



Closing the Water Loop with NEWater

The Story of Recycled Water in Singapore

November 20, 2019



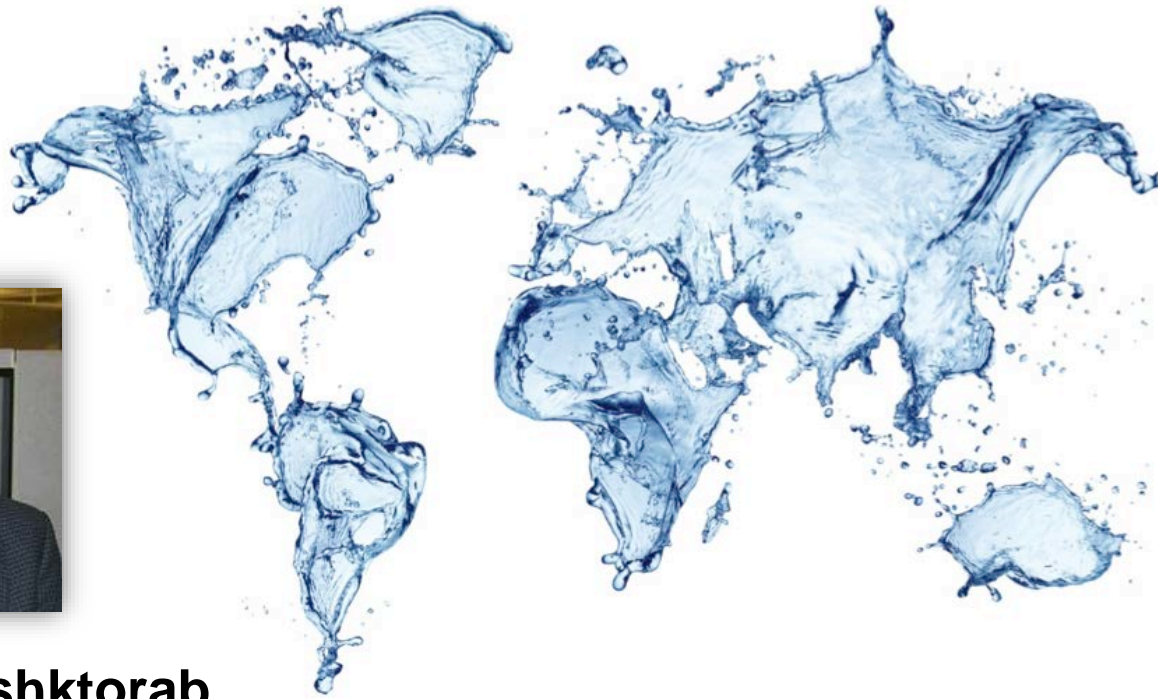
WaterReuse Webcast Series

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WaterReuse International Advisory Group



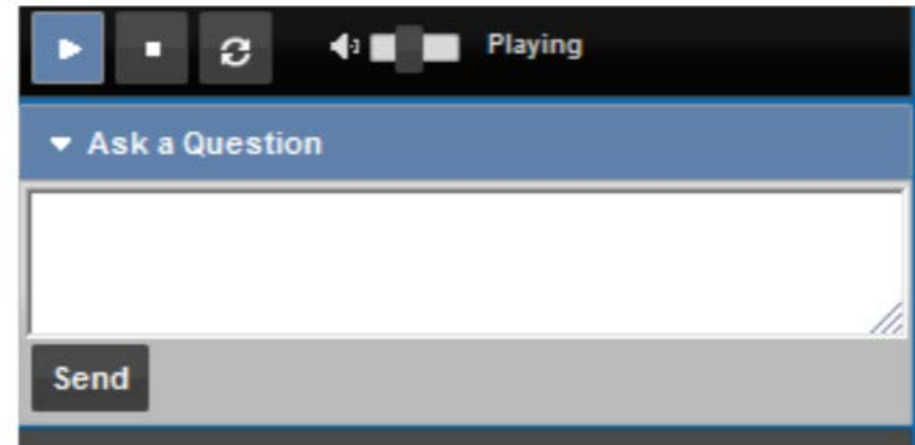
Hossein Ashktorab
IAG Chair
Valley Water



Melanie Tan
Moderator
Kennedy Jenks

A Few Notes Before We Start...

- Today's webcast will be 60 minutes.
- There is one (1) Professional Development Hour (PDH) available for this webcast.
- A PDF of today's presentation will be shared via email
- Please type questions for the presenters into the chat box located on the panel on the left side of your screen.



