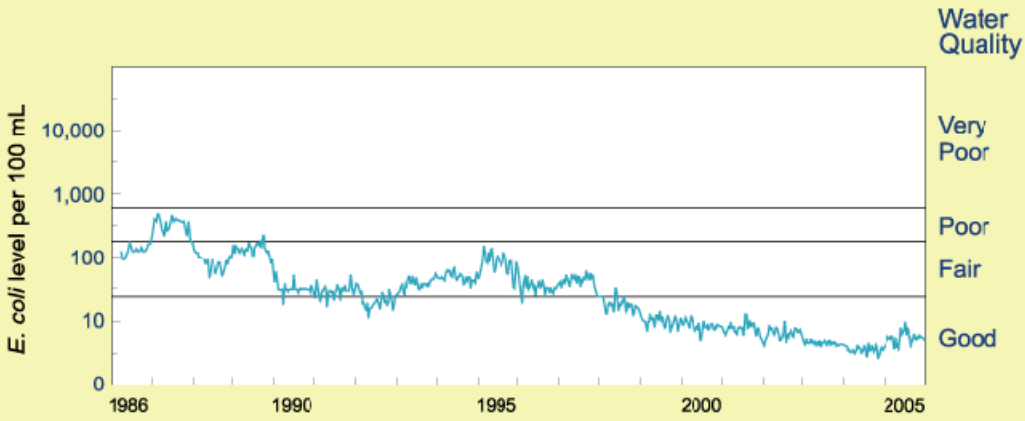
Trends in beach water quality over 20 years - South Bay Beach



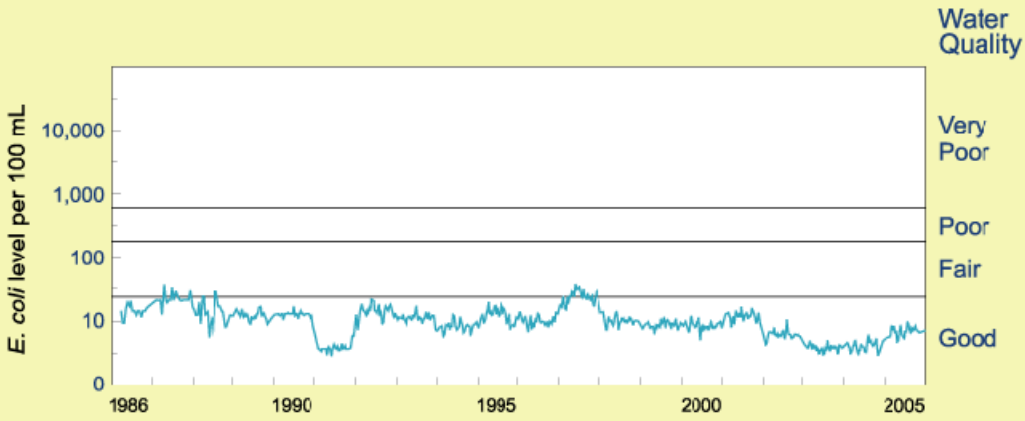
Trends in beach water quality over 20 years - St. Stephen's Beach



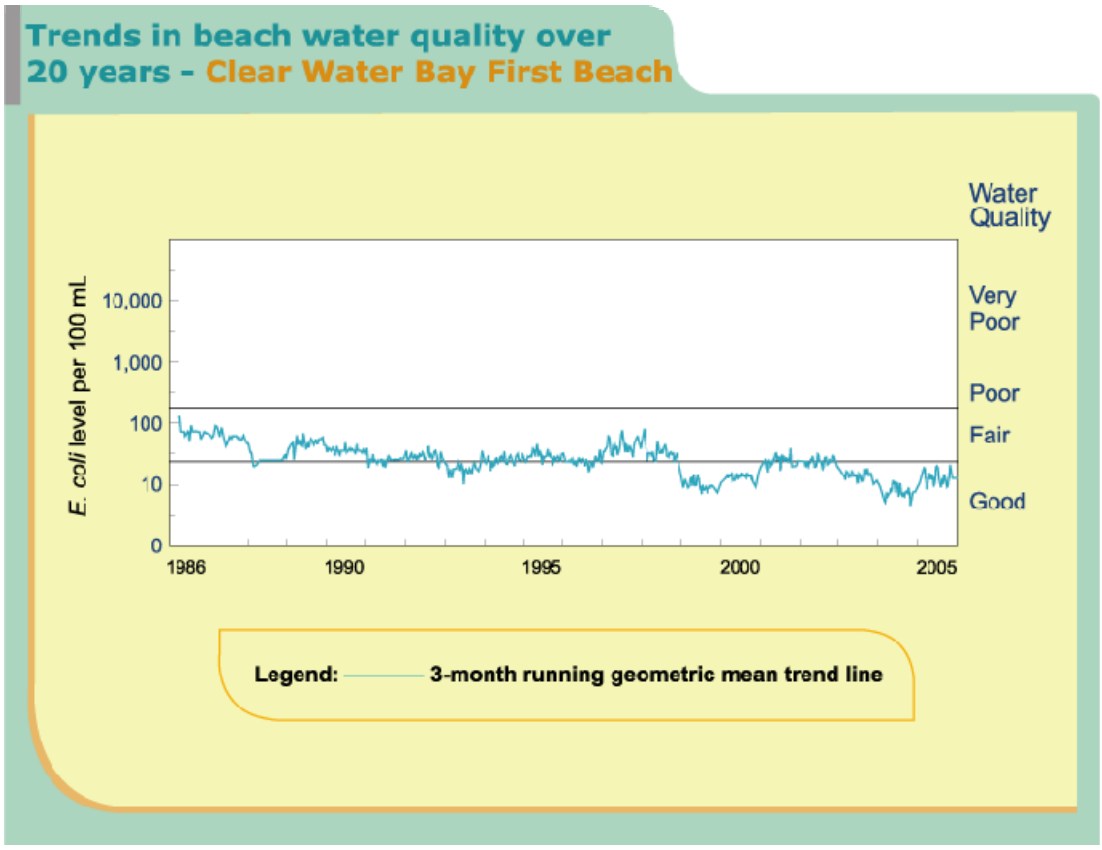
Trends in beach water quality over 20 years - Stanley Main Beach

