Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

1000 – 1005 hrs	Opening & Housekeeping Singapore Water Association
1005 - 1015 hrs	Welcome Address Singapore Water Association
1015 – 1030 hrs	Overview and Outlook of PUB Water Reclamation (Plants) Process Technology and Operations PUB
1030 – 1045 hrs	Smart Integrated Validation and Demonstration Plant (IVP) PUB
1045 – 1055 hrs	Q & A SWA/PUB
1000 – 1100 hrs	Closing, Singapore Water Association

Organised by:

SWA Singapore Water Association

PUB Singapore's National Water Agency

VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

Housekeeping

- ✓ To ensure a smooth session, please mute your microphone and turn off the camera. You may communicate with us after the event.
- ✓ Please share your questions in the chat where we will try to provide answers where possible in the Q & A Segment.
- ✓ Do identify yourself so we can respond to any unanswered questions
- ✓ We will be recording this session and reserve the rights to the video
- ✓ Please complete a post event survey which upon return, we will forward the recording and presentation deck to the respondents.

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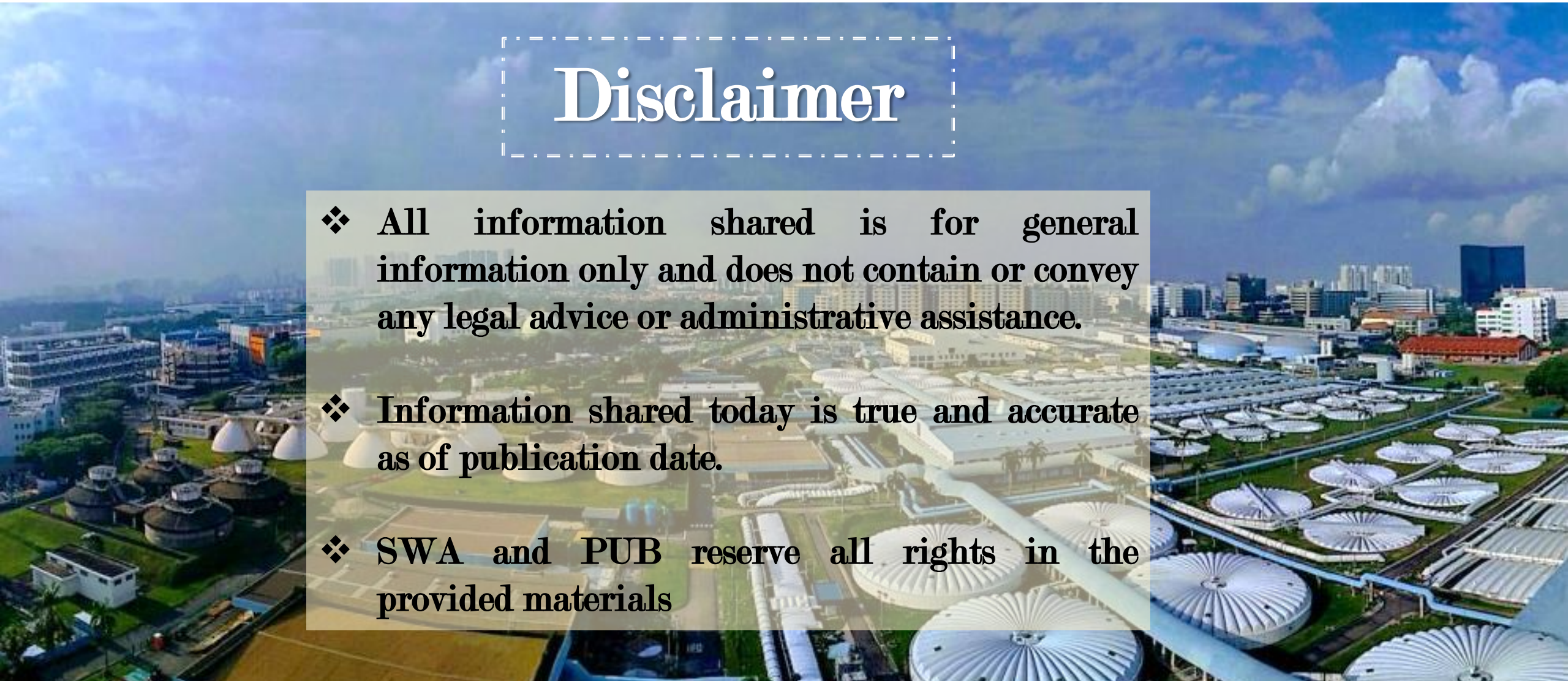
Virtual Introduction on PUB Water Reclamation Process & Technology Outlook



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VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

Dr Mamta Jain

Singapore Water Association
Council Member

Director of Consultancy Services,
DHI Water & Environment (S) Pte Ltd)

Welcome Address

Organised by:

SWA
SINGAPORE WATER ASSOCIATION

PUB
SINGAPORE'S NATIONAL WATER AGENCY

VIRTUAL

OCTOBER
22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

SWA Initiatives

(since April 2020)

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VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

Dr TAO Guihe [Ph.D, CEng]
Principal Specialist
(Water Reclamation)
Process and R&D, Water Reclamation
(Plants) Department

Overview and Outlook of PUB Water Reclamation (Plants) Process Technology and Operations

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VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

Mr PHUA Kian Ming [M. Eng]
Engineer
Process and R&D, Water Reclamation (Plants) Department

Smart Integrated Validation and Demonstration Plant (IVP)

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VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

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SWA
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PUB
SINGAPORE'S NATIONAL WATER AGENCY

VIRTUAL

OCTOBER
22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

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VIRTUAL

OCTOBER 22

10am

Virtual Introduction on PUB Water Reclamation Process & Technology Outlook

For further queries on this event, please contact :

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T: (65) 6515 0812
E: enquiry@swa.org.sg
www.swa.org.sg

