

**For discussion**  
**26 March 2013**

**Legislative Council Panel on Development**

**Quality of Dongjiang Water and  
Water Quality Monitoring by the Water Supplies Department**

**PURPOSE**

This paper briefs members on the quality of Dongjiang (DJ) water and water quality monitoring by the Water Supplies Department (WSD).

**BACKGROUND**

2. Hong Kong does not have any natural lake, river or rich underground water resources. It also lacks reliable and evenly distributed rainfall. Therefore, it is a formidable challenge to develop a reliable and adequate source of water supply that can keep pace with the continual development of this city. Since the mid-19th century, Hong Kong has started to build reservoirs to store rainwater for use of its people. At the end of the 1950s, Hong Kong started using seawater for flushing purpose to reduce potable water consumption. Since the 1960s, Hong Kong began to import raw water from Guangdong Province to meet the growing demand. At present, rainwater collected locally can only provide 20% to 30% of the water supply in Hong Kong. The remaining 70% to 80% has to be imported from Dongjiang of Guangdong (GD) Province. Therefore, DJ water is one of the main sources of water for Hong Kong.

**QUALITY OF DONGJIANG WATER**

**Dongjiang River Basin**

3. The DJ is one of the three major river systems in the Pearl River Basin. Its sources are located at the Xunwu (尋烏), Anyuan (安遠) and Dingnan (定南) Counties near the northeastern frontier of GD Province. After convergence in Heheba (合河壩) at Longchuan County (龍川縣) of GD Province, the combined river is called the DJ. The total area of the DJ River Basin is 35,340 km<sup>2</sup> with 31,840 km<sup>2</sup> within GD Province, representing 90% of the total river basin area. The protection of water resources for this large area coverage presents a big

challenge to relevant authorities. For comparison, the area of the local water gathering ground in Hong Kong is only 0.85% of that of the DJ. A location plan of the DJ and related counties and cities is shown at **Annex I**.

4. According to the “Water Resources Distribution Plan in the Dongjiang River Basin of Guangdong Province” (廣東省東江流域水資源分配方案)<sup>1</sup>, the long term mean annual flow of the DJ is 32 700 million cubic metre (mcm), of which the usable annual water quantity is about 10 700 mcm and the remaining quantity is to serve navigation, power generation and ecological conservation purposes. The flow rate of the main stream of DJ is huge and the river itself possesses natural self-purification capacity. Thus, trace amount of pollutants will not have impact on the overall quality of DJ water. The current DJ Water Supply Agreement (the Supply Agreement) signed with GD Authorities has adopted an annual supply ceiling of 820 mcm<sup>2</sup> which represents only about 2.5% of the annual flow of the main stream of DJ.

5. There are three large reservoirs namely Xinfengjiang Reservoir (新豐江水庫), Fengshuba Reservoir (楓樹壩水庫), and Baipenzhu Reservoir (白盆珠水庫) at the middle-upper stream of the DJ River Basin with a total storage capacity of 17 060 mcm. The total storage capacity of the three reservoirs is about 74 times of that of Plover Cove Reservoir in Hong Kong.

### **Dongjiang – Shenzhen (Dongshen) Water Supply System**

6. The total length of the main course of DJ is 562 km of which 127 km flows through Jiangxi Province (江西省) and the remaining 435 km through GD Province. The DJ travels about 490 km from the sources before reaching the intake point of DJ water supplied to Hong Kong – the Taiyuan Pumping Station (太園泵站). To protect the water source from contamination when travelling through the more industrialized regions, the Dongshen Water Supply System deliveries DJ water from Taiyuan Pumping Station to Shenzhen Reservoir through the dedicated aqueduct of about 60 km long which was completed in 2003. The DJ water is then conveyed through pipelines to the Shenzhen Special Economic Region and crossing the border to the Muk Wu Pumping Station (木湖抽水站) of Hong Kong.