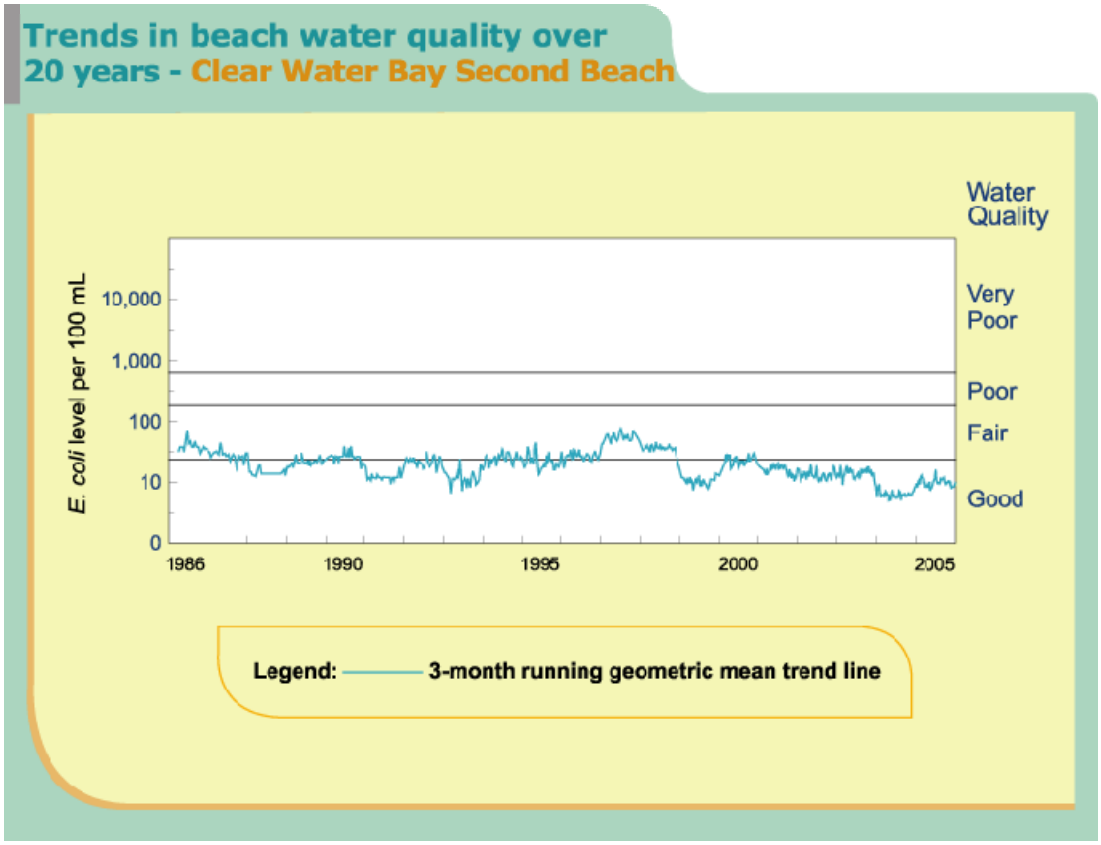


Trends in beach water quality over 20 years - Turtle Cove Beach

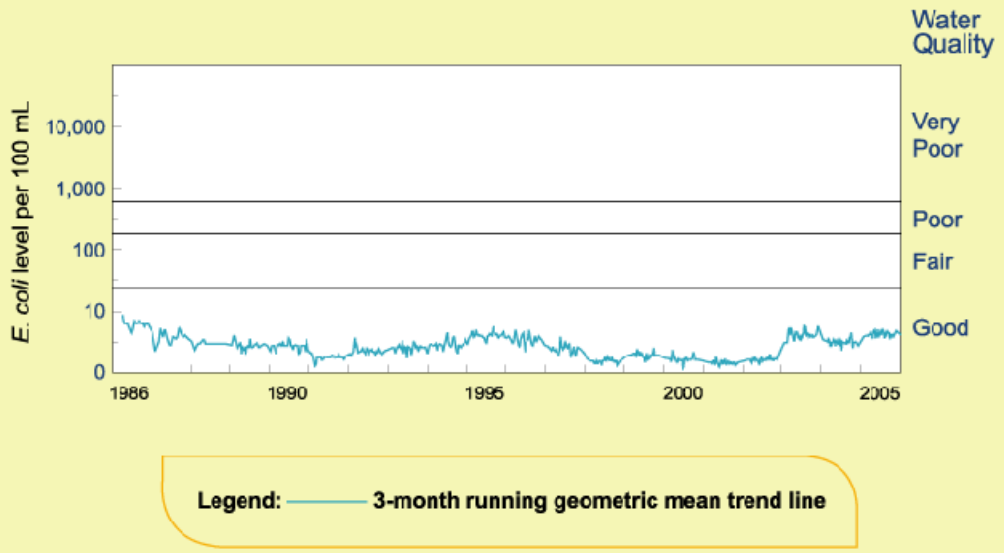


Sai Kung District

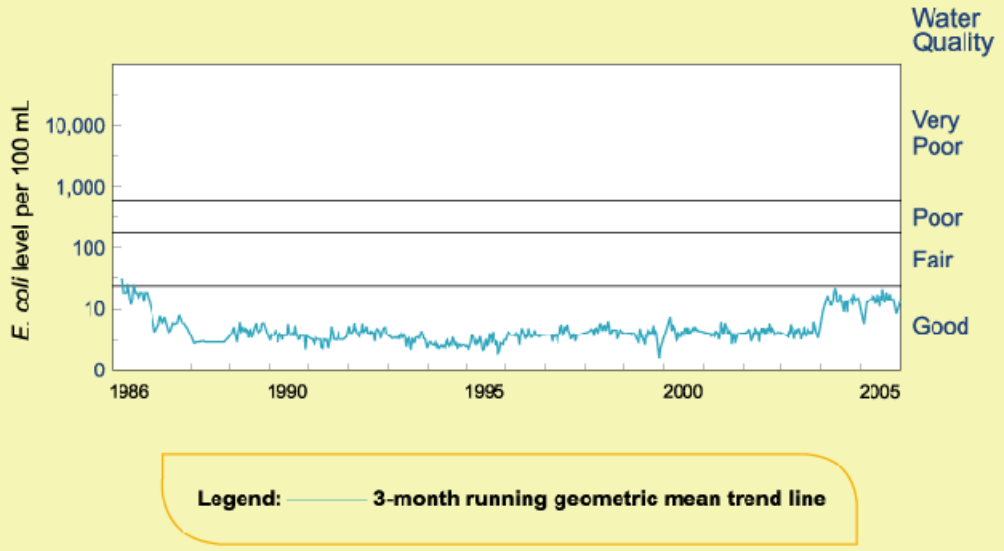




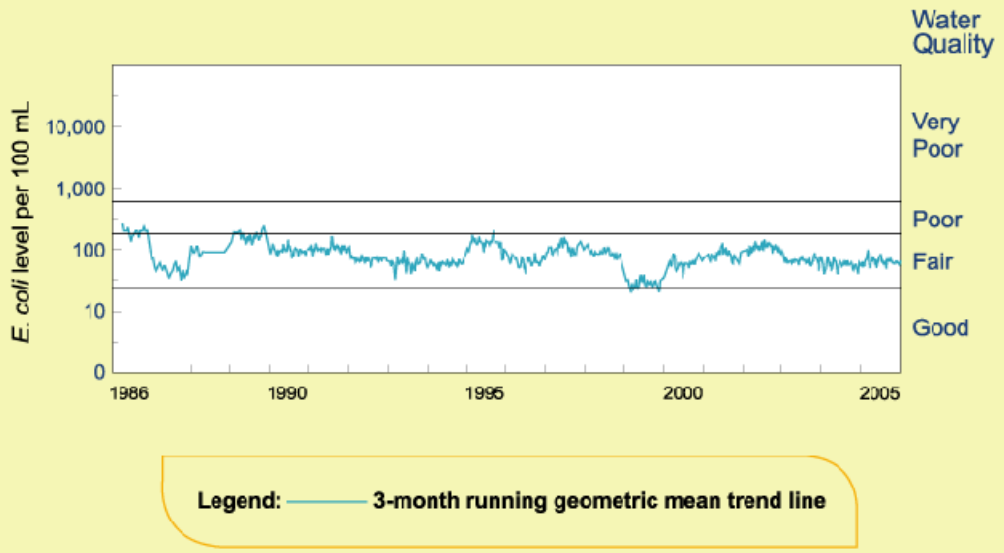
Trends in beach water quality over 20 years - Hap Mun Bay Beach