SINGAPORE WATER ASSOCIATION

PUB SINGAPORE'S NATIONAL WATER AGENCY

Water Reclamation Process & Technology Outlook

Dr Tao Guihe

Mr Phua Kian Ming

Leveraging on Technologies for Efficient Water Reclamation

Fully Automated 5 MGD MBR

2005

2009

Advanced Changi WRP (DTSS1)

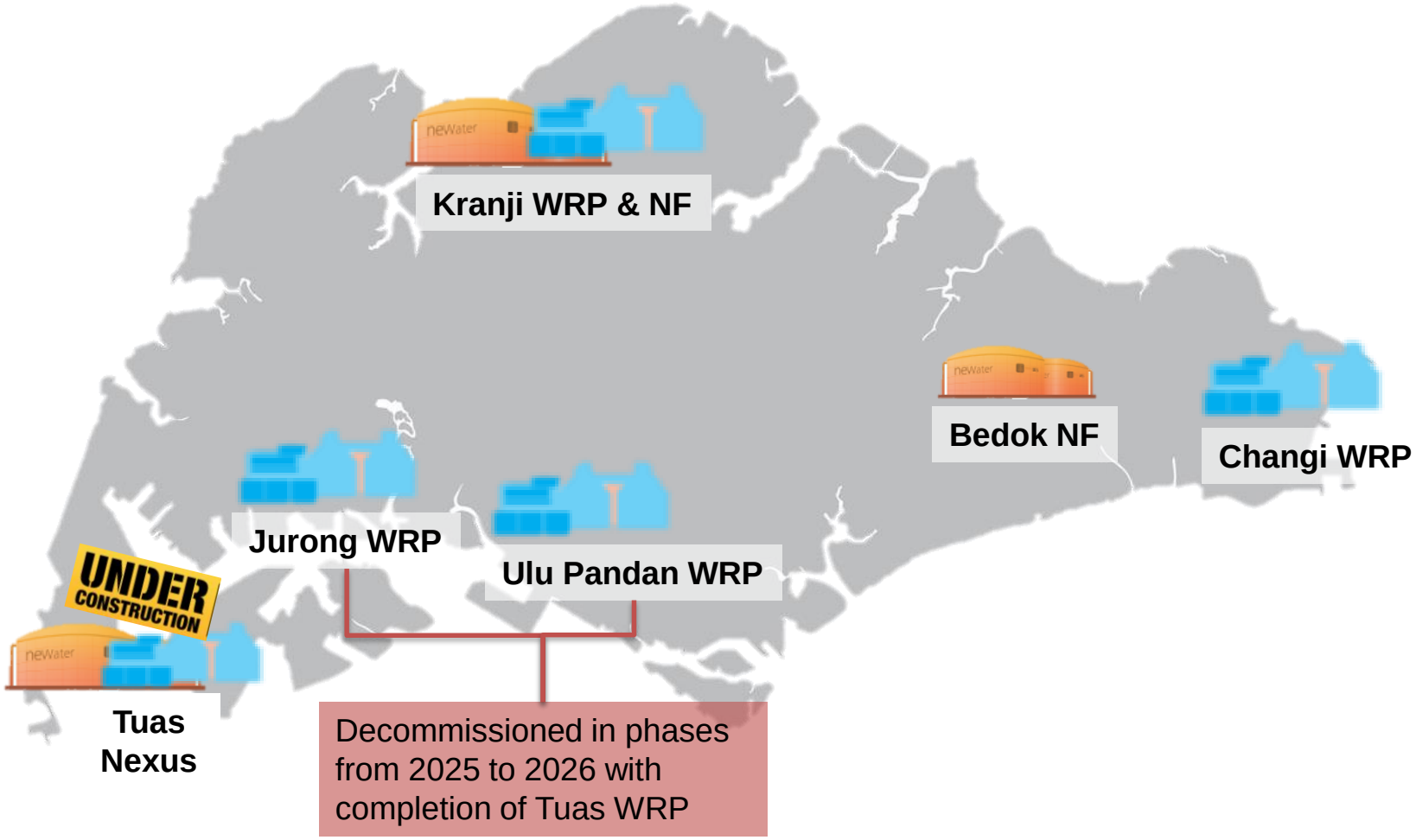
2.75 MGD Integrated Validation Plant

2017

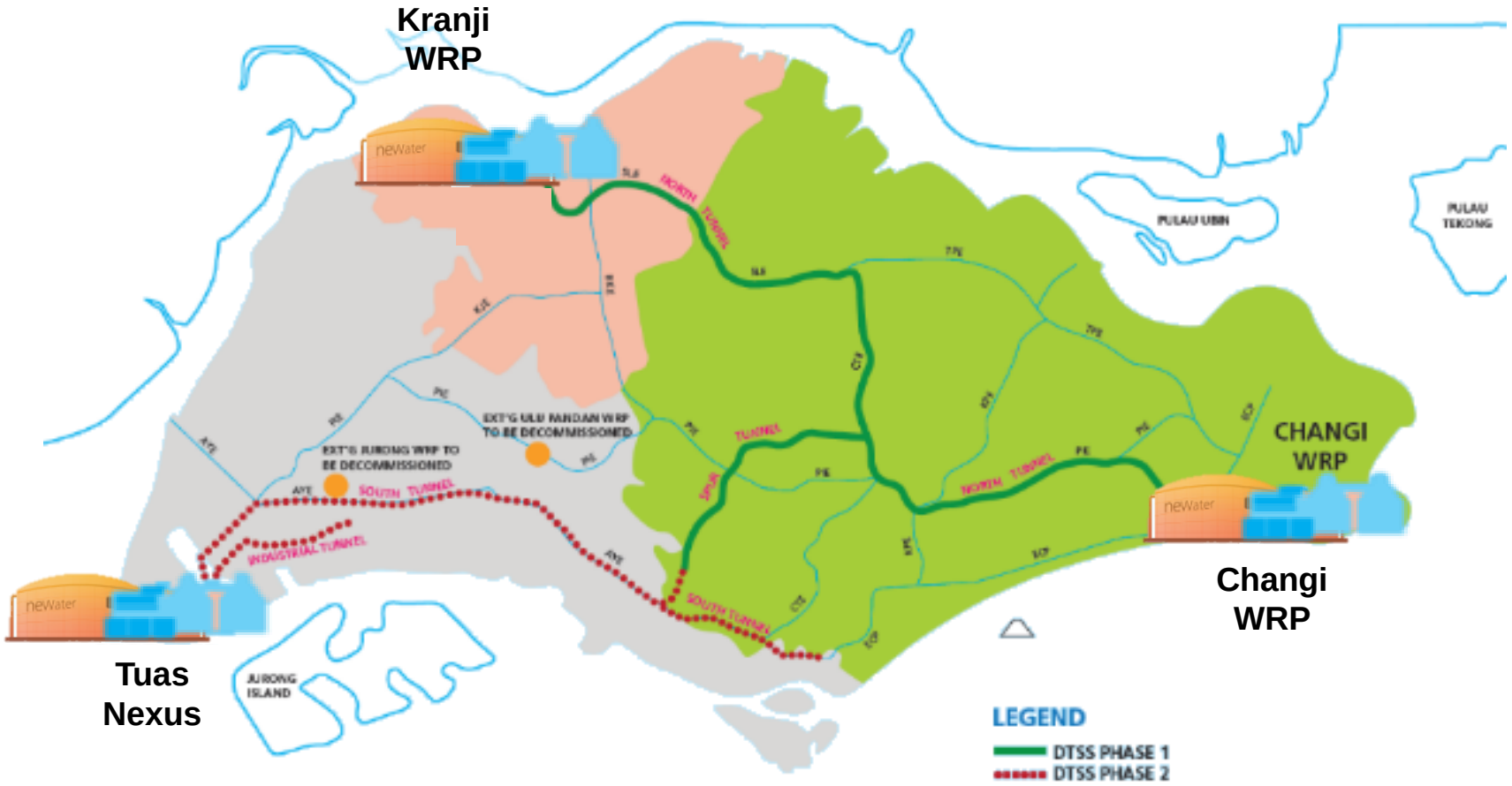
2026

Most Technologically Advanced TWRP

WRP Operations – Gradual decommissioning of UPWRP and JWRP



3-Node WRP Operations in 2026 with Completion of Tuas Nexus



Tuas Nexus – Tuas WRP

Tuas WRP (Artist's Impression)
World's Largest Membrane Bioreactor Plant