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<sup>1</sup> Cities in Guangdong drawing water from DJ include Heyuan (河源), Meizhou (梅州), Guangzhou (廣州), Dongguan (東莞), Huizhou (惠州), Shenzhen (深圳) and Hong Kong.

<sup>2</sup> The ultimate annual supply quantity of DJ water as specified in the Supply Agreement is 1 100mcm.

## Safeguard of DJ Water Quality

7. Under the Supply Agreement, the quality of the DJ water supplied to Hong Kong should conform to the national standard set out for Type II waters (applicable for the abstraction for human consumption in first class protection area) in the "Environmental Quality Standards for Surface Water GB3838-2002" 《地表水環境質量標準》. This is the highest standard applicable for the abstraction for human consumption.

8. The GD Authorities have attached great importance to the protection of DJ water and have implemented a series of measures on prevention and control of water pollution, including enactment of related laws and instructions, and implementation of a series of works so as to ensure that the quality of DJ water supplied to Hong Kong complies with the Supply Agreement.

### *Enactment of laws and instructions*

- (a) 《廣東省東江流域新豐江楓樹壩白盆珠水庫庫區水資源保護辦法》sets out measures to enhance the protection of the water quality of reservoir areas and the respective reservoir protection zones, including the requirement to seek advice from the management authority of the DJ River Basin for works projects within the reservoir protection zones and prohibition of polluting activities such as quarrying, mining and extensive poultrying;
- (b) 《廣東省東江水系水質保護條例》serves the main objectives of enhancing the protection of water quality in the DJ River Basin, preventing and controlling water pollution, and safeguarding water supply through the measures such as establishment of water quality protection targets, implementation of unified monitoring and control for water pollution preventive works, construction of sewage treatment plants in major cities and restriction of polluted discharge;
- (c) The GD Authorities follow the three red lines management<sup>3</sup> under the

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<sup>3</sup> The three red lines management under the 《國務院關於實行最嚴格水資源管理制度的意見》are : (1) the red line management to enhance the control on total water consumption (加強水資源開發利用控制紅線管理) ; (2) the red line management to control on water usage efficiency (加強用水效率控制紅線管理) ; and (3) the red line management to enhance the control on pollution in water function area (加強水功能區限制納污紅線管理).

《國務院關於實行最嚴格水資源管理制度的意見》 to implement the most stringent water resources management system. Among these, the “Red line management to enhance the control on pollution in water function area” (加強水功能區限制納污紅線管理) is to implement stringent monitoring and management in water function area, so as to enhance the protection of drinking water source, as well as take forward the protection and restoration of aquatic ecosystems; and

*Implementation of works*

- (d) The GD Authorities have carried out a series of works to enhance the protection of DJ water, including relocation of the intake point of DJ water supply to Hong Kong for better water quality; commissioning of the bio-nitrification plant at Shenzhen Reservoir; delivery of DJ water directly from the Taiyuan Pumping Station to Shenzhen Reservoir through a dedicated aqueduct; various sewage diversion and interception projects; setting up of a CCTV surveillance system at Shenzhen Reservoir to monitor the surrounding environment and key facilities for better control of incidents affecting water quality. Furthermore, the GD Authorities is undertaking the construction works of the “DJ Water Quantity and Quality Monitoring and Control System” to improve facilities for monitoring quantity and quality of DJ water such as on-line water quality monitoring. The GD Authorities has also started the study for the “Remote Sensing of Water Quality Monitoring Technology Project” with a view to exploring the feasibility of adopting such new technology for systematic monitoring and macro-management of the DJ water quality.

9. Following the implementation of the above water pollution prevention and control measures by the GD Authorities, the quality of DJ water supplied to Hong Kong has shown significant improvement. This has been reflected in the water quality monitoring results of DJ water at Muk Wu Pumping Station in Hong Kong. Details of the monitoring results of DJ water delivered to Hong Kong are given in paragraph 13 below.