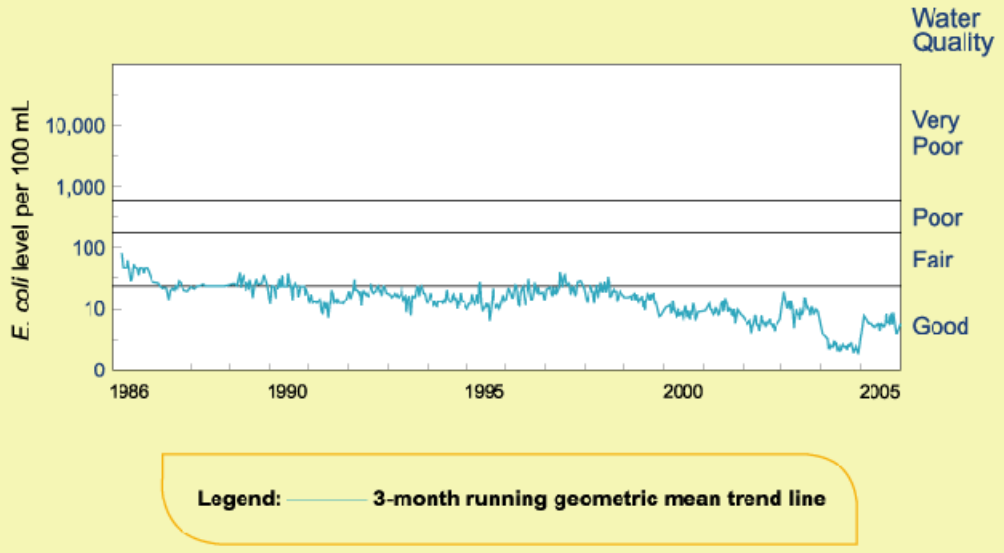
Trends in beach water quality over 20 years - Kiu Tsui Beach



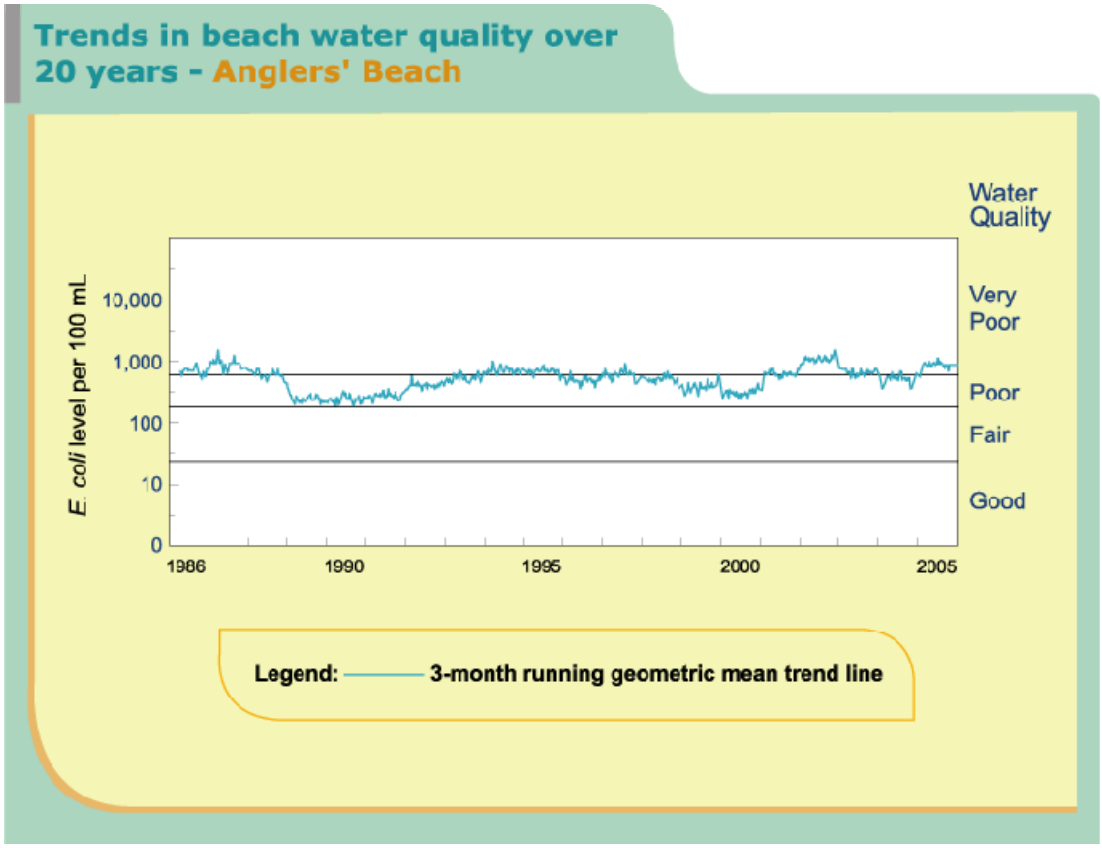
Trends in beach water quality over 20 years - Silverstrand Beach