with 30% more compact footprint

Innovative Process Technologies

1. Lamella Plate Primary sedimentation Tanks
2. Membrane Bioreactor (MBR)
3. Thermal Hydrolysis Process (THP)

Tuas Nexus – Integrated Waste Management Facility (IWMF)

Integrated Waste Management Facility (Artist's Impression)

<u>Synergies with Water Reclamation Process</u>

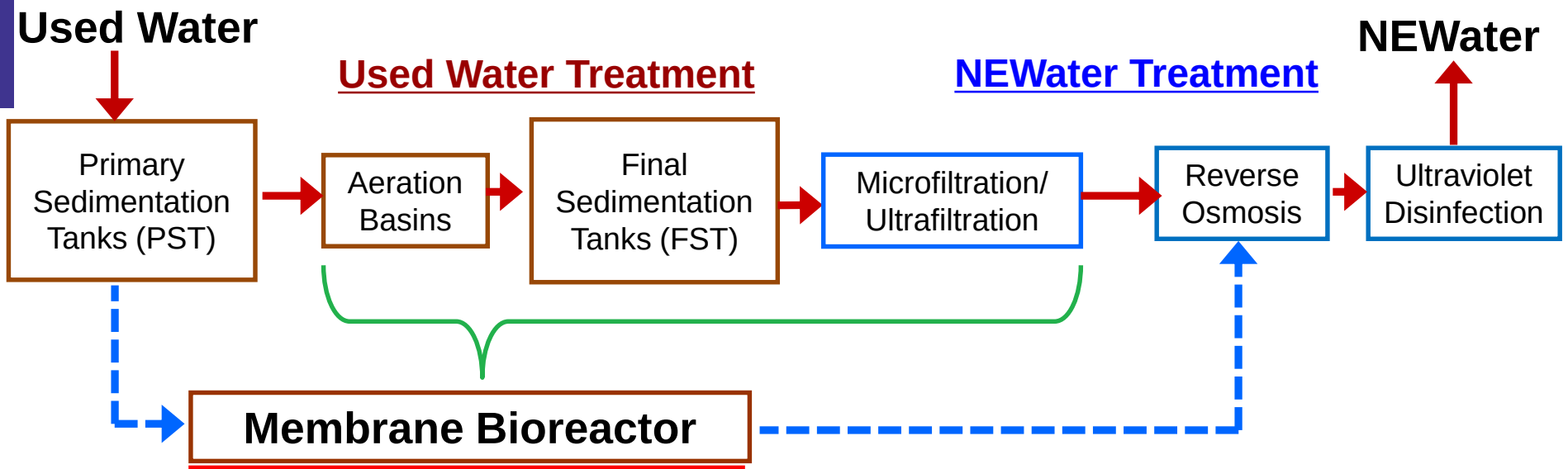
1. Co-digestion of source segregated food waste with used water sludge
2. Steam from IWMF transferred to TWRP for Thermal Hydrolysis Process
3. Close proximity for dewatered sludge, screenings and grit treatment and disposal

Integrated Validation and Demonstration Plant (IVP)