Today's Presenters



Liu Bingrui
Operations Engineer –
Kranji NEWater Factory
PUB



Joelyn Tan
Operations Engineer –
Bedok NEWater Factory
PUB



Singapore: A City State with Challenges



- Population of 5.70 million
- Land area of 720 km² (~278 mi²)
- 7,917 persons/km² (~20,504 persons/mi²) density
- 430 mgd (~516 US mgd) water demand
- Very limited natural resources
 - Long-term average annual rainfall 2,320 mm (~91 inches)
 - High water stress in 2040 by Water Resources Institute (WRI) in 2015

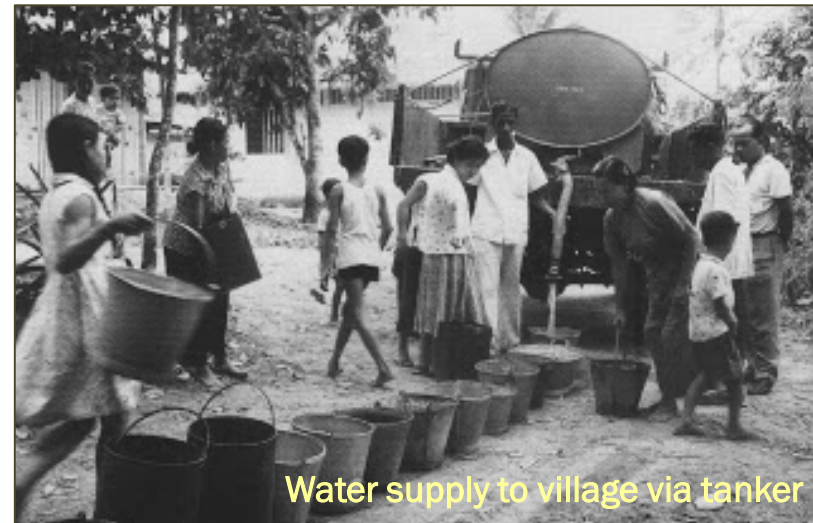
Our early days: Difficult and Humble Beginnings



Flooding at Orchard Road



Singapore River



Water supply to village via tanker

1960s..



Last Water Rationing
in 1963

Independence in
1965



Scarce water
resources

1960s..



No proper sanitary facilities



Poor Public health conditions



1960s..

Floods were
common
occurrences...



1960s..

Polluted, Smelly Rivers





Singapore Today...



Singapore Today...



■ Potable water at the turn of tap

➤ *4 National Taps*

- Local catchment water
- Imported water (Johor)
- NEWater
- Desalinated water

■ Modern sanitation

➤ *Deep Tunnel Sewerage System (DTSS)*

■ Flash floods (clear within minutes)