## **WATER QUALITY MONITORING BY THE WATER SUPPLIES DEPARTMENT**

10. The WSD has implemented a Water Safety Plan to monitor the water quality against international standards. Apart from water quality monitoring, a designated institutional mechanism has also been set up for the GD and HK sides to meet on a regular basis to discuss issues relating to DJ water. Furthermore, a notification mechanism has been established between the GD and Hong Kong sides to cater for any major contamination incident affecting the quality of DJ water.

### **Water Quality Monitoring of DJ Water**

11. At the Muk Wu Pumping Station, quality of DJ water delivered to Hong Kong is monitored 24-hours round the clock through on-line water quality monitoring systems for real-time measurement of various parameters including ammoniacal nitrogen, dissolved oxygen, pH, conductivity, salinity, chlorophyll, turbidity etc. Samples of DJ water are also taken on a regular basis for physical, chemical, bacteriological and radiological analyses, etc.

12. Raw water including DJ water and local yields in the reservoirs will then be conveyed to WSD's water treatment works for treatment. All water treatment works are equipped with on-line water quality monitoring systems to gauge the quality of raw water. Samples of raw water are taken on a regular basis for physical, chemical, bacteriological and radiological analyses, etc. On detection of any abnormality in the DJ water quality at the Muk Wu Pumping Station or water treatment works, the WSD will step up the monitoring, adjust the water treatment processes and liaise with the GD Authorities to ensure the quality and safety of water supply.

13. According to the WSD's routine water quality monitoring results, the quality of DJ water delivered to Hong Kong has remained stable and of good quality. All monitoring parameters comply with the national standard set out for Type II waters in the Environmental Quality Standards for Surface Water GB3838-2002. For instance, the average levels of the 5-day biochemical oxygen demand, total phosphorus, manganese and nitrate for 2011-12 have decreased significantly by 87.2%, 83%, 72.7% and 47.4% respectively when compared to the corresponding levels for 2002-03. During the same period, the dissolved oxygen

level in the DJ water supplied to Hong Kong has increased by about 51% attesting to the effectiveness of various water quality protection measures and projects.

### **Institutional Mechanism**

14. The GD and HK sides maintain close liaison on various issue relating to DJ water supply to Hong Kong through an established institutional mechanism.

- (a) The GD/HK Water Supply Business Meeting (粵港供水工作會議) is convened at the time when a new DJ Water Supply Agreement is signed between the GD and HK sides. The GD's delegation led by the Director of Guangdong Water Resources Department and the HK's delegation led by the Secretary for Development will discuss various issues relating to DJ water supply including water resources protection and water quality monitoring;
- (b) The HK/GD Water Supply Operation and Management Technical Cooperation Sub-group Meeting (粵港供水運行管理技術合作小組會議) is convened twice each year to examine water quality monitoring work, discuss, follow up and take forward measures for reducing pollution of DJ at sources and its implementation apart from other operation and management issues; and
- (c) The Special Panel on the Protection of DJ Water Quality (東江水質保護專題小組) under the Expert Group (專家小組) of the HK/GD Joint Working Group on Sustainable Development and Environmental Protection (粵港持續發展與環保合作小組) is convened once a year to advise on DJ water quality and discuss the strategies, the plans and their effectiveness.

### **Notification Mechanism**

15. In the event of any major contamination incident affecting the quality of DJ water delivered to Hong Kong, designated liaison officers of the Department of Environmental Protection of GD Province (for contamination incidents relating to the Dongjiang river or water body) or the Yue Gang Water Supply Co. Ltd.<sup>4</sup> (for

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<sup>4</sup> Yue Gang Water Supply Co. Ltd. is the representative of Water Supply Engineering and Administration Bureau (供水工程管理總局) of the Department of Water Resources (水利廳) to operate the Dongshen Water Supply System.

contamination incidents occurring within the Dongshen Water Supply Scheme) will immediately notify the designated liaison officers of the WSD by phone and subsequently supplement with detailed information. If necessary, the WSD will cooperate and coordinate with the parties concerned, and take appropriate control measures and corresponding actions so as to ensure the safety of water quality in Hong Kong. Major control measures include:

- (a) immediately stepping up monitoring of the quality of DJ water at Muk Wu Pumping Station;
- (b) when necessary reducing or suspending the supply of DJ water to Hong Kong depending on the actual water quality condition;
- (c) discharging all incoming DJ water at Muk Wu Pumping Station if necessary;
- (d) switching the raw water for water treatment works receiving DJ water to local water sources; and
- (e) collecting more detailed information from the GD Authorities so as to formulate further actions required.