Test bedding plant for process and digital technologies for WRPD

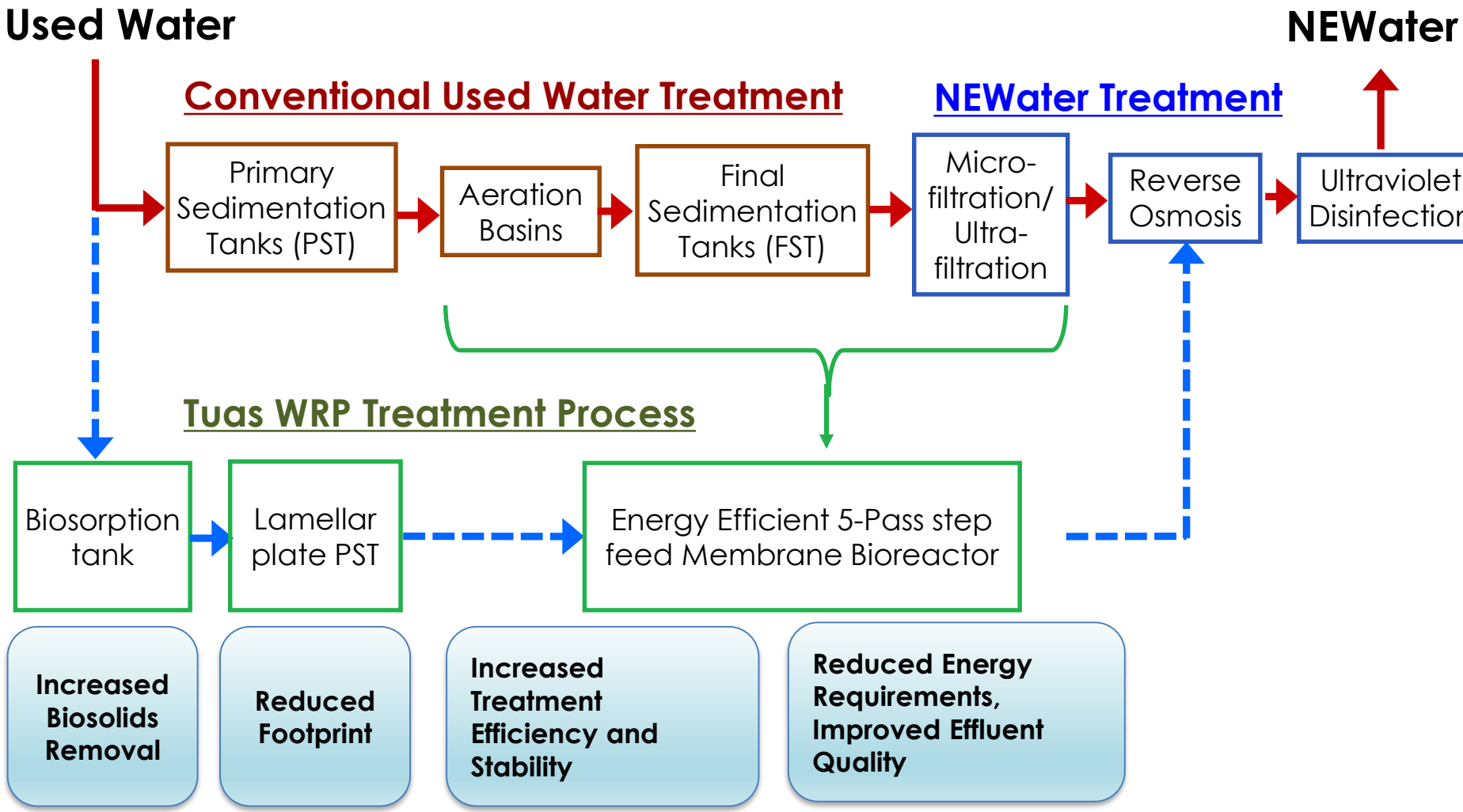
Night View of IVP

Conventional WRP Process Vs Membrane Bioreactor

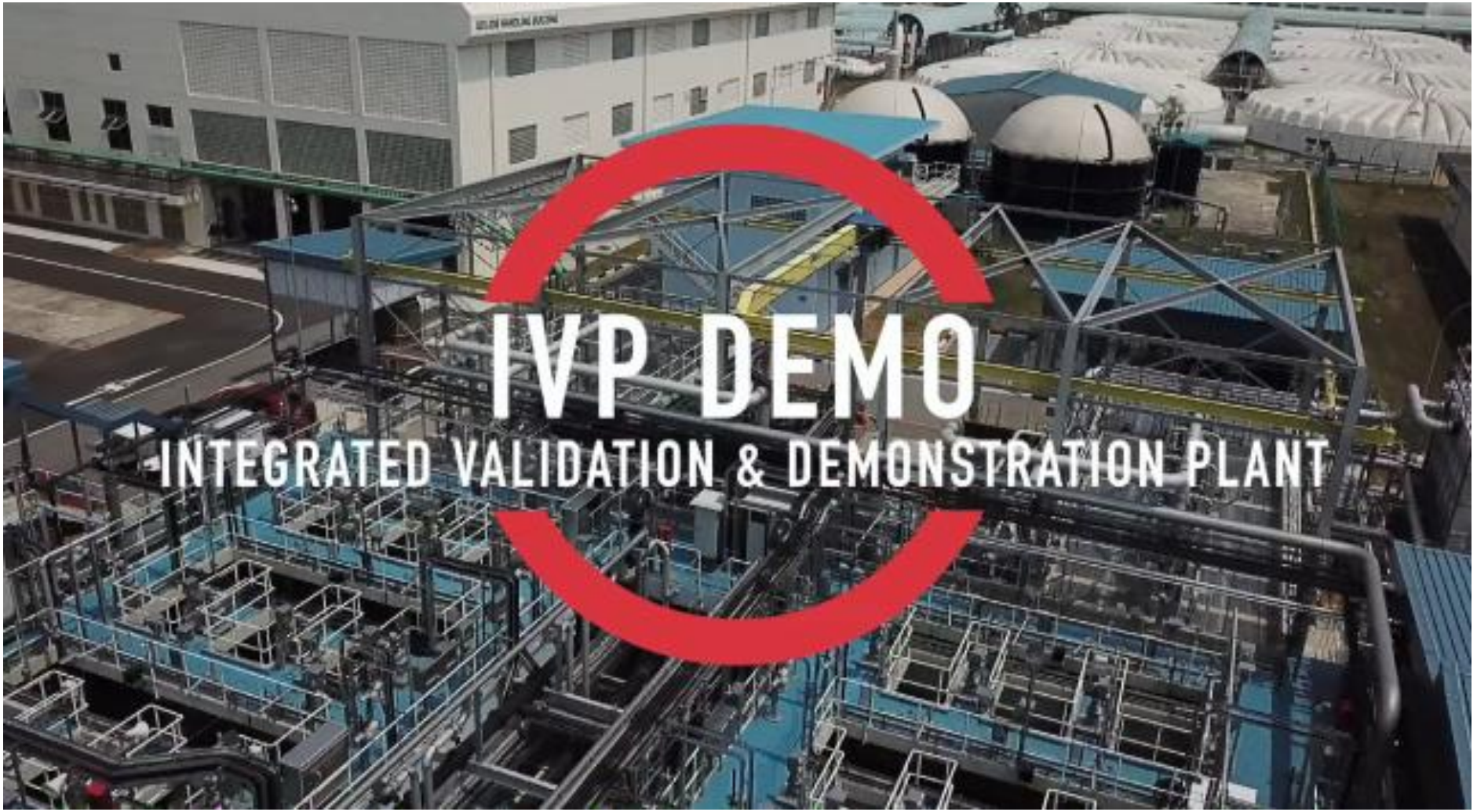


Parameters	Raw Sewage	Conventional	MBR
		Final Effluent Quality	Product Water Quality
BOD5	233 mg/l	3.7 mg/l	<1.0 mg/l