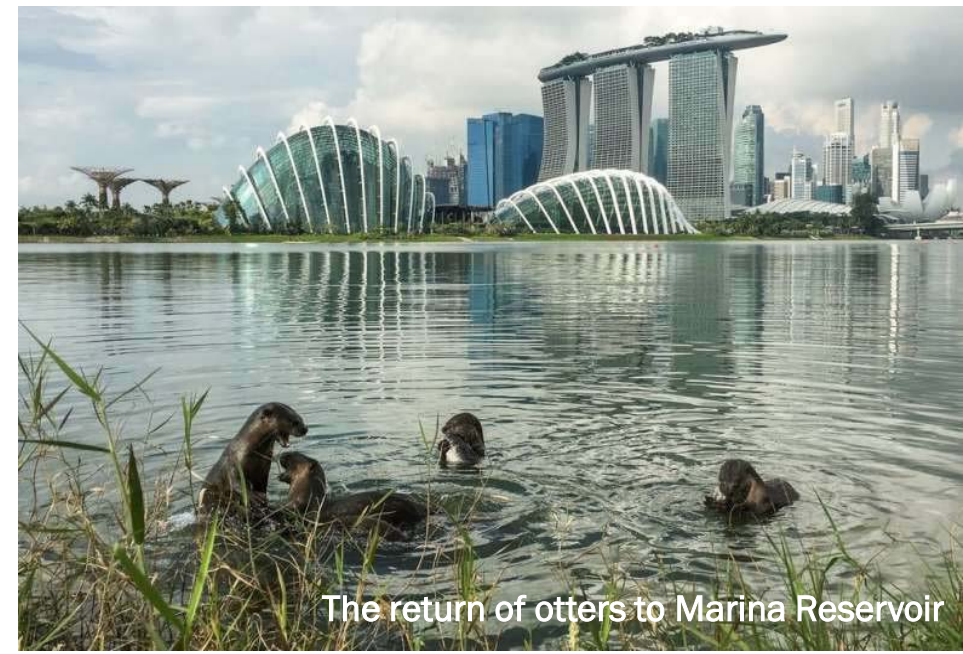
■ Clean Waterways

➤ *ABC Waters Programme*





PUB's ABC Water Learning Trails



The return of otters to Marina Reservoir



Community bonding and experiential learning



Water activities in Marina Reservoir

Singapore's Journey



Water as a Key Resource



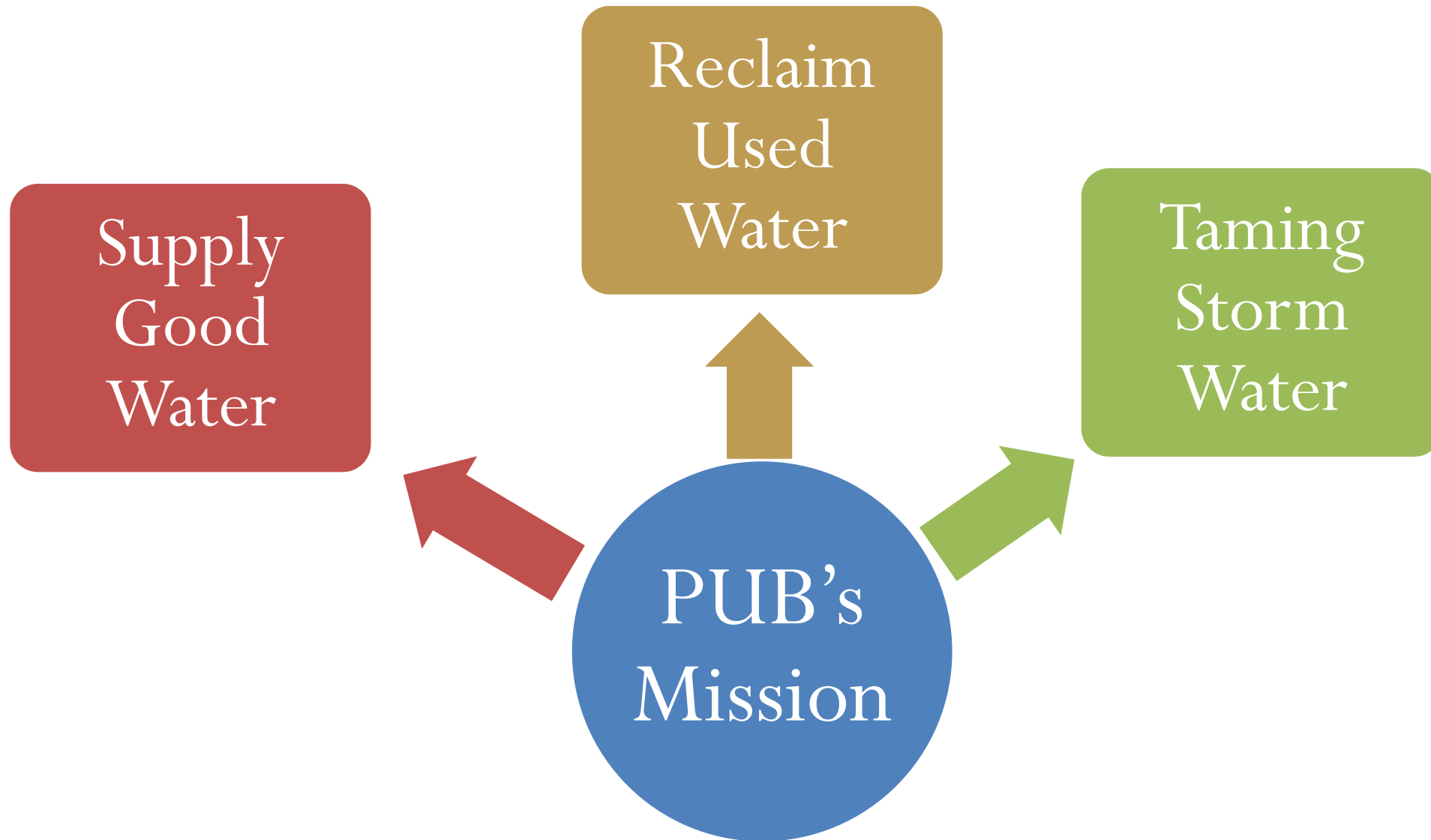
“The Singapore Water Story is one where we strive for sustainability through long-term planning and investing ahead of our needs. This approach is more critical with climate change, where we need to grapple with both extremes of drought and flooding **Over the years, we augmented our water supply with weather-resilient sources – NEWater and desalinated water** Water is entwined with our nation’s survival and our everyday lives. It is not enough that the Government pumps billions of dollars into infrastructure to ensure supply. Policies to manage demand are as important.”