### **Water Quality Monitoring of Drinking Water**

16. All raw water including DJ water undergoes rigorous treatment processes and disinfection at the water treatment works in Hong Kong to ensure that the drinking water is clean, wholesome and pathogen-free before supplying to consumers for protection of public health.

17. The Water Safety Plan implemented by the WSD is based on the preventive risk management and multiple-barrier approach promulgated by the World Health Organization's "Guidelines for Drinking-water Quality". The Plan can assure the quality and safety of water from source, through water treatment processes to distribution system. Water samples are taken by the WSD at various points of the entire supply system for analyses, including physical, chemical, bacteriological and radiological analyses. Every year, over 160,000 water samples are taken from water gathering grounds, DJ water delivered to Hong Kong, impounding reservoirs, water treatment works, service reservoirs and distribution network for testing.

18. The WSD continually develops and adopts advanced state-of-the-art technologies with a view to enhancing the capability of rapid and preventive monitoring to safeguard the quality of water supply. Details of the advanced water quality monitoring technologies adopted by the WSD are given at **Annex II**.

## **CONCLUSION**

19. Both GD and Hong Kong sides have strived to safeguard the quality of DJ water. The WSD's water quality monitoring results have revealed that the quality of DJ water delivered to Hong Kong complies with the relevant national standard.

20. Treated drinking water from water treatment plants is also in full compliance with the requirements stipulated in the latest World Health Organization's "Guidelines for Drinking-water Quality" (WHO 2011) and is safe for consumption.

21. Availability of DJ water and monitoring of its quality are subject matters deserving focused attention as a result of rapid development in the regions of GD Province and the impact of climate change. The GD Authorities and Hong Kong have been achieving good effectiveness on the work done on these subject matters. We will continue to work closely with the GD to meet the challenges in future. If needed, additional resources will be sought to strengthen the work.