Suspended solids	277 mg/l	13 mg/l	(below detection limit)

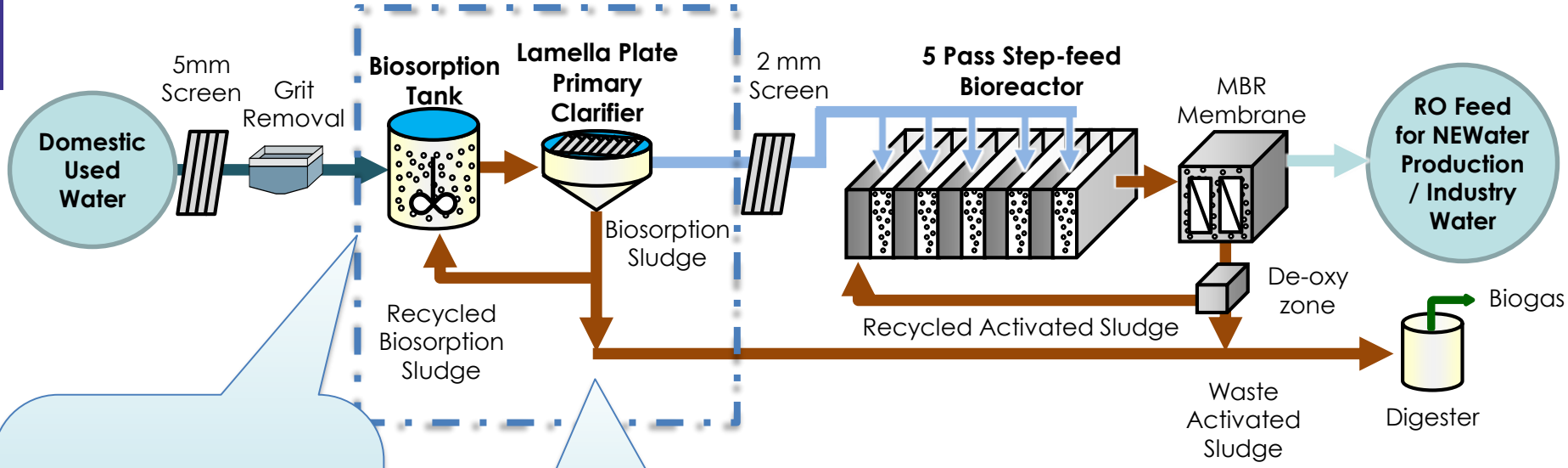
Conventional WRP Process Vs Tuas WRP Process



Integrated Validation and Demonstration Plant (IVP)



Biosorption Process for Enhanced Primary Treatment



Biosorption Tank

Biosorption process captures organics to **increase biogas generation** and **reduce aeration energy** requirements.