- Mr Masagos Zulkifli
(Minister for the Environment and Water Resources)

One National Water Agency

Managing entire water loop by one Organisation, under one Ministry

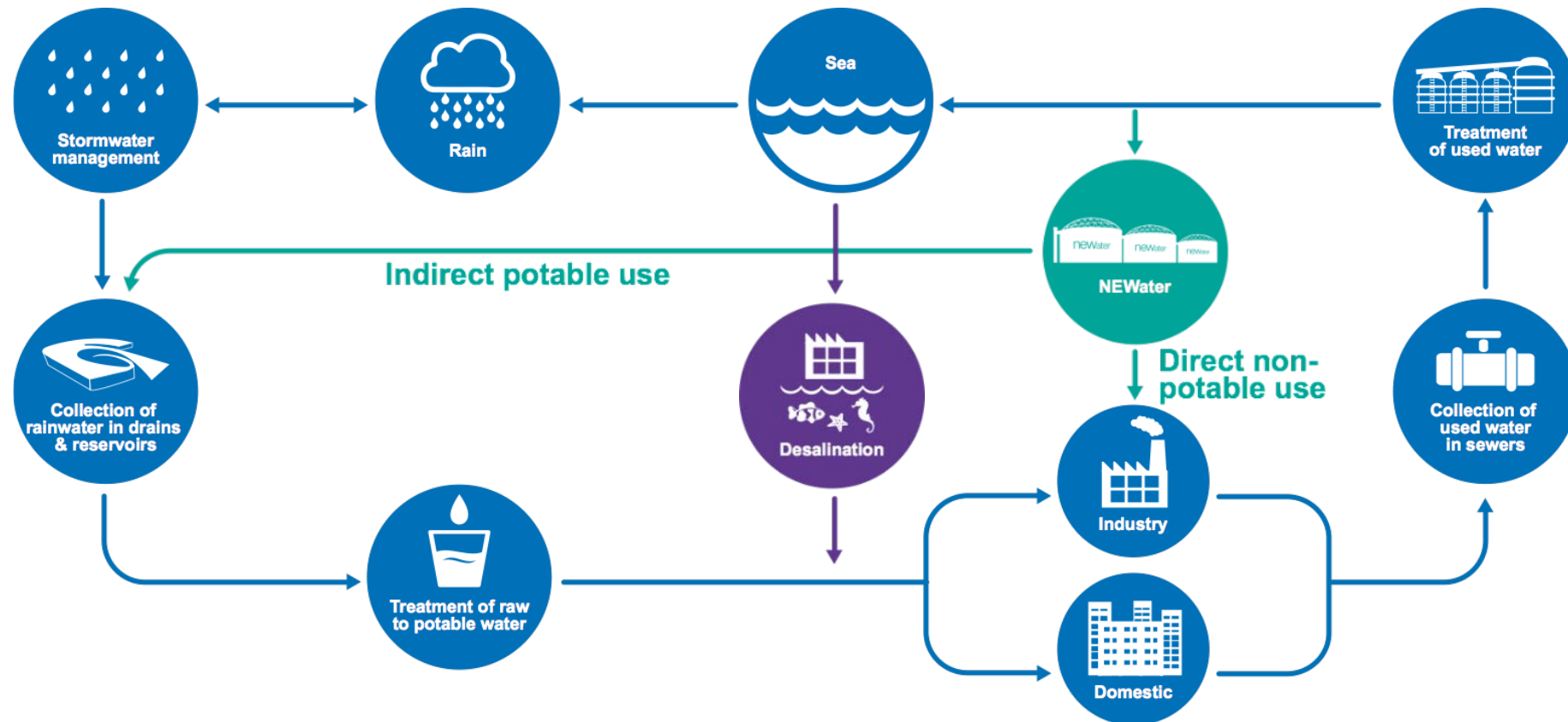




Closed Water Loop (2001)