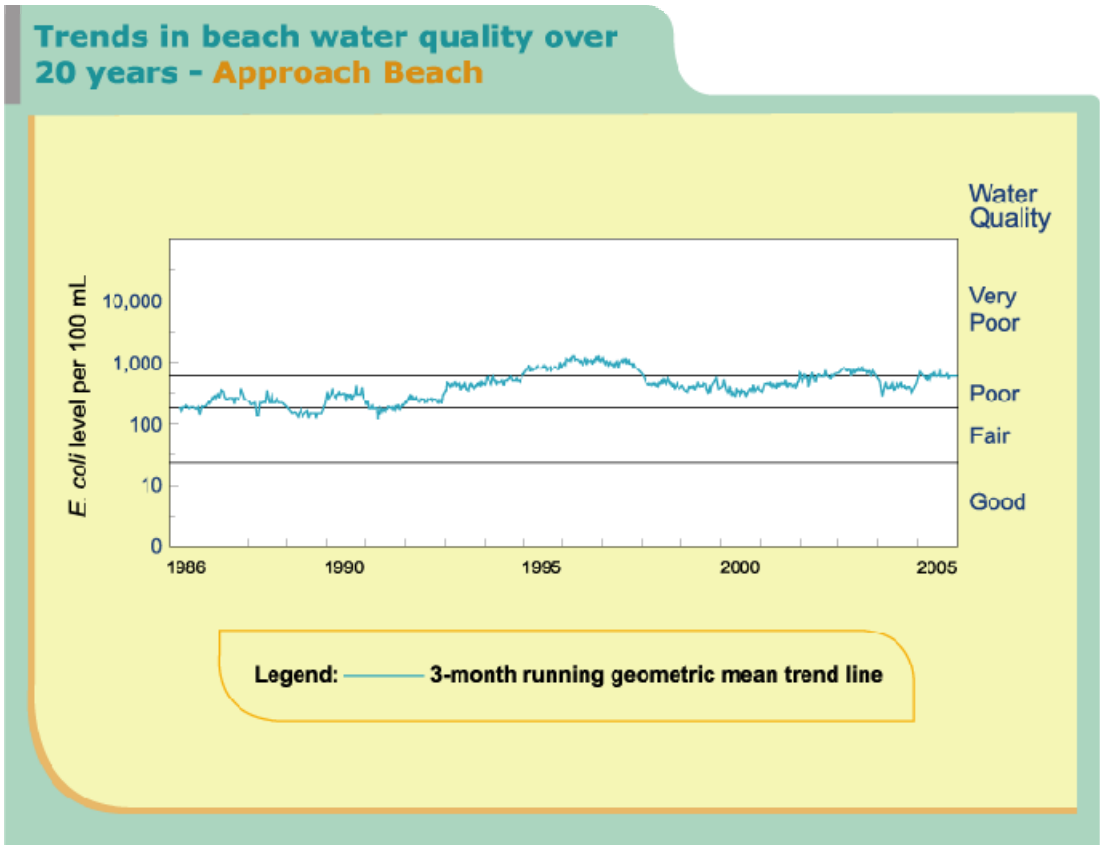


Trends in beach water quality over 20 years - Trio Beach

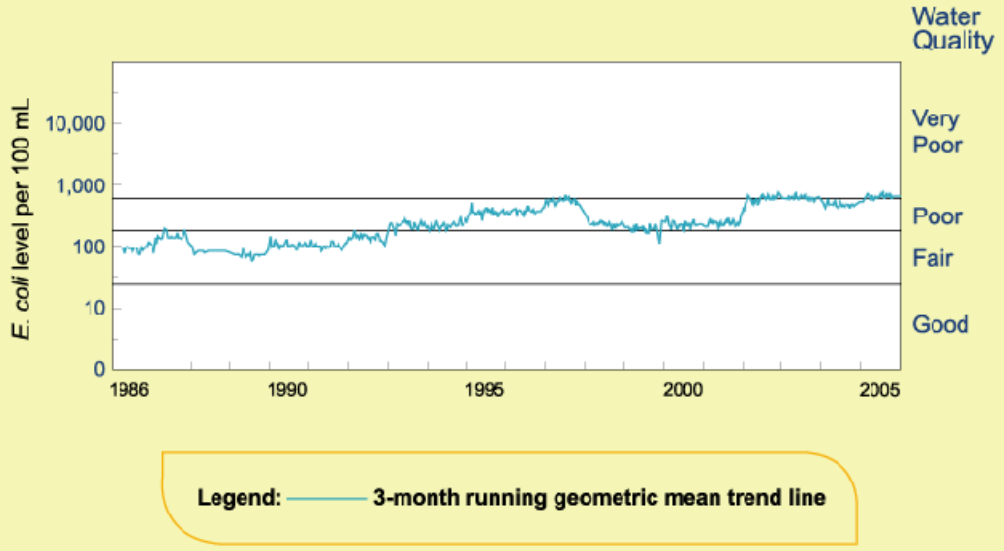


Tsuen Wan District

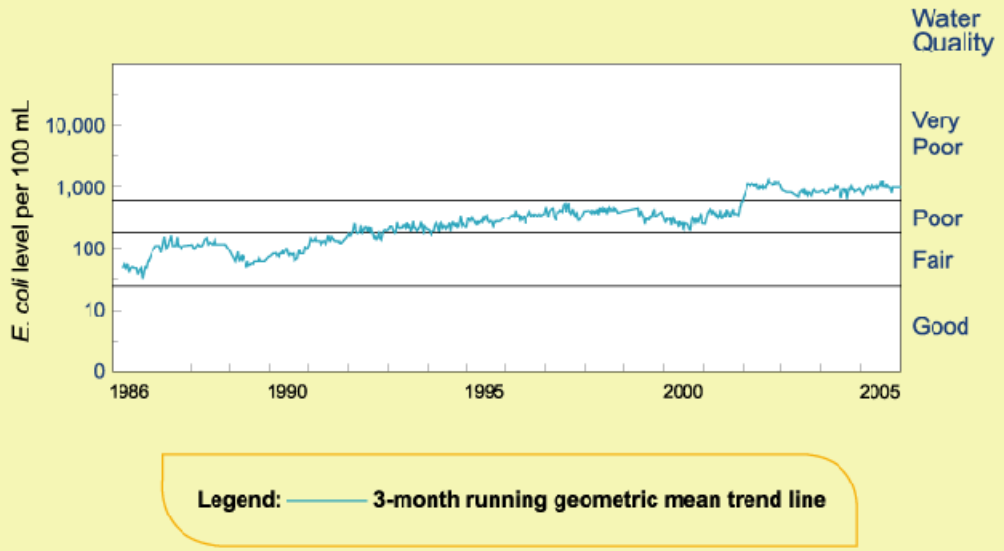




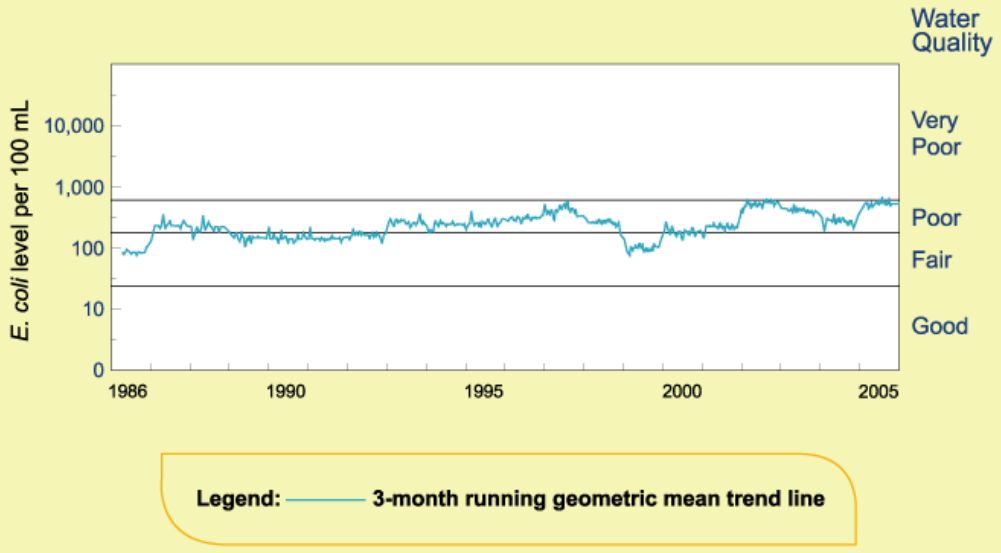
Trends in beach water quality over 20 years - Casam Beach



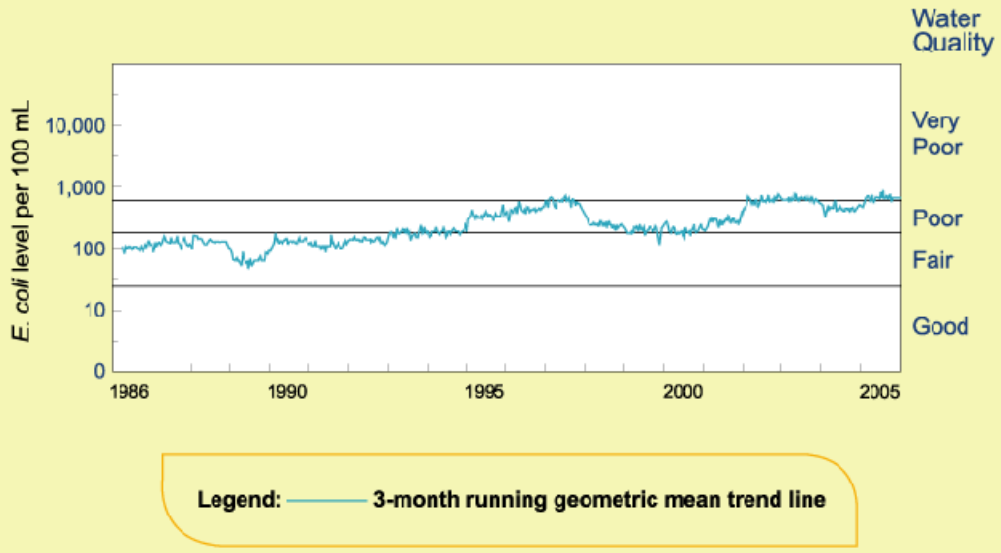
Trends in beach water quality over 20 years - Gemini Beaches



