In-Building Sewer Mining System

HONG KONG PRODUCTIVITY COUNCIL

TechDive Apr2020

Environmental Technology

Water Management and Urbanisation

What is the Problem?

Due to urbanisation and population growth:

- Increasing demand of water resources
- Great demand of uninterrupted supply of good quality water
- Higher per capita consumption of water compared to rural areas

Hong Kong: 7.4 million people

Tokyo: 38 million people

Shanghai: 22 million people

New York: 8.4 million people

Hong Kong at a Glance

- Expected annual housing supply: ~43,000 unit
- HK's annual water consumption: 1,012 million m3
- HK's annual sewage discharge: 1,007 million m3
- Water consumption & sewage discharge: ↑ ~ 1-2% every year
- Pressure on sewerage infrastructure

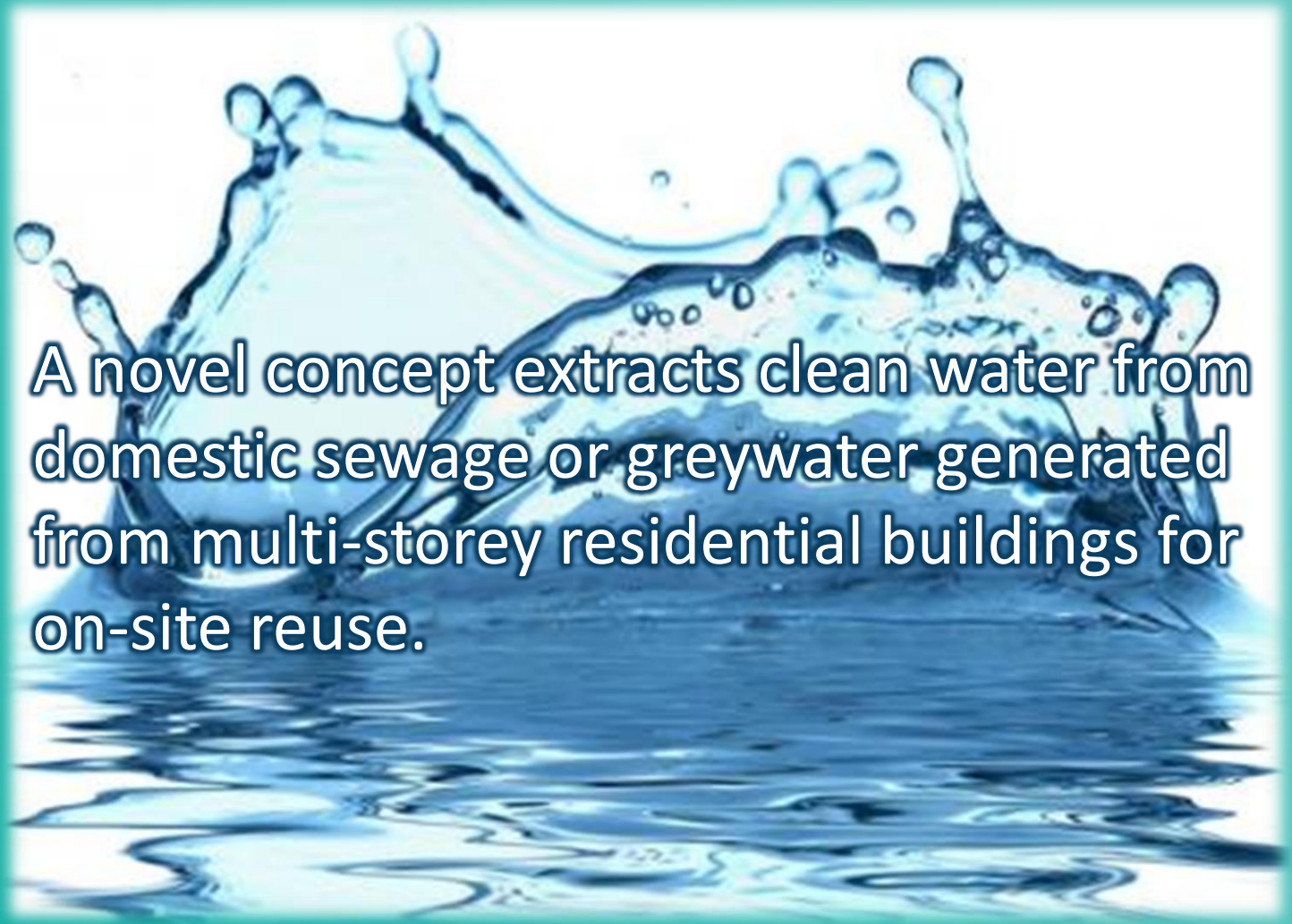
Sewer Mining in Urban Cities

Sydney Olympic Park

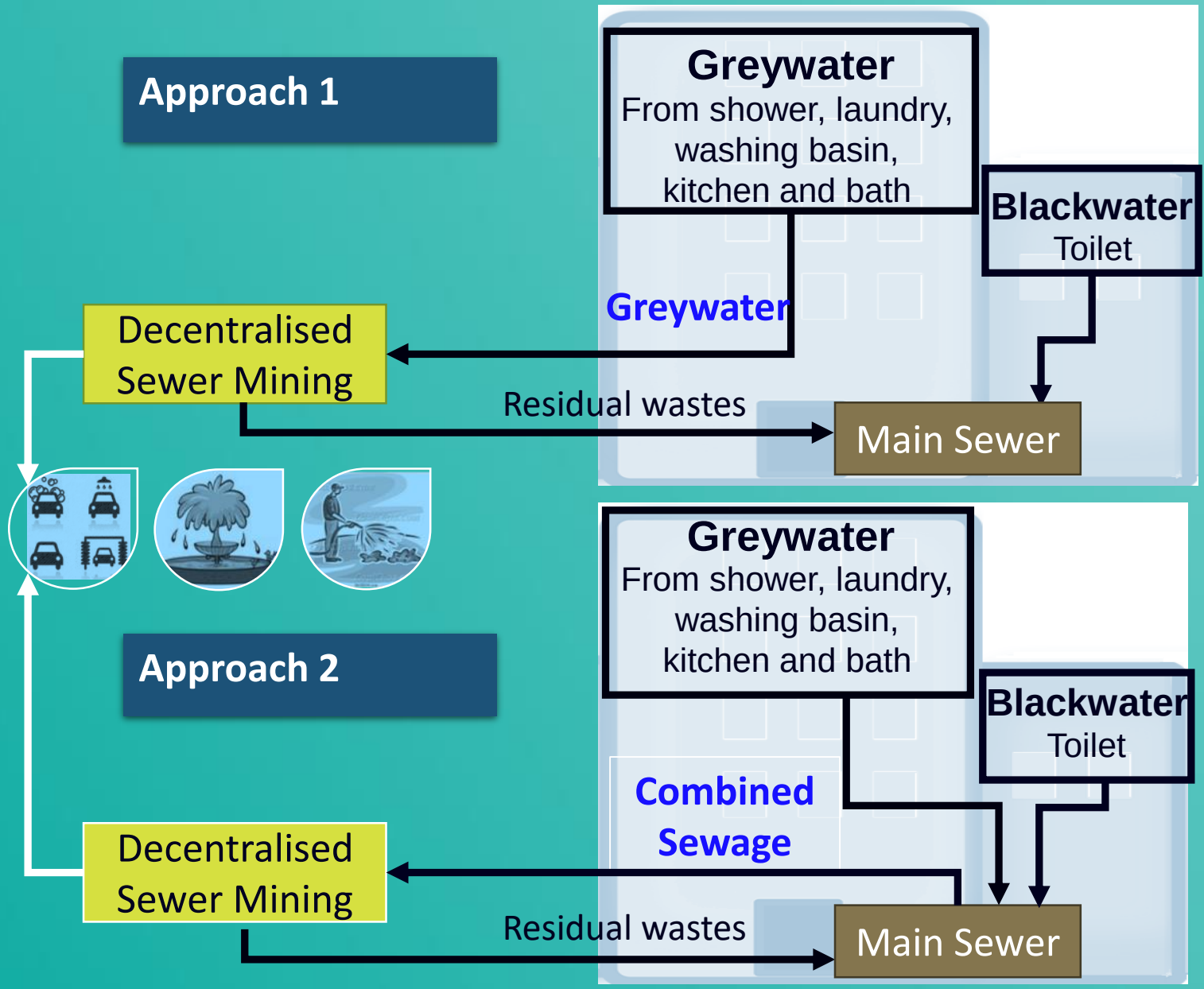
- a large scale sewer mining unit has been installed for using recycled water **for toilet flushing, irrigation and ornamental fountain**
- Under the entire Water Reclamation and Management Scheme (**WRAMS**)
- **Substitutes more than 50% of potable water**