Integrated Planning :PUB Manages the Complete Water Cycle

From sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, drainage of storm water



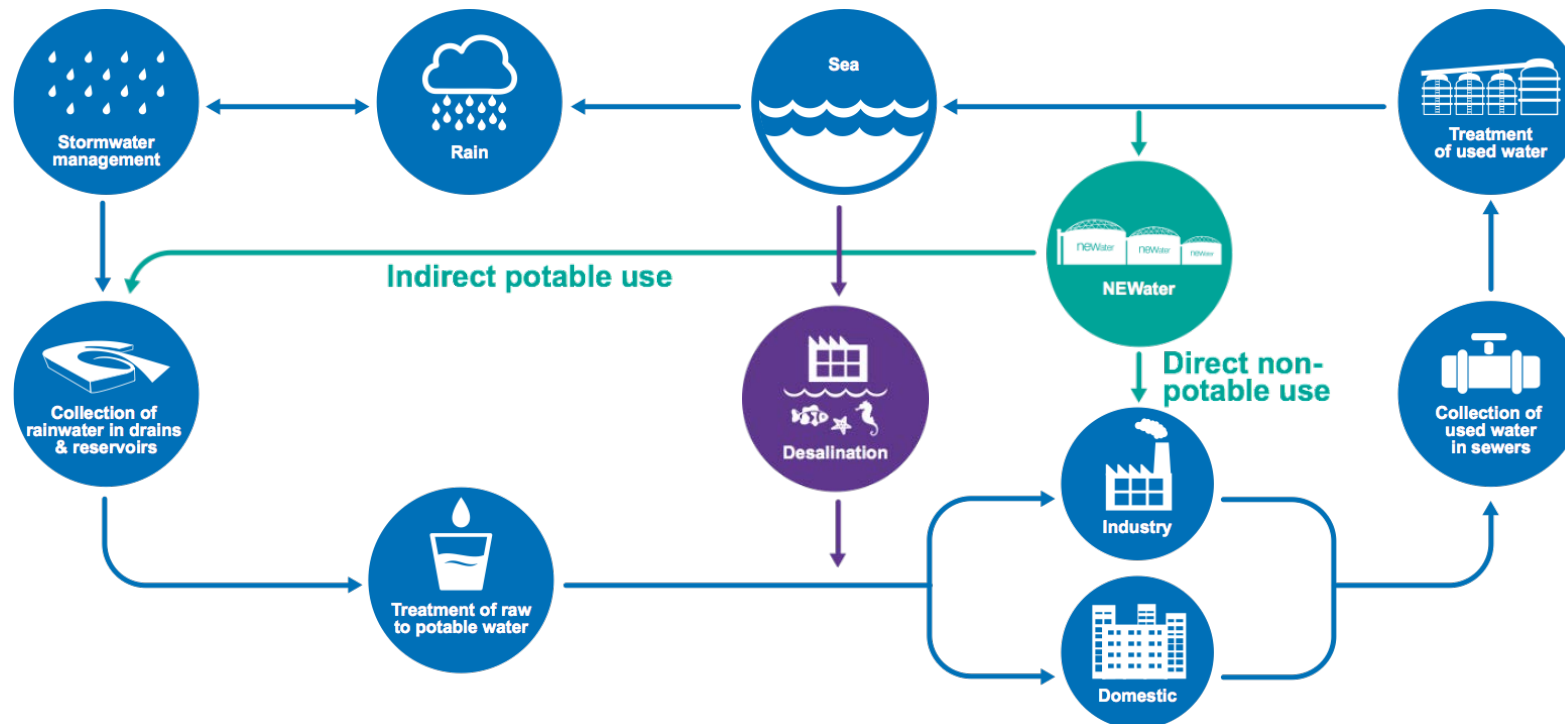
Two Separate Collection Systems

Rainwater collection

Collected through drains, canals and rivers – channeled to reservoirs

Used water collection

Collected through underground sewers and DTSS that lead to a water reclamation plant



Water Supply: 4 National Taps



**WATER FROM
LOCAL CATCHMENT**



**IMPORTED
WATER**



NEWATER



**DESALINATED
WATER**

Third National Tap: NEWater - Timeline

Learning from Overseas experiences (e.g. Orange County, USA)

International Audit Panel of Experts



Third National Tap : NEWater

NEWater: Closing the water loop

KRANJI
22 MGD
(~26 US
MGD)



BEDOK
18 MGD
(~22 US MGD)