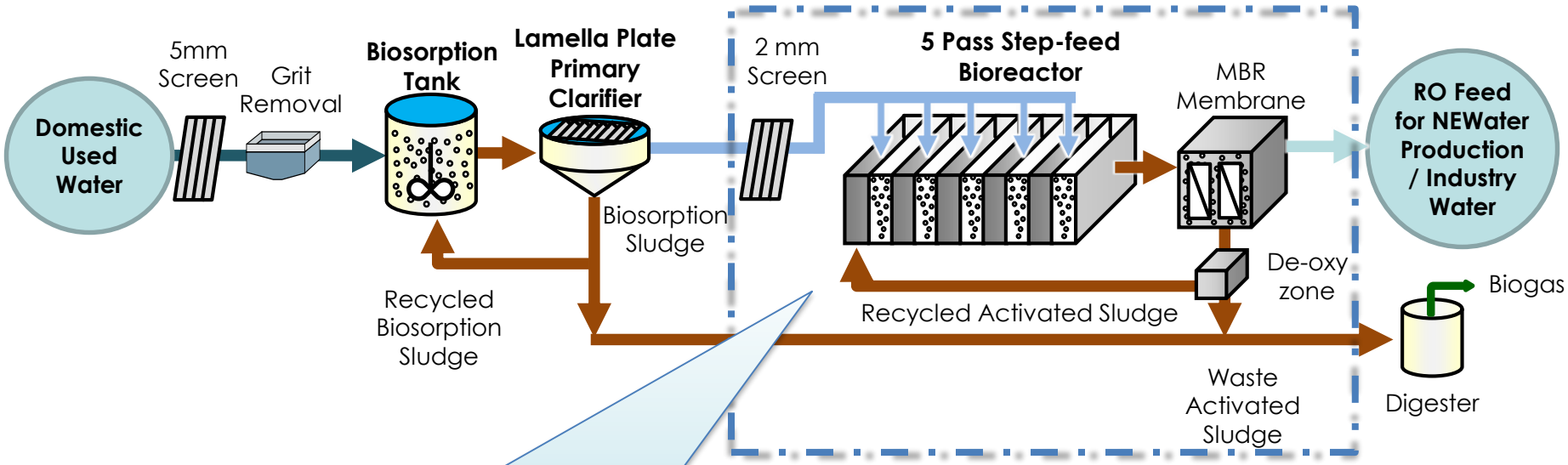
Lamella Plates

Lamella plates **reduce footprint requirements** with increased surface area for settling.

Biologically Enhanced Primary Treatment

- 20% more COD capture than conventional primary treatment
- Biosorption HRT : 0.5 hour
- Ratio of Lamella Plate Settling Area and Installation Floor Area : 10

Step Feed MBR for Nutrient Removal and Energy Optimisation



5-Pass Step Feed

Step-feed process can be configured for different treatment requirements, such as N or P removal.
Man-less automation strategies are being tested for effective and energy efficient operation.

Step-Feed Membrane Bioreactor

- Primary Effluent Distribution: 20% each basin
- Bioreactor HRT: 5 hours
- Bioreactor SRT: 5-7 days
- Lowest MLSS in last basin: 2,000 mg/l
- State-of-the-art Membrane Scouring Technology
- Design net/ peak flux: 20/ 30 lmh

MBR Membrane Air Scouring

The lowest for sustainable membrane operation for over 3 years

- 20% of the conventional MBR membrane scouring energy : <**0.04 kWh.m^{-3}** (conventional MBR membrane scouring energy: ~0.2 kWh.m^{-3})
- About half of the aeration blower pressure
- There is **no chemical recovery cleaning** since the start of operation in August 2017
- Less than 25% of TMP increase required for chemical recovery cleaning after 38-month of operation

Building a Smart WRP

Process Control, Monitoring & Simulation

Improve performance and efficiency of processes

Data Analytics & Visualisation

Dashboard monitoring of KPI with data cleaning, analytics and automated reports

Predictive Maintenance

Use of non-intrusive sensors for condition monitoring of critical equipment

Smart Safety & Security

Enhance safety of plant personnel and security of premises

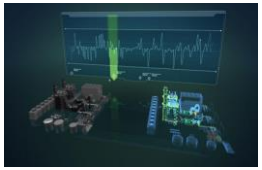
***Man-less* Operations**

Autonomous systems and automated processes to reduce mundane work

Smart IVP – Piloting digital technologies

Animation Video

Smart Features Piloted at IVP



Digital Twin
Training & Simulations

Geofencing

Wireless
Sensing

AI Driven Advanced
Process Control

Integrated
IoT Dashboard

2.75 MGD Integrated
Validation Plant

2026

Most Technologically
Advanced TWRP

2017

Smart Devices
for Maintenance

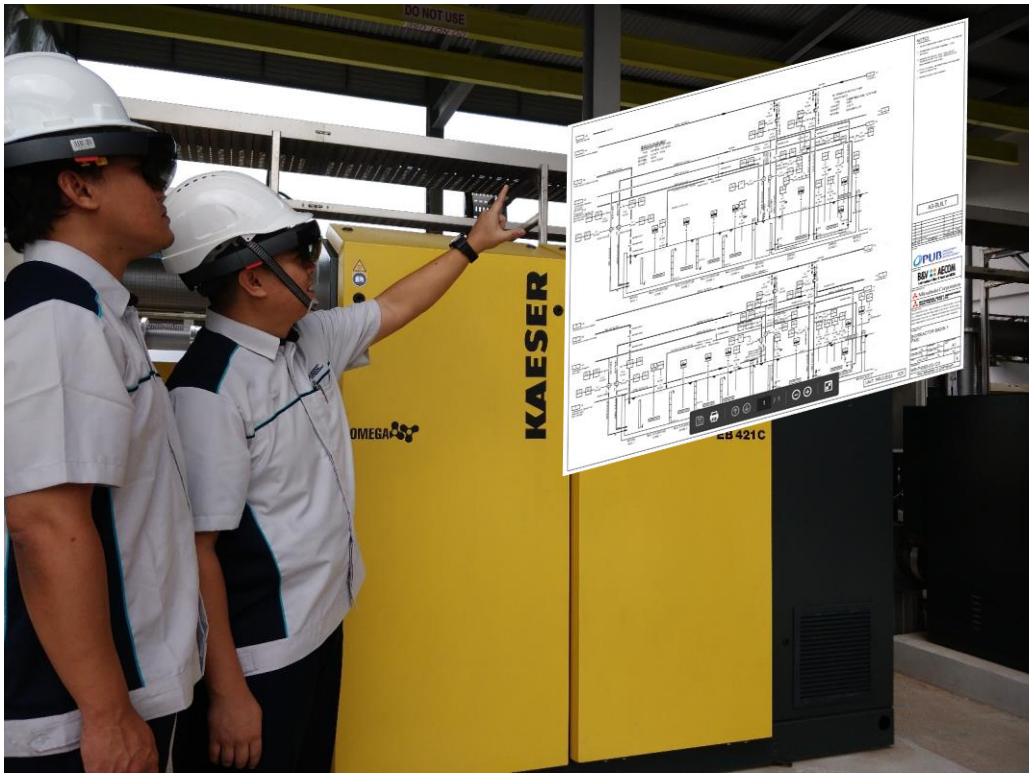
CCTV Monitoring
Water Quality

Location
Tracking

Condition
Monitoring

Autonomous Robot
Surveillance &
Sample Collection

Smart Devices for Maintenance



Microsoft HoloLens

- Hands-free viewing of technical documents
- Remote mentoring with off-site expert
- Digitalised maintenance procedures for training