**Development Bureau**  
**Water Supplies Department**  
**March 2013**





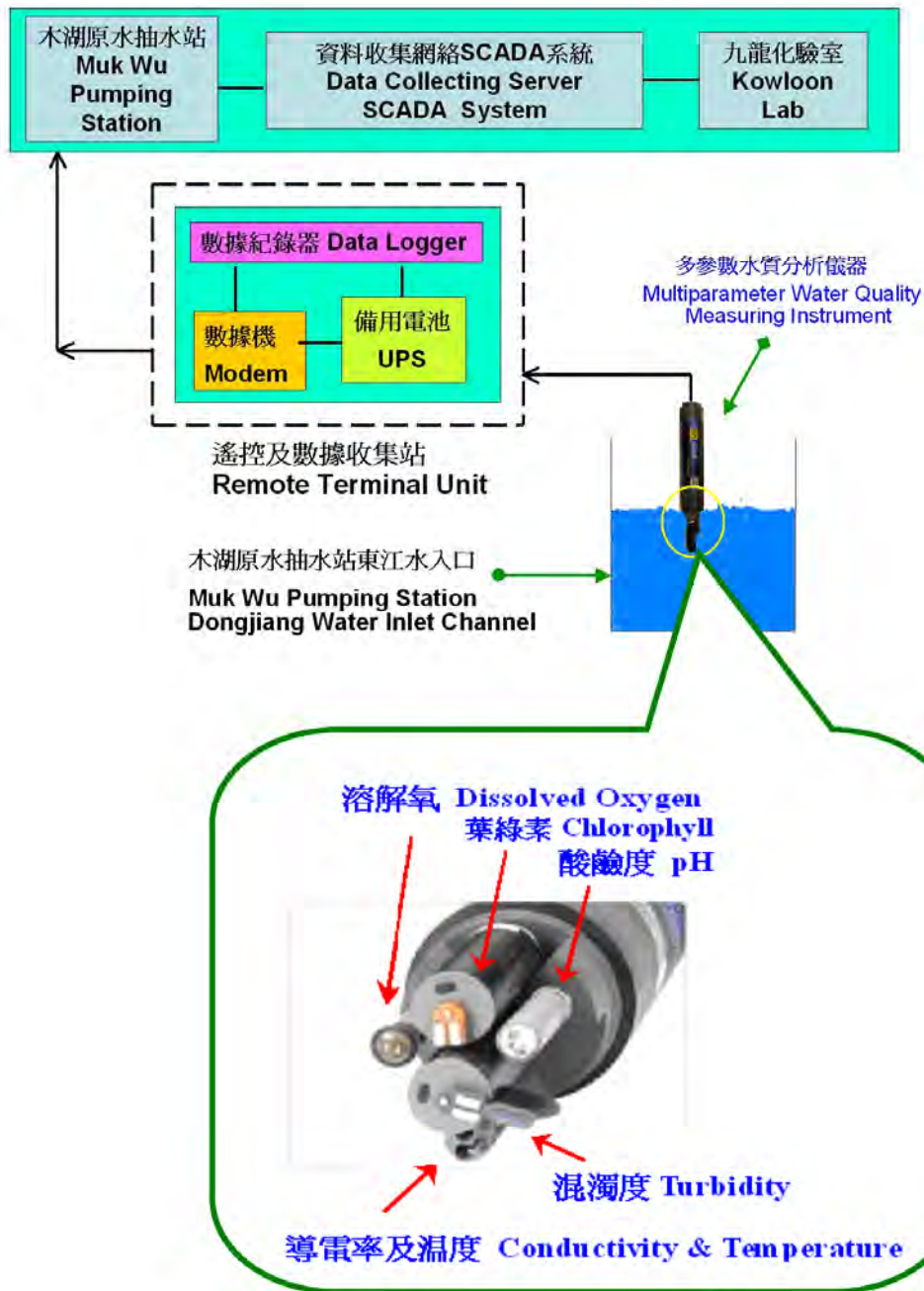
### **Advanced Water Quality Monitoring Technologies adopted by the WSD**

1. Automated multi-parameters water quality monitoring technology – a specially designed probe with several specific sensors for different water quality parameters, is suspended and immersed directly in the water body for real-time monitoring of water quality. The water quality monitoring system is currently employed to monitor DJ water quality at Muk Wu Pumping Station and water quality of the major impounding reservoirs;
2. Bioluminescent testing technology – the technology makes use of the bioluminescent property of a bacterium which emits light from metabolic activity for rapid toxicity testing of water quality. If any harmful substance is present in the water, the light emission from bacteria would be inhibited; and
3. Zebrafish water quality monitoring system – this system is based on the principle that zebrafish is highly sensitive to pollutants in the water. The activities and behaviour of zebrafish are automatically monitored and analysed through the computer system for bio-monitoring of water quality. When the system detects any abnormal change, an alert will be sent to the relevant personnel. Together with the bioluminescence testing technology, the system enables rapid detection of harmful substances so as to safeguard the water quality.

### **水務署所採用的先進水質監測技術**

1. 全自動多參數水質監測技術 – 這技術是採用可安裝多個感應器的特別設計探頭，直接懸放於水體中進行實時監測。這個水質監測系統現應用於監測木湖抽水站的東江水和主要水塘的水質變化；
2. 生物發光測試技術 – 這技術利用發光細菌在新陳代謝時發光的特性，快速測試水質毒性。當水中含有有害物質時，細菌的發光特性便會被抑制；及
3. 斑馬魚水質監察系統 – 這套系統是利用斑馬魚對水中的污染物的高靈敏度反應，並透過電腦系統自動分析和偵測斑馬魚的行為和活動作為水質的生物監察。當系統偵測到異常變化時，就會發出警報給有關人員。這系統配合生物發光測試技術，能快速檢測水中的有害物質，保障供水安全。