ULU PANDAN
35 MGD
(~42 US MGD)

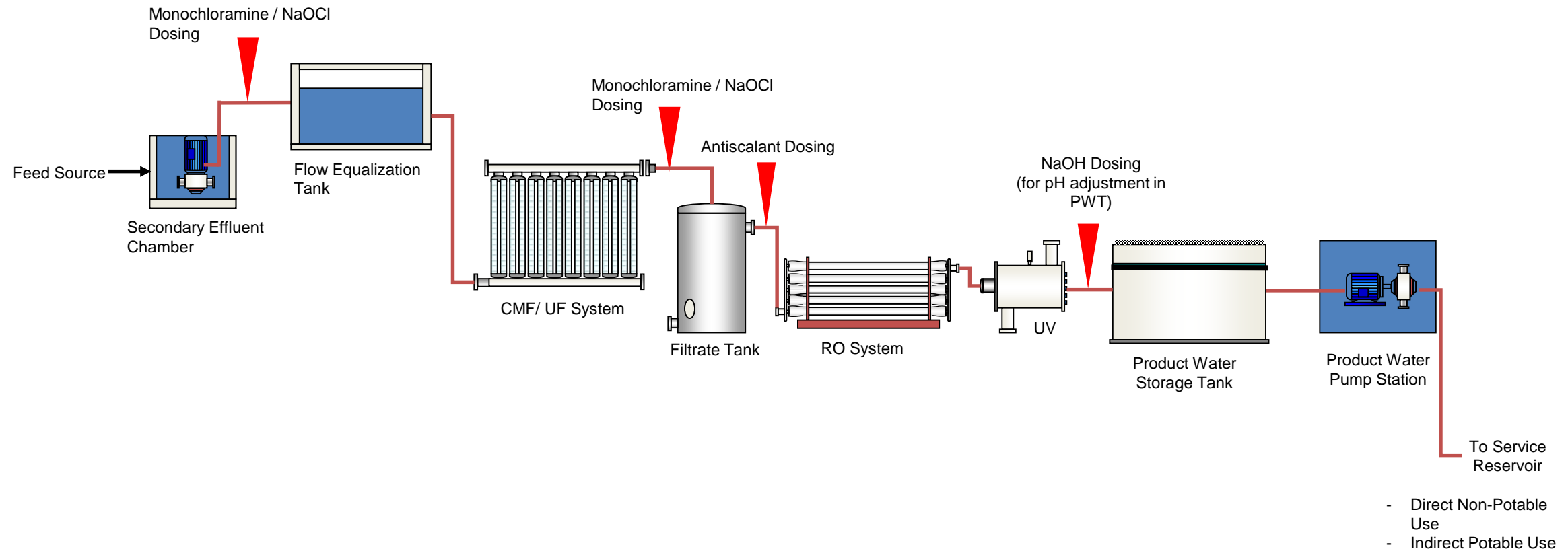
LEGEND

-  NEWater Pipeline
-  NEWater Plant



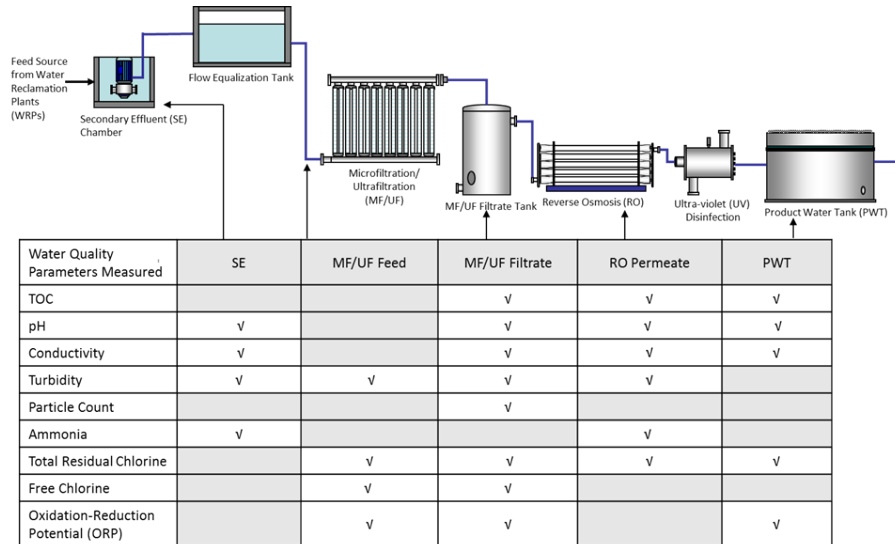
CHANGI 1 & 2
100MGD
(~120 US MGD)