Smart Devices for Maintenance – Guided Maintenance Procedure

Digitalised Maintenance Procedures for Training

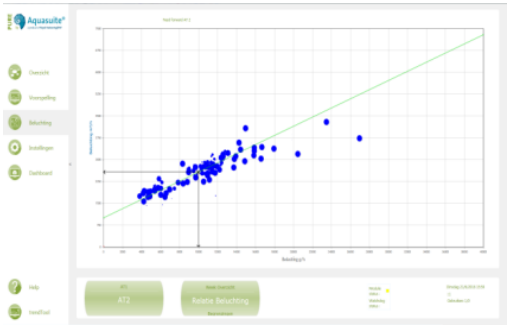
Smart Devices for Maintenance – Remote Mentoring

Remote Mentoring with Offsite Expert

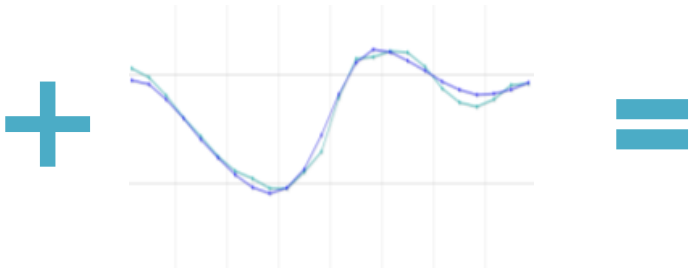
AI Driven Advanced Process Control

APC for Bioreactor Aeration Control

- Reduced need for manual intervention
- Optimised process aeration energy



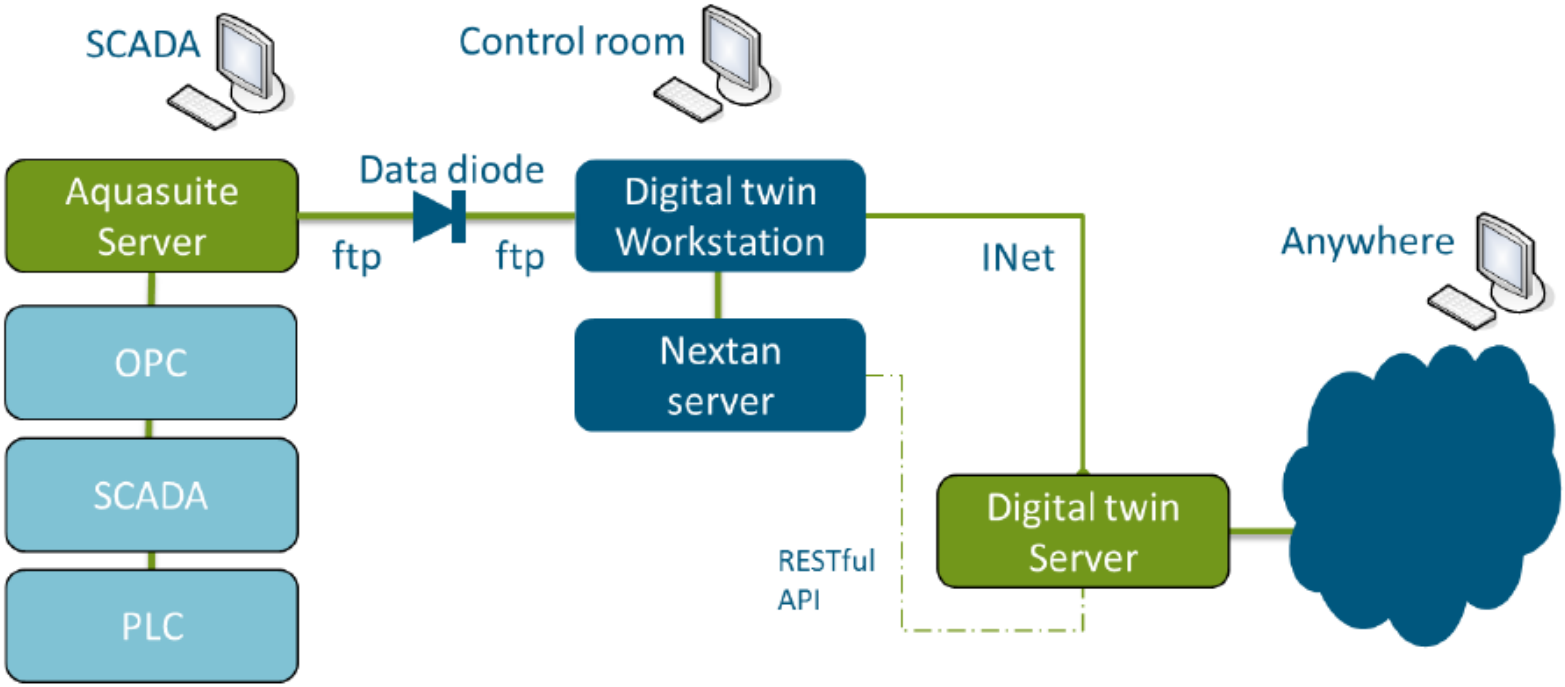
Machine learning



Incoming load prediction

48-hours prediction & control

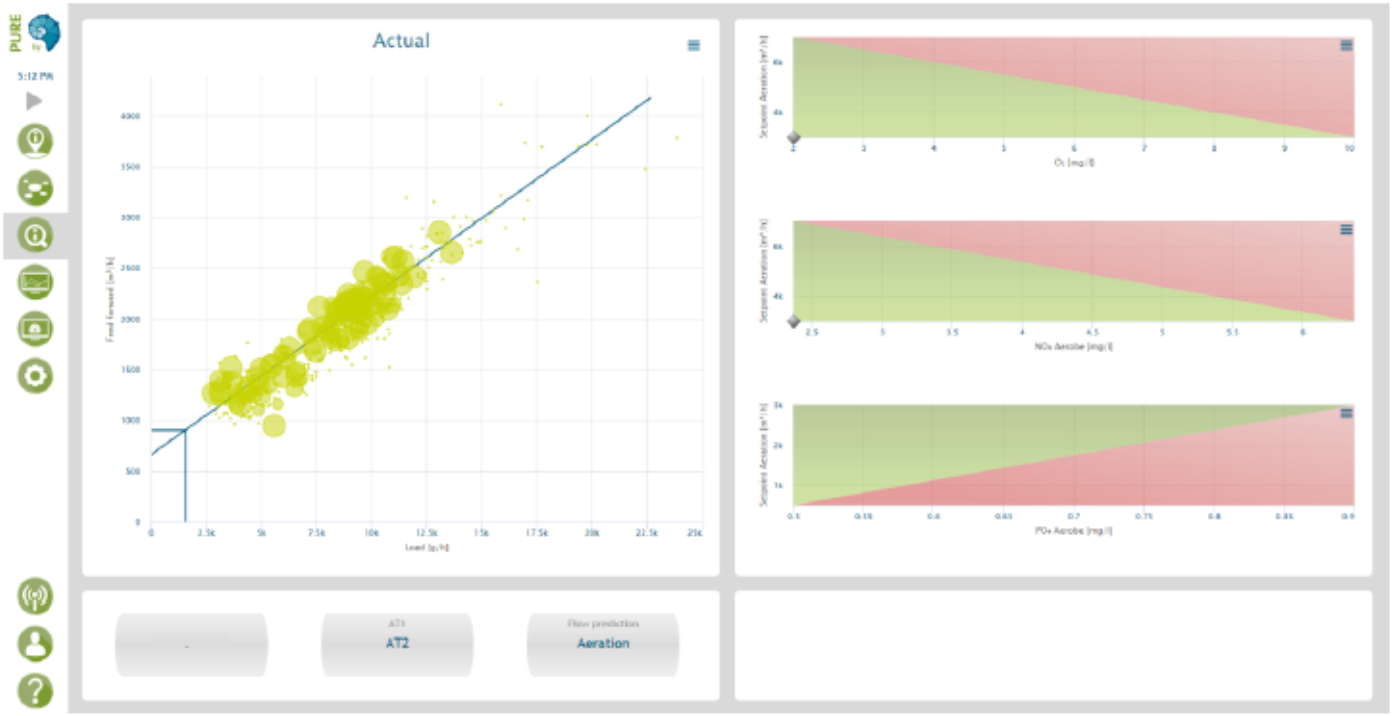
AI Driven Advanced Process Control



AI Driven Advanced Process Control

Flow Prediction Dashboard

AI Driven Advanced Process Control



Machine Learning – Aeration against Load

Autonomous Robots – Water Sample Collection

AIRobot – Autonomous Robot