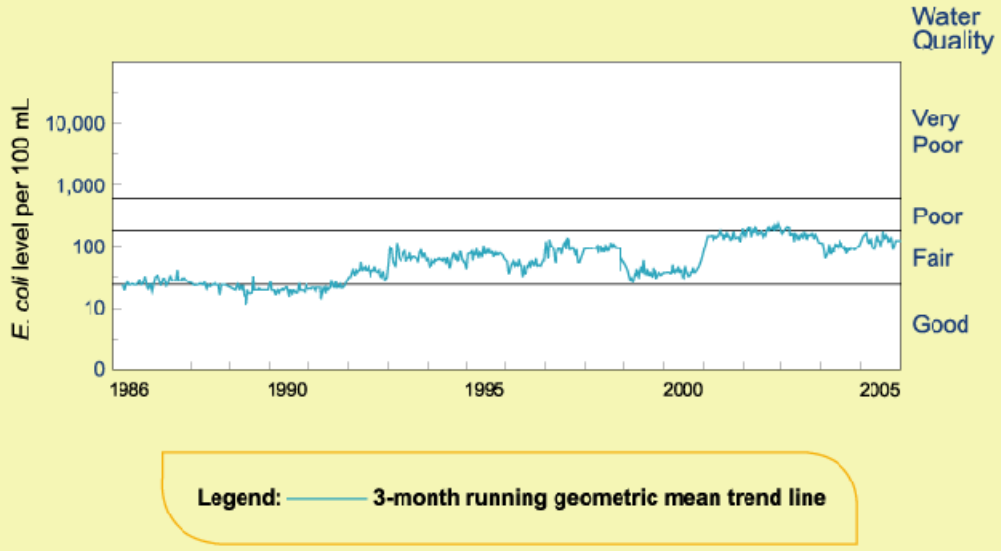
Trends in beach water quality over 20 years - Hoi Mei Wan Beach



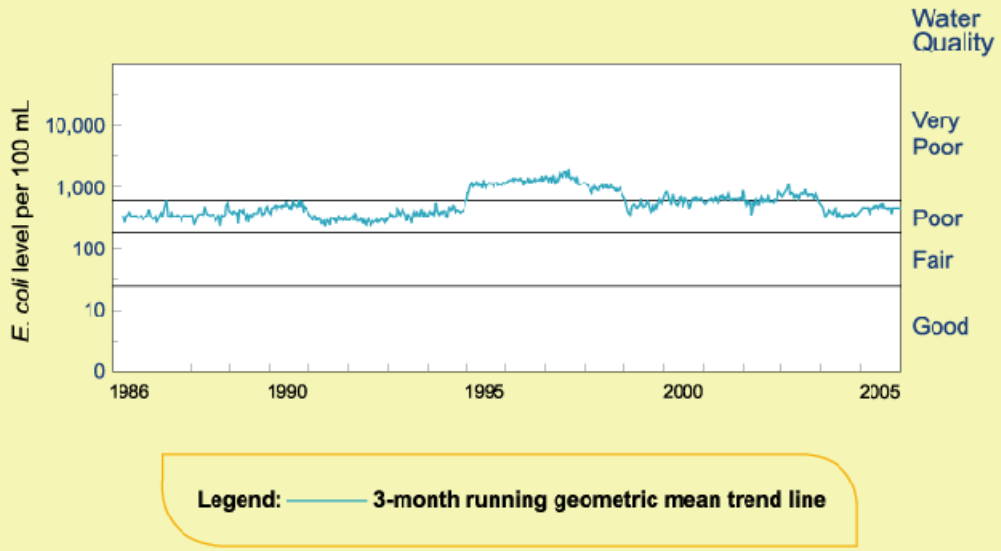
Trends in beach water quality over 20 years - Lido Beach



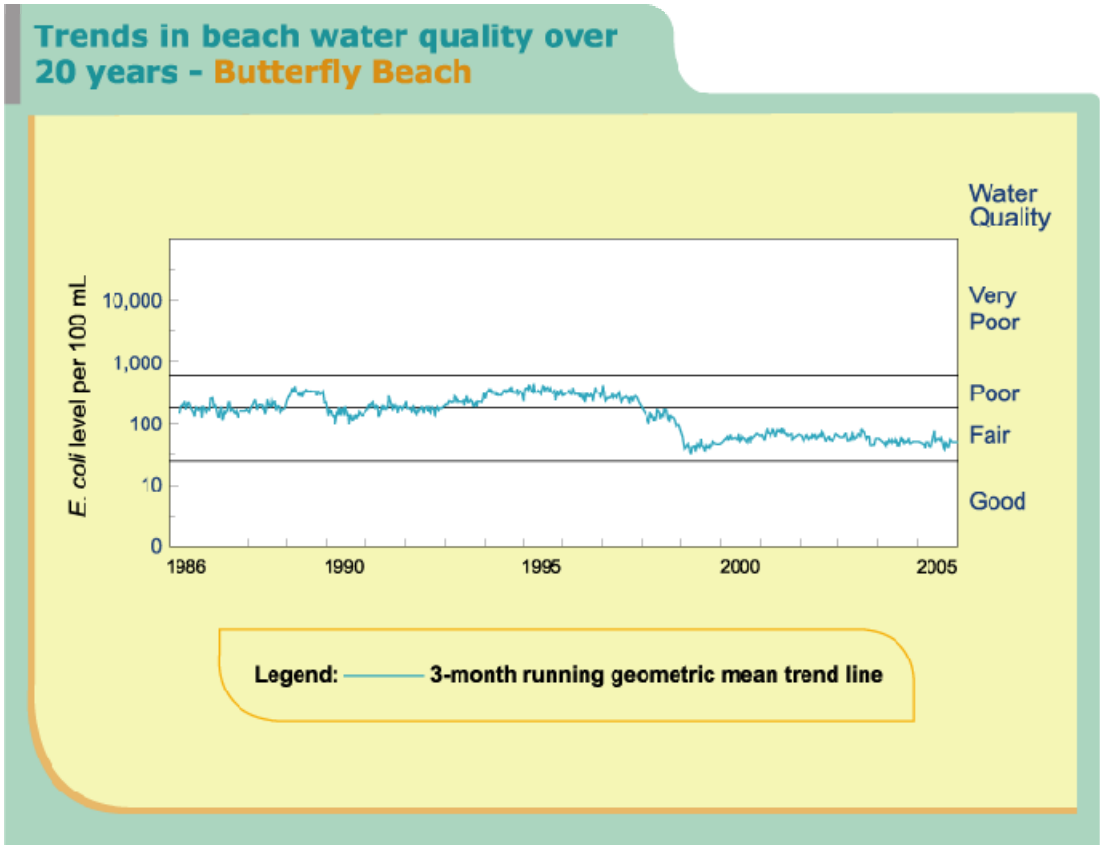
Trends in beach water quality over 20 years - Ma Wan Tung Wan Beach