NEWater – General Process Schematic



NEWater – Water Quality Monitoring

- Real time monitoring of water quality via SCADA



- 8-hourly water sampling of critical parameters at key stages
- Comprehensive sampling program carried out by Water Quality Department for feed water (secondary effluent) and NEWater
- Real time monitoring of parameters like pH, TOC and Conductivity at the NEWater Service Reservoirs

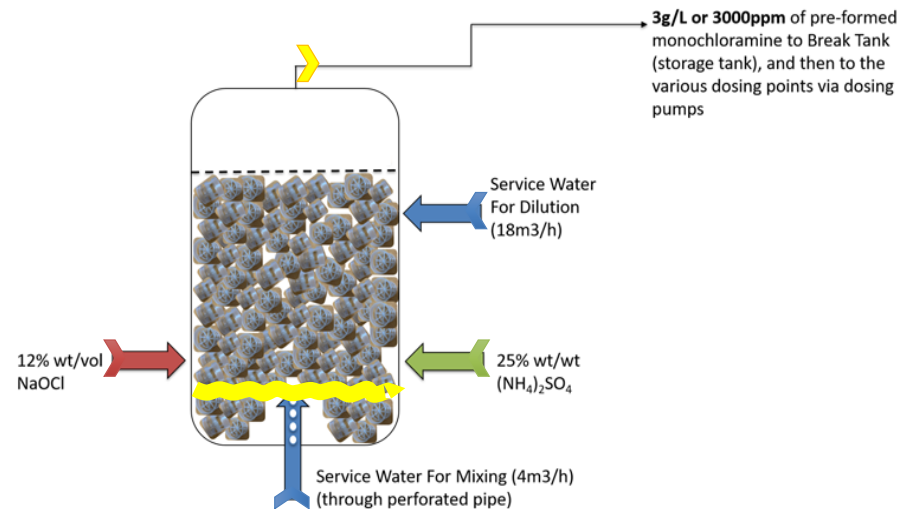
NEWater – Source Control

- Dedicated team within Water Reclamation Network Department working on administering the trade effluent discharge regulations on trade factories in Singapore, which comprises the following 4 aspects:
 1. Prevention and Deterrence – “High Risk” and “Low Risk” factories, up to biweekly audits, mandatory installation of specific monitoring sensors
 2. Enforcement & Penalty – Harsher penalties especially for recalcitrant offenders
 3. Stakeholders’ Engagement and Education – engaging owners and occupiers of trade factories as stakeholders to create awareness
 4. Capability Development – building competent manpower and harnessing of technologies to perform the work (eg. build customised sewer robot capable of collecting effluent samples from lateral sanitary connections)



NEWater – Enhancements: Pre-formed Monochloramine System

- Overcome the limitation of low ammonia in Secondary Effluent
- Increase the concentration of monochloramine KNF's NEWater treatment process
- Control membrane bio-fouling and improve plant's operating performance and efficiency



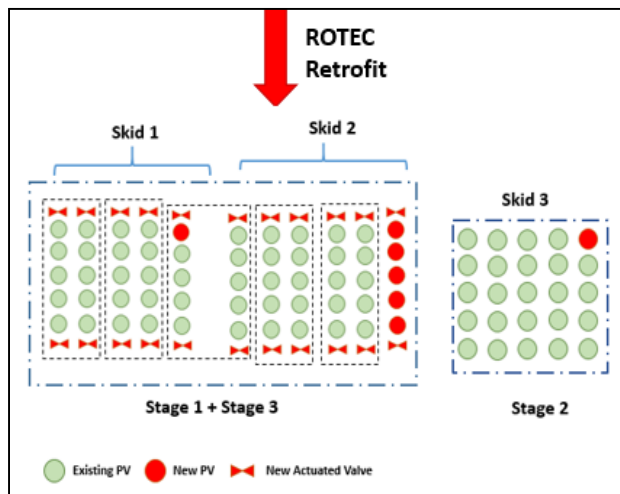
NEWater – Enhancements: Increasing NERater Recovery

- Increasing NERater recovery beyond the current 75-80% can bring about exponential benefits due to the multiplier effect
- At current 75% recovery, the first drop is quadrupled. If NERater recovery is increased to 90%, the first drop can be increased 10 fold over the long term
- RO recovery needs to be improved in a sustainable manner (weigh in energy consumption and water production costs)