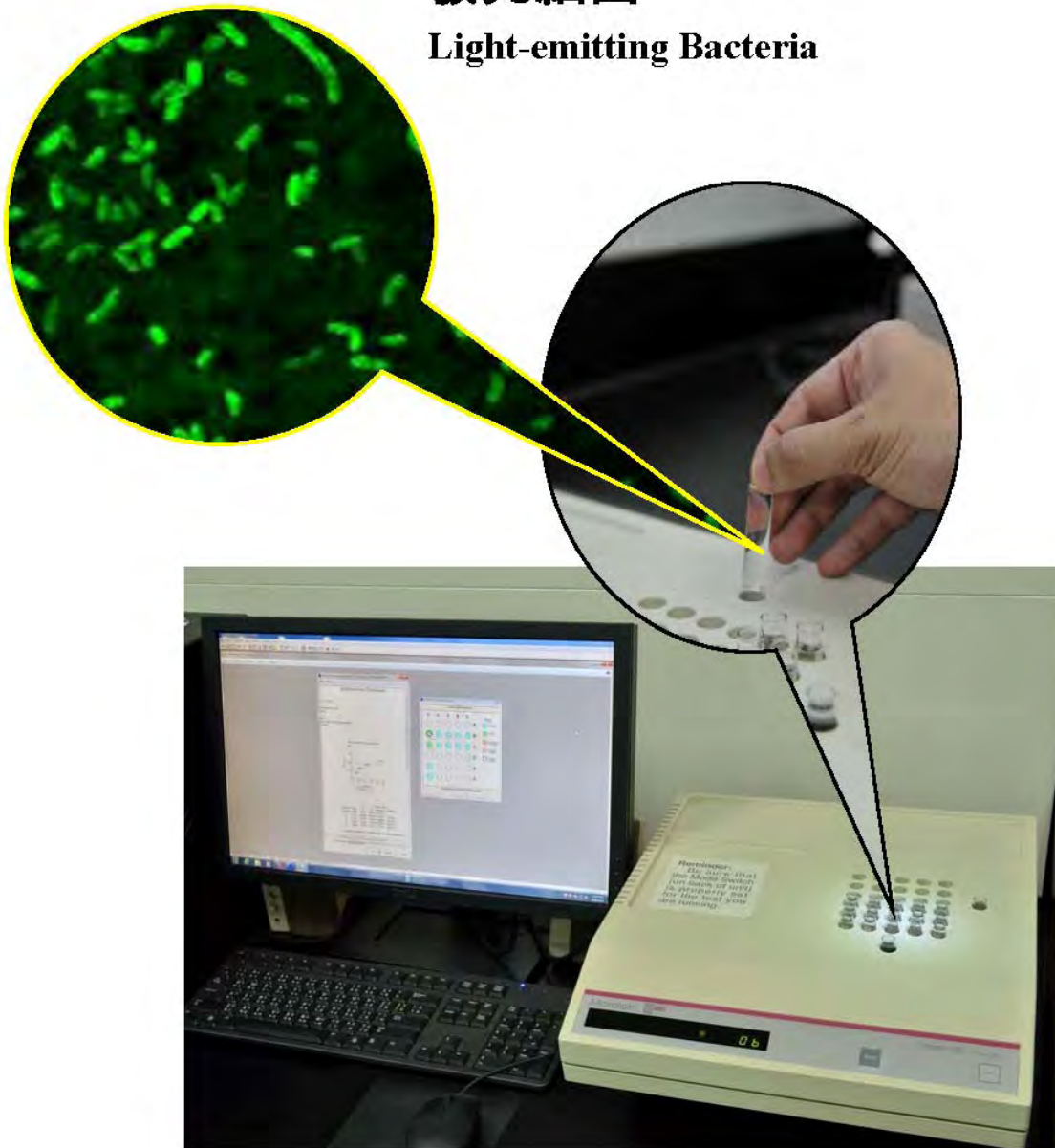
## 多參數水質監測系統 Multiparameter Water Quality Monitoring System