Athens's Demonstration Plant

In-Building Sewer Mining System



Concept of Sewer Mining



Potential Applications of Reclaimed Water

Toilet Flushing

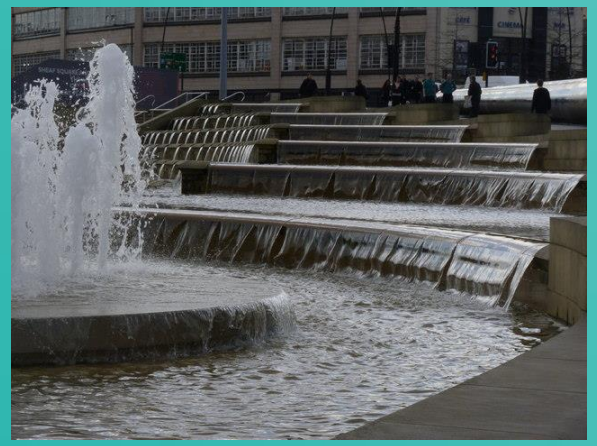
Irrigation

(excluding irrigation sprinklers)

Fire Water Tank

General Washing

(excluding high pressure jet washing and general washing at markets and food establishments)

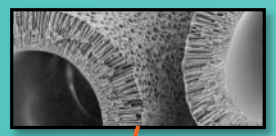


Water Feature

Makeup Water for Cooling Tower

Our Sewer Mining Technology

Greywater or Combined sewage



Attached growth bioreactor & Membrane Filtration

Reclaimed water applications

Reclaimed Water Quality

Parameter	Typical Grey water	Reclaimed water	Recommended water quality standards
pH	6 – 9	6.4 – 8.2	6 – 9
Colour (Hazen unit)	--	<5	≤20
Turbidity (NTU)	30 – 400	<0.3	≤5
Biochemical oxygen demand (BOD_5)/(mg/L)	50 – 500	<8	≤10
Chemical oxygen demand (mg/L)	100 – 700	<29	--
Ammonia nitrogen (mg/L)	2 – 15	<0.2	≤1
Total Suspended solids（ mg/L)	30 – 200	<5	≤5
E. Coli (cfu/100 mL)	10^4 - 10^8	<1	<1
Total residual chlorine (mg/L)	--	System outlet 1.0 – 1.8	≥1 existing treatment system; ≥0.2 at user end

Reference: Technical Specification on Grey Water Reuse and Rainwater Harvesting, WSD (2015)

Our Solution
Compact, Unmanned in-building system

- Reclamation of sewage or greywater while disposing by-products back to sewer networks

- Small footprint system at the basement of multi-storey building to directly purify sewage and segregated greywater from building