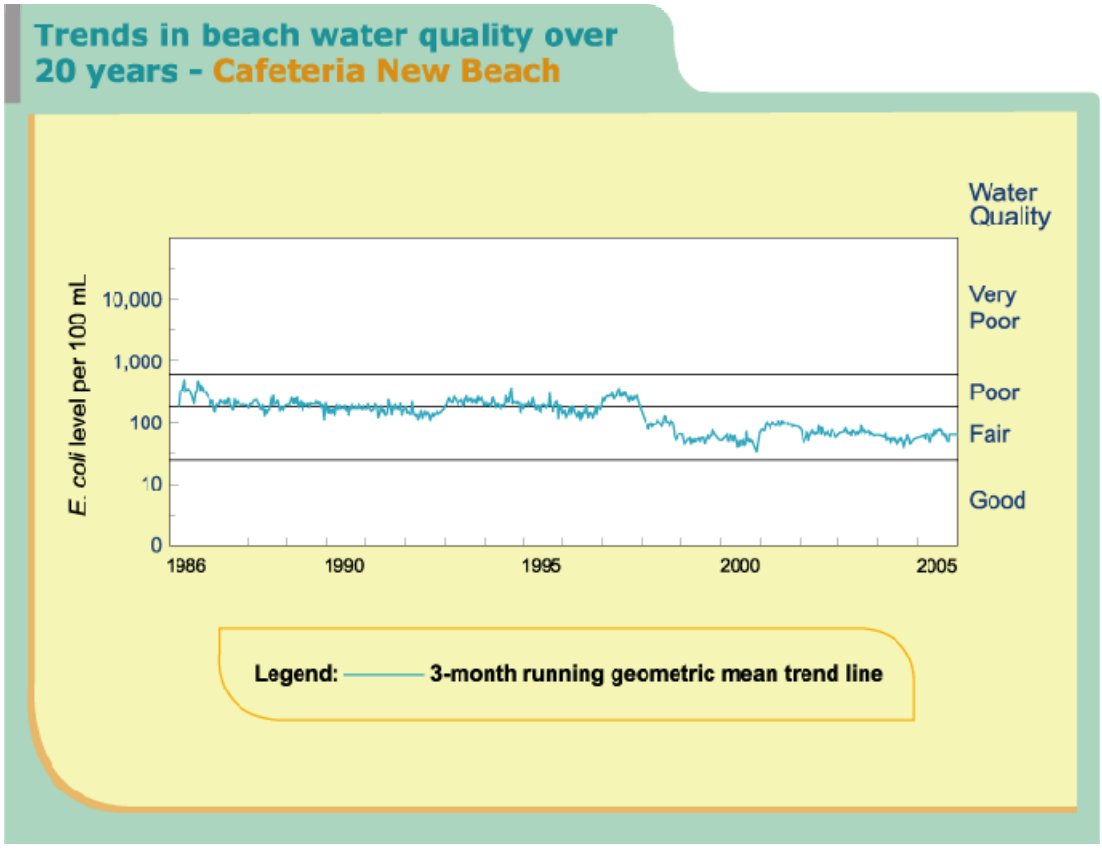


Trends in beach water quality over 20 years - Ting Kau Beach

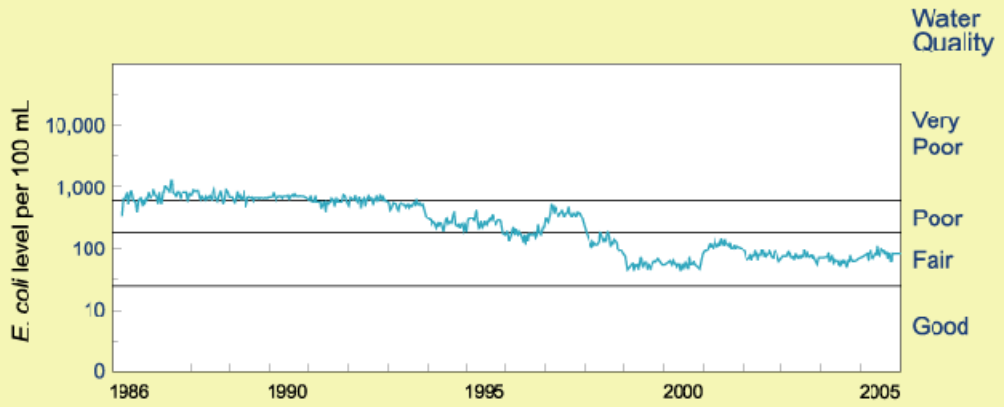


Tuen Mun District

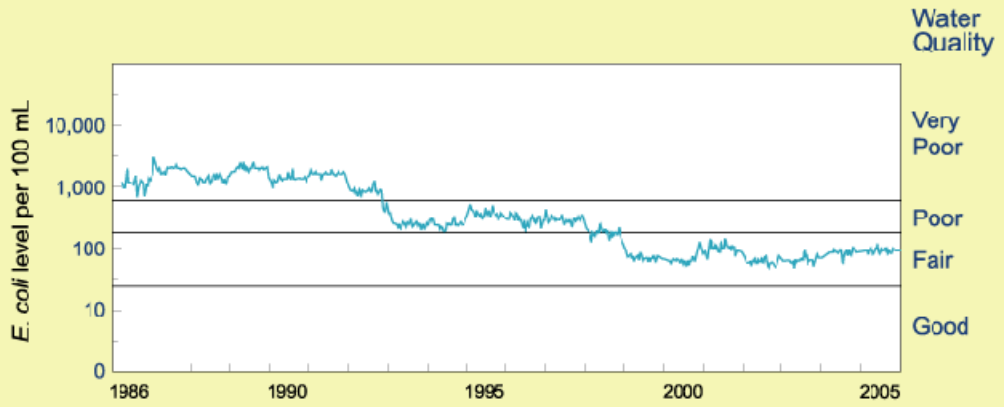




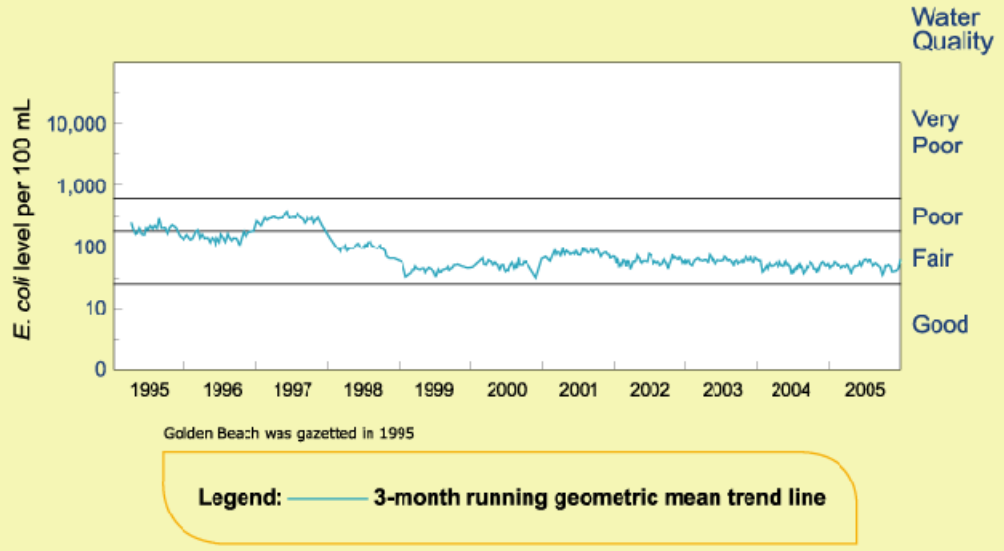
Trends in beach water quality over 20 years - Cafeteria Old Beach