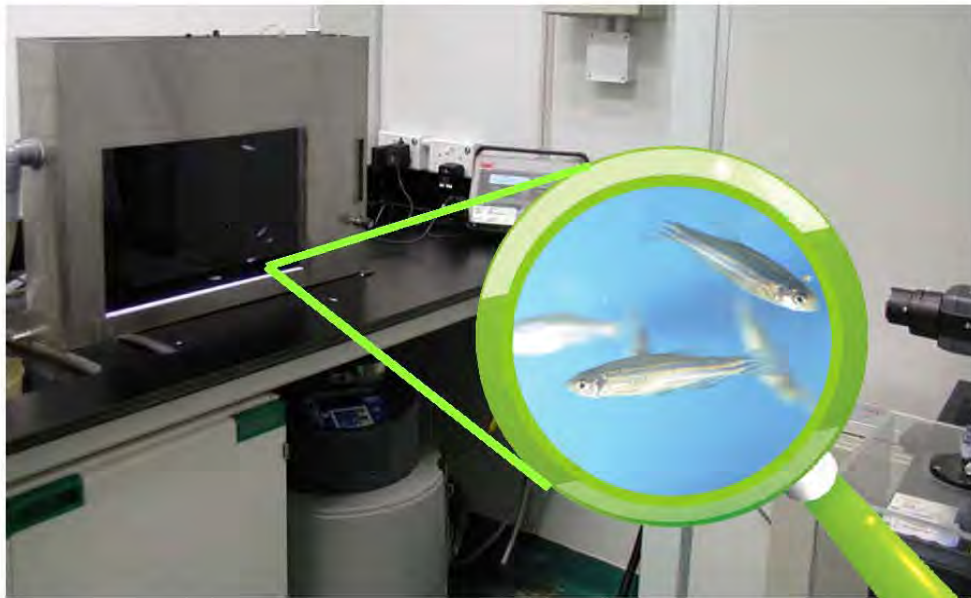


# 生物發光測試技術 Bioluminescent Testing Technology

## 發光細菌 Light-emitting Bacteria



## 斑馬魚水質監察系統 Zebrafish Water Quality Monitoring System



Tracking results			
5% 0%	2% 0%	5% 0%	6% 0%
2% 0%	4% 0%	2% 0%	4% 0%
3% 0%	1% 0%	4% 0%	1% 0%
6% 0%	21% 0%	20% 0%	14% 0%

Pause
Restart
Settings
Set tank
View logs
Statistics

Live video
  Background
  Distribution
 Reset
Alarm closed

**System settings**

Parameter

- Comparison threshold (%)
- Minimum frame rate (fps)
- Minimum object length (mm)
- Maximum object length (mm)
- Minimum object thickness (mm)
- Maximum skip time (second)
- Maximum speed (mm / second)
- Maximum change in size (%)
- Expected no. fishes / tank
- Missing fish grace period (second)
- Idle fish region (% from top / bottom)
- Inactive fish speed (mm / second)
- Inactive fish grace period (second)
- Sign of Suffocation (cells)
- Sign of Suffocation (%)
- Suffocation grace period (second)
- Sign of Avoidance (cells)
- Sign of Avoidance (%)
- Avoidance grace period (second)
- Recipient phone nos.
- Alert guard time (minute)
- Maximum no. of alert (per day)

**Detection results**

- Background frame updated: Ready 50s
- Current frame rate
- Tracked fishes: 5
- Inactive fishes
- Inactive fish detected since
- Inactive fish last detected since
- Missing fish detected since
- Missing fish last detected since
- Suffocation detected since
- Suffocation last detected since
- Avoidance detected since
- Avoidance last detected since

系統監察顯示 System Monitoring Display