Merits of Sewer Mining System

Merits

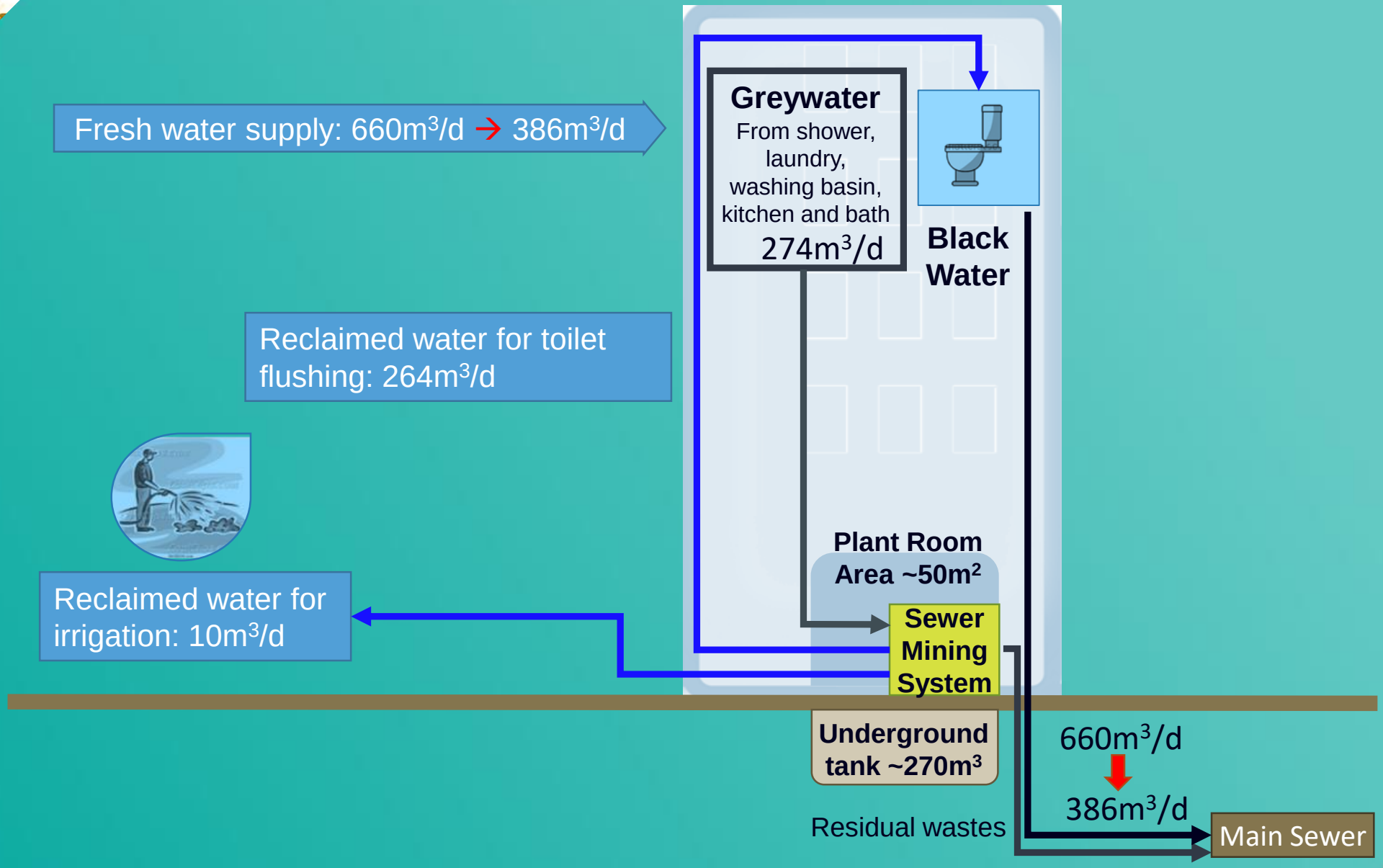
- ❖Very compact and flexible
- ❖Fully automatic system with unmanned operation
- ❖Superior reclaimed water quality meeting the most stringent reuse water quality standards
- ❖Low treatment cost resulting in saving of >HK$4 per m^3 recycled water

Cost Saving of Sewer Mining System

- For 50 m^3/d capacity system

Cost Saving from In-Building Sewer Mining in Hong Kong	Key Features
Lower Treatment Cost • From electricity supply, chemical consumption, membrane replacement & media replacement	$2.2/$m^3$ (~US$0.28/$m^3$)
Annual saving of fresh water for irrigation	12,045 m^3 (100% saving)
Annual saving from water tariff and sewage tariff	$58,780 (~US$7,536)

In-Building Sewer Mining



Modular In-building Sewer Mining System

1 m^3/day
AIA Building, Central

1 m^3/day
Yuet Wah Street URA Project

Customization of In-building Sewer Mining System

70 m^3/day
City University of Hong Kong
(Our first installation in HK, 2009)

50 m^3/day
Yan Tin Estate, Tuen Mun
(The first installation in PRH Development in HK)

Demonstration of Water Reclamation from Combined Sewage Application in Redevelopment Project in Shanghai, PRC

30 m^3/day
Innovative green building features in redevelopment of an old piano factory into a commercial complex

KEY TAKE-HOME MESSAGE

- Using advanced treatment technologies, sewer mining systems can be very compact and unmanned operation.

- For a residential building with 1,000 households with 3 members per household, the total water consumption and sewage discharge was estimated to be 660 m^3/d. If the novel in-building sewer mining system is installed for recycling of domestic sewage or greywater for toilet flushing and irrigation, the overall water consumption and sewage discharge can be reduced by around 40%.

- The system operation cost including electricity supply, chemical consumption, membrane replacement is HK$2.2/$m^3$, resulting in a cost saving of HK$4.9/$m^3$ from freshwater supply and sewage discharge tariff.

KEY TAKE-HOME MESSAGE

- For a residential building with 1,000 households, the in-building sewer mining system only occupy 50m^2 of plant room area and 270 m^3 of underground storage tank. The system can be installed at the basement of a multi-storey residential building to directly purify domestic sewage or segregated greywater from the building.

- In-building sewer mining system are proved to be technically and economically feasible to be installed in high-density residential buildings.

Hong Kong Productivity Council
香港生產力促進局

HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong
香港九龍達之路78號生產力大樓
+852 2788 5678 www.hkpc.org