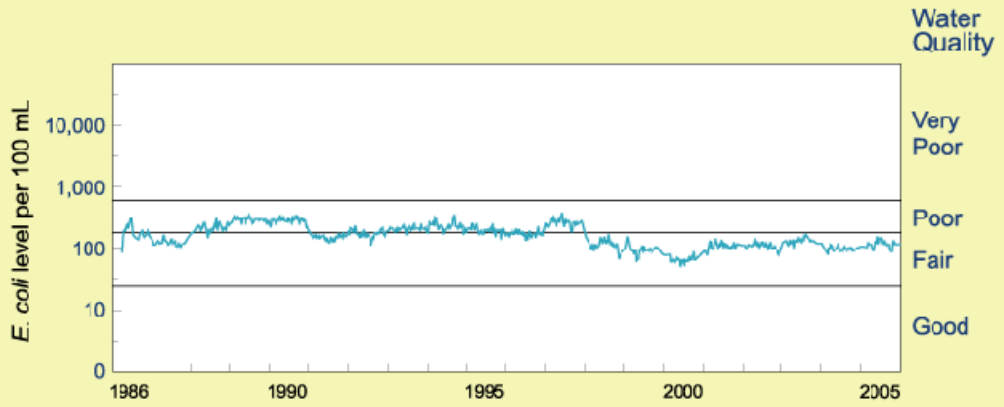
Trends in beach water quality over 20 years - Castle Peak Beach



Trends in beach water quality over 11 years - Golden Beach

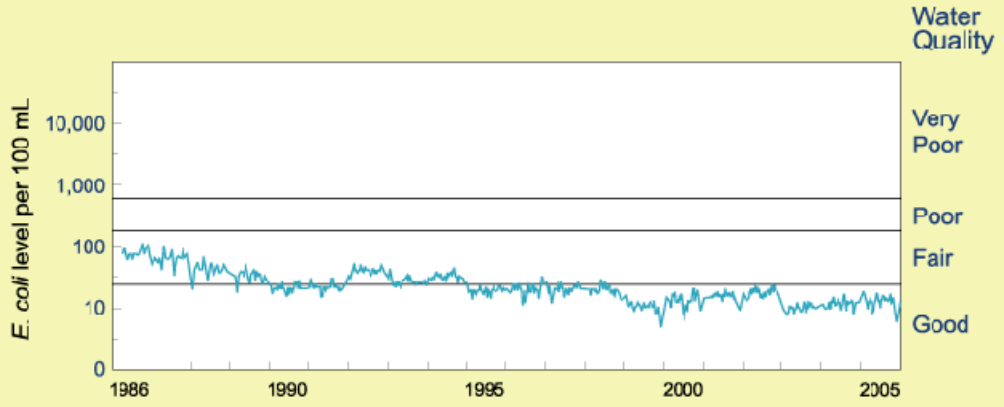


Trends in beach water quality over 20 years - Kadoorie Beach

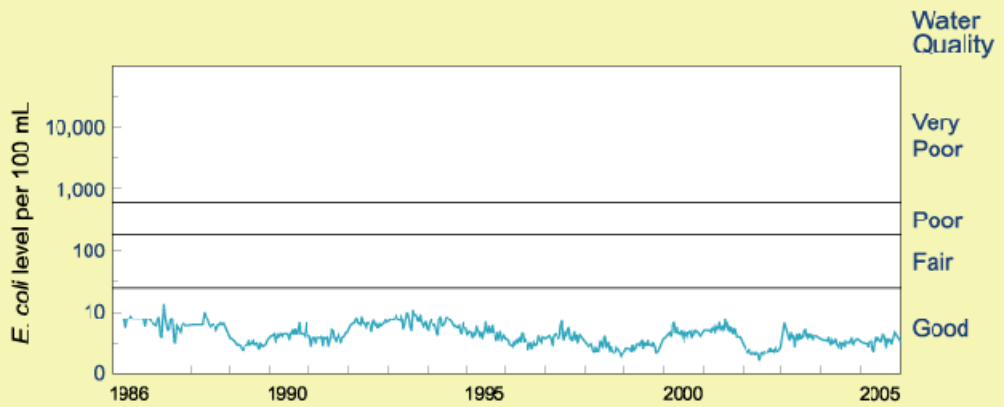


Outlying Islands

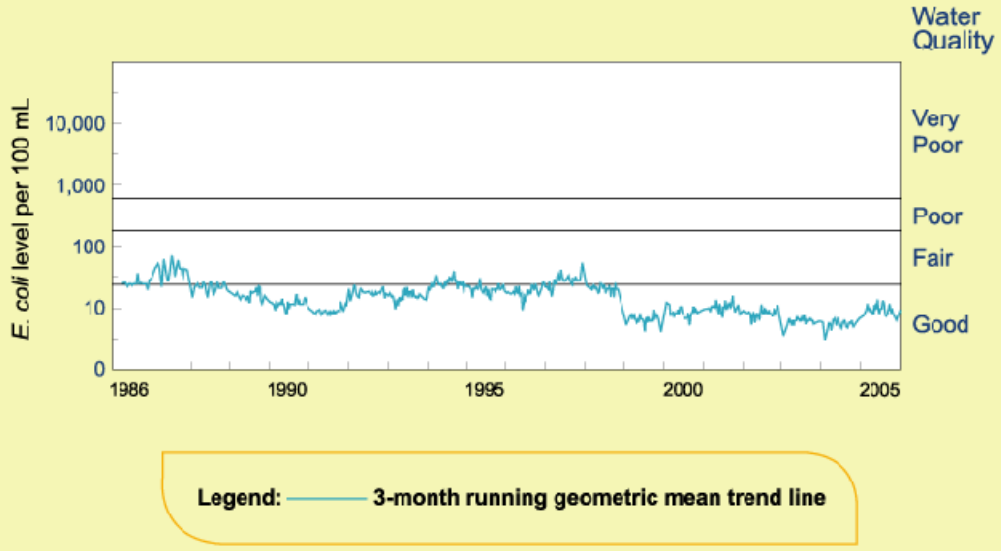
Trends in beach water quality over 20 years - Cheung Chau Tung Wan Beach



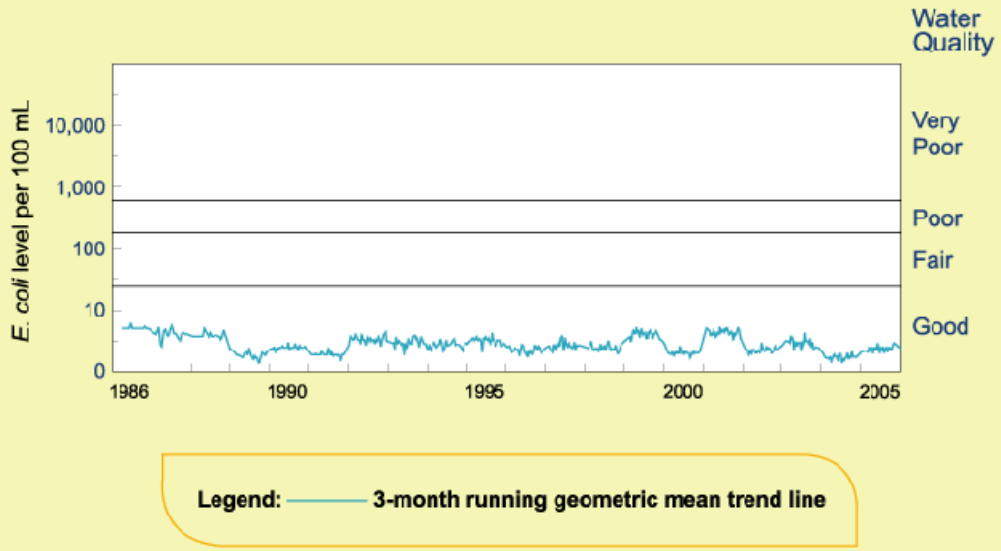
Trends in beach water quality over 20 years - Hung Shing Yeh Beach