NEWater – Enhancements: ROTEC

- Retrofitted ROTEC technology in one RO train for demonstration study



- Recovery was progressively increased to 90%
- CIP intervals were comparable between ROTEC RO train and conventional RO train
- Lower energy index at 85% for ROTEC train compared to conventional RO train at 75% recovery

NEWater – Education & Public Acceptance

- NEWater Visitor Centre is the focal point of our continuing education on:
- Strong political leadership and Grassroots leaders helped reach out to community e.g. public tasting
- Launch of NEWBrew at SIWW 2018



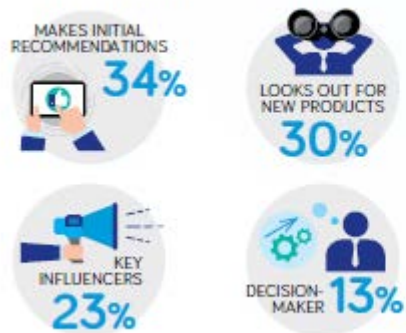
Singapore International Water Week

Held biennially (last held in 2018), it is the global platform to share and co-create innovative solutions

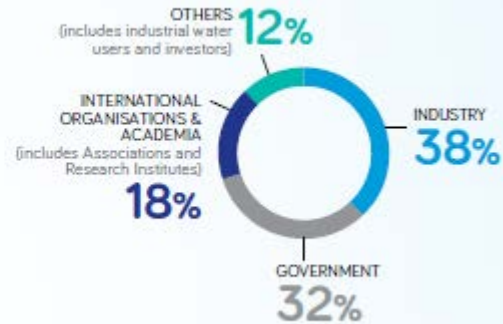
Highlights at the Singapore International Water Week in 2018

Singapore International Water Week (SIWW) 2018 concluded on a high with more than 24,000 people in attendance and \$23 billion worth of deals and opportunities unveiled.

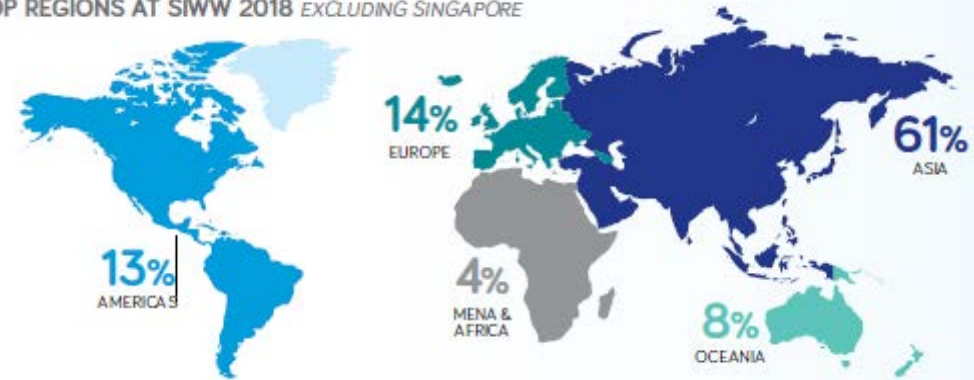
PROFILE/PURCHASING DECISION



SECTOR BREAKDOWN

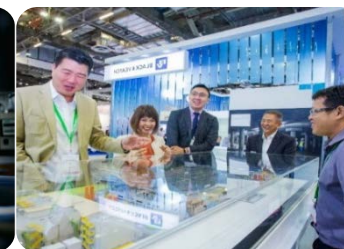


TOP REGIONS AT SIWW 2018 EXCLUDING SINGAPORE



The Global Platform to Share and Co-Create Innovative Water Solutions

Celebrating over ten years of water excellence



THOUGHT LEADERSHIP	<ul style="list-style-type: none"> • Water Leaders Summit • Young Water Leaders Summit
BUSINESS & NETWORKING	<ul style="list-style-type: none"> • Business Forums • Water Expo @ City Solutions Singapore
SOLUTIONS & TECHNOLOGIES	<ul style="list-style-type: none"> • Lee Kuan Yew Water Prize • Water Convention • TechXchange

SIWW 2020 Key Thematic Areas

Climate Resilience

Resource Resilience

SMART Utility



The Global Platform to Share and Co-Create Innovative Water Solutions

Business. Thought Leadership. Solutions. Technology.

Thank you!

See you

5 – 9 July 2020

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Thank You



Questions?