**Air* means water in Malay

Future Outlook – Water Reclamation

Water Reclamation

Attain high water recovery for NEWater production (>90%)

Energy Efficiency

Adopt energy and chemical efficient processes

Digital Transformation

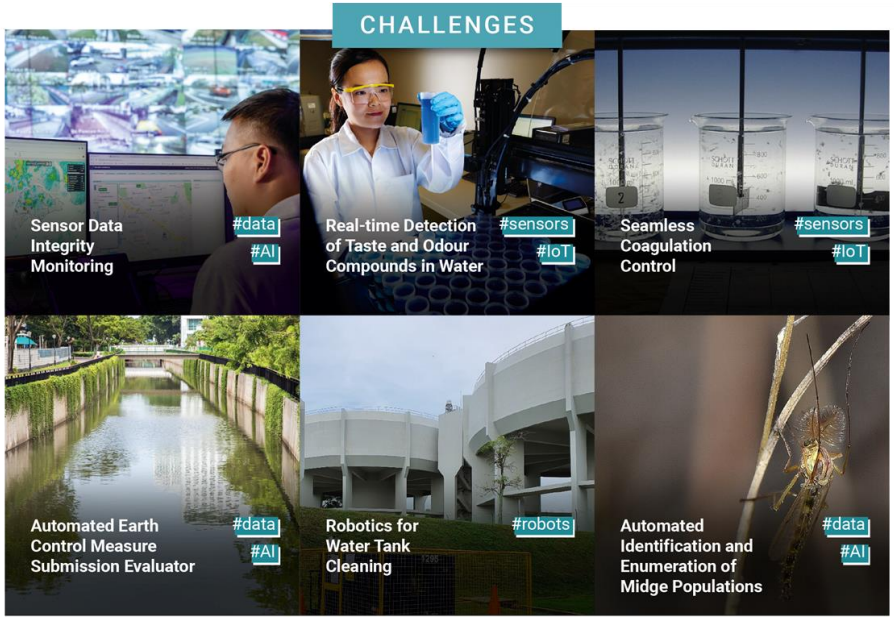
Implement digital technologies for efficient, resilient and safe operation and maintenance

Resource Recovery

Improve resource recovery for sustainability (phosphorus, nitrogen and others)

PUB Global Innovation Challenge

Seeks to accelerate PUB's discovery and adoption of digital solutions and smart technologies to improve operational excellence and meet future water needs



Timeline

Application	Evaluation	Interview	Pilot
September	Early November	Mid November	2021 - 2022

https://pub.gov.sg/innovationchallenge

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Thank You
Q&A