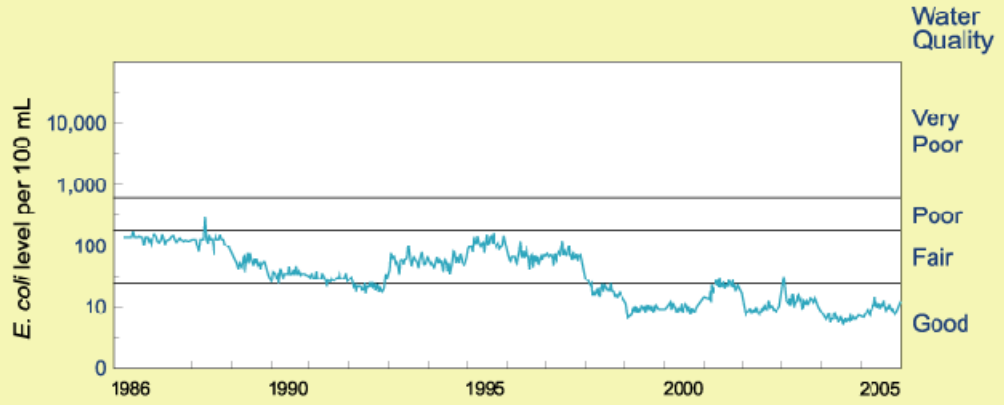
Trends in beach water quality over 20 years - Kwun Yam Beach



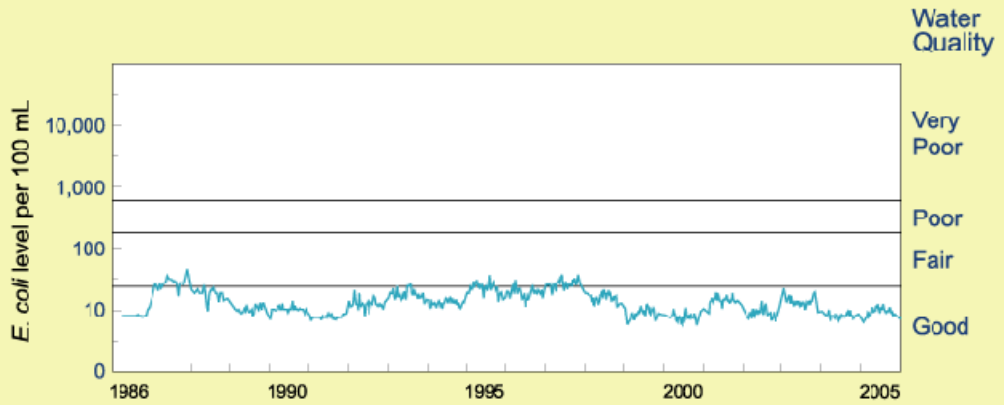
Trends in beach water quality over 20 years - Lo So Shing Beach



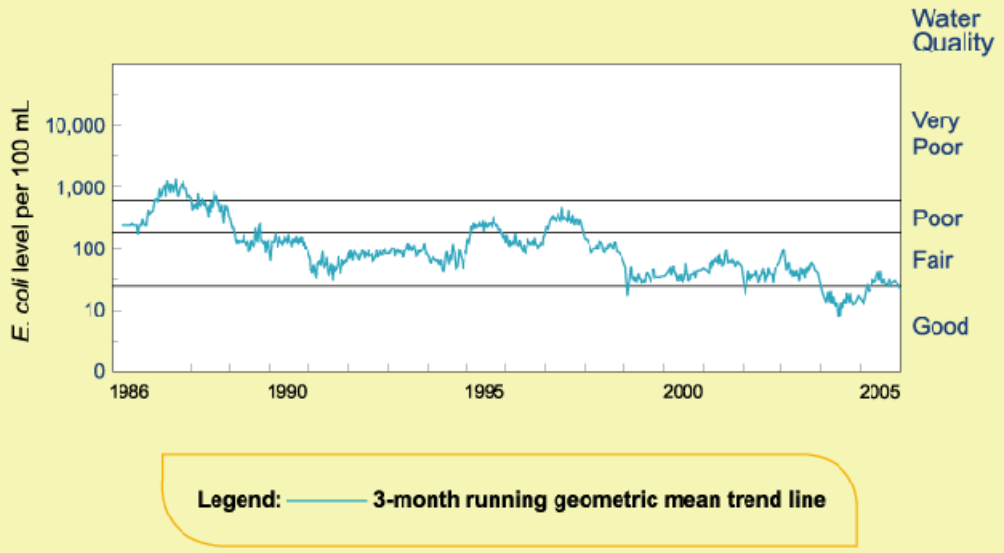
Trends in beach water quality over 20 years - Lower Cheung Sha Beach



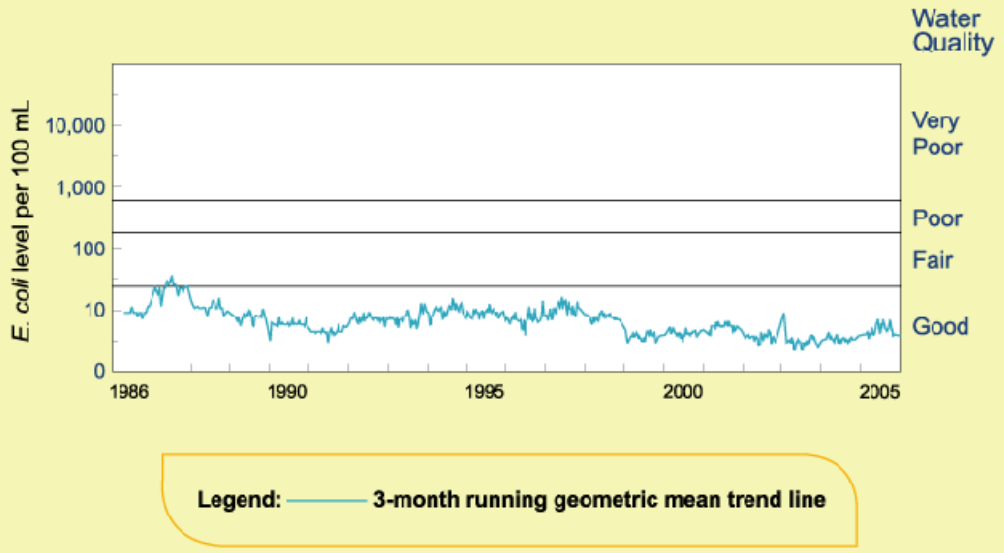
Trends in beach water quality over 20 years - Pui O Beach



Trends in beach water quality over 20 years - Silver Mine Bay Beach



Trends in beach water quality over 20 years - Tong Fuk Beach



Trends in beach water quality over 20 years - Upper Cheung Sha Beach