



The Metropolitan

Water Reclamation District

of Greater Chicago

**WELCOME
TO THE MARCH EDITION
OF THE 2016
M&R SEMINAR SERIES**

BEFORE WE BEGIN

- **SAFETY PRECAUTIONS**
 - PLEASE FOLLOW EXIT SIGN IN CASE OF EMERGENCY EVALUATION
 - AUTOMATED EXTERNAL DEFIBRILLATOR (AED) LOCATED OUTSIDE
- PLEASE SILENCE CELL PHONES OR SMART PHONES
- QUESTION AND ANSWER SESSION WILL FOLLOW PRESENTATION
- PLEASE FILL EVALUATION FORM
- SEMINAR SLIDES WILL BE POSTED ON MWRD WEBSITE (www.MWRD.org: Home Page ⇒ Reports ⇒ M&R Data and Reports ⇒ M&R Seminar Series ⇒ 2016 Seminar Series)
- STREAM VIDEO WILL BE AVAILABLE ON MWRD WEBSITE (www.MWRD.org: Home Page ⇒ MWRDGC RSS Feeds)

ZHIGUO YUAN, Ph.D.

Current: Director of the Advanced Water Management Centre (AWMC) at The University of Queensland, Brisbane, Australia


Experience: - *Postdoctoral research fellow*, in wastewater management at Ghent Univ., Belgium
- *Postdoctoral research fellow*, *Deputy Director*, and *Professor* at AWMC of The University of Queensland, Australia
- *Founder*, three biotechnology businesses namely SeweX, Cloevis and Lodomat
His research has delivered documented savings of over \$400 million to the Australian water industry

Education: Ph.D. in aeronautical engineering, Beijing University of Aeronautics and Astronautics, Beijing, China.

Professional: International Water Association (IWA) Fellow
Named as one of Australia's Top 100 Most Influential Engineers for 2015.
Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE).

Publication: over 280 fully refereed journal papers including a paper in *Nature* (2013) and *Science* (2014). His h-index is 52 (Scopus, Feb 2016), with over 8200 citations.

Award: 2015 ATSE Clunies Ross Award
IWA 2014 Global Project Innovation Award (Applied Research Category)



Innovative Solutions to Corrosion and Odor Problems in Municipal Sewer Networks

Professor Zhiguo Yuan, FTSE, IWA Fellow
Director, Advanced Water Management Centre
The University of Queensland



**THE UNIVERSITY
OF QUEENSLAND**
AUSTRALIA

Presentation outline

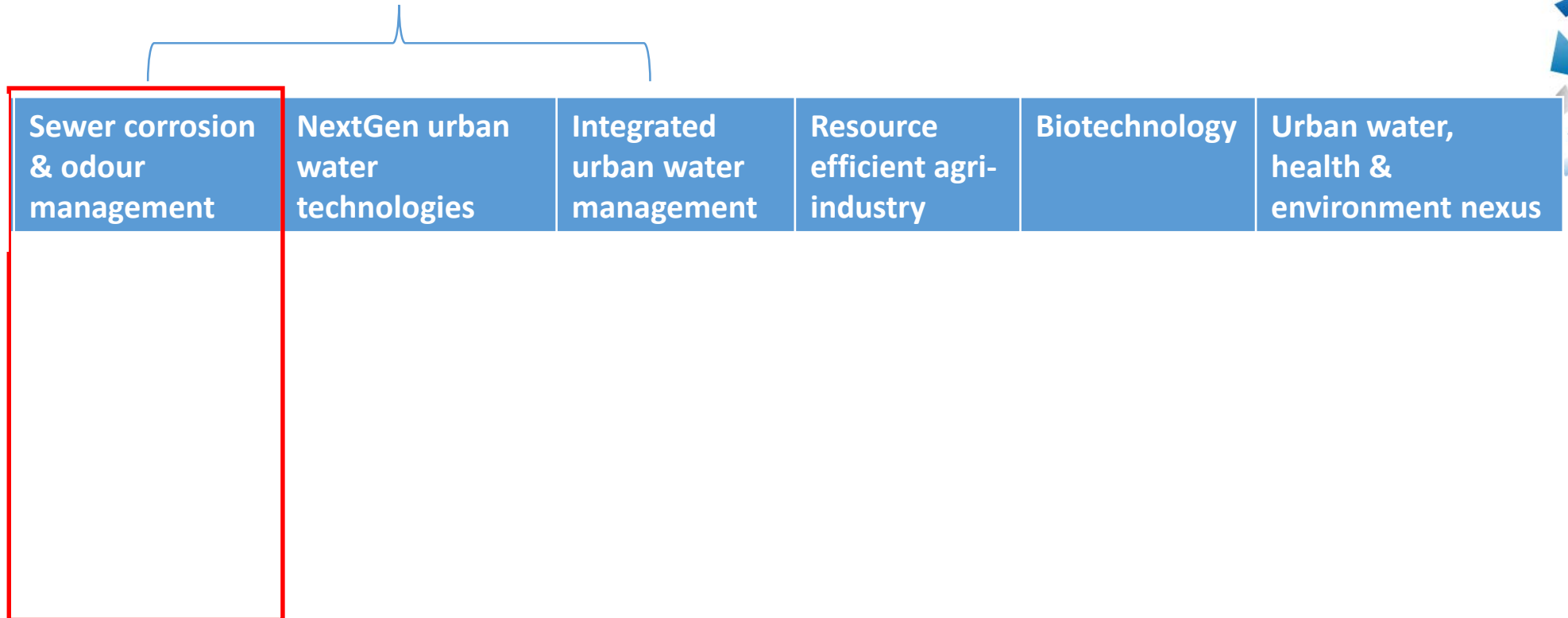
- Brief introduction to AWMC @ UQ
- Sewer research outcome highlights
- On-going activities

Introduction to AWMC @ UQ

- A significant water research center
 - ▶ >100 staff and PhD students
 - ▶ Annual budget \$8-9m
- Excellent synergy between fundamental and applied research
 - ▶ Delivered substantial industry benefits
 - ▶ 70 - 90 journal articles annually, papers in Nature and Science
- Three spin-offs
 - ▶ SeweX, Cloevis and Lodomat

Introduction to AWMC @ UQ

Urban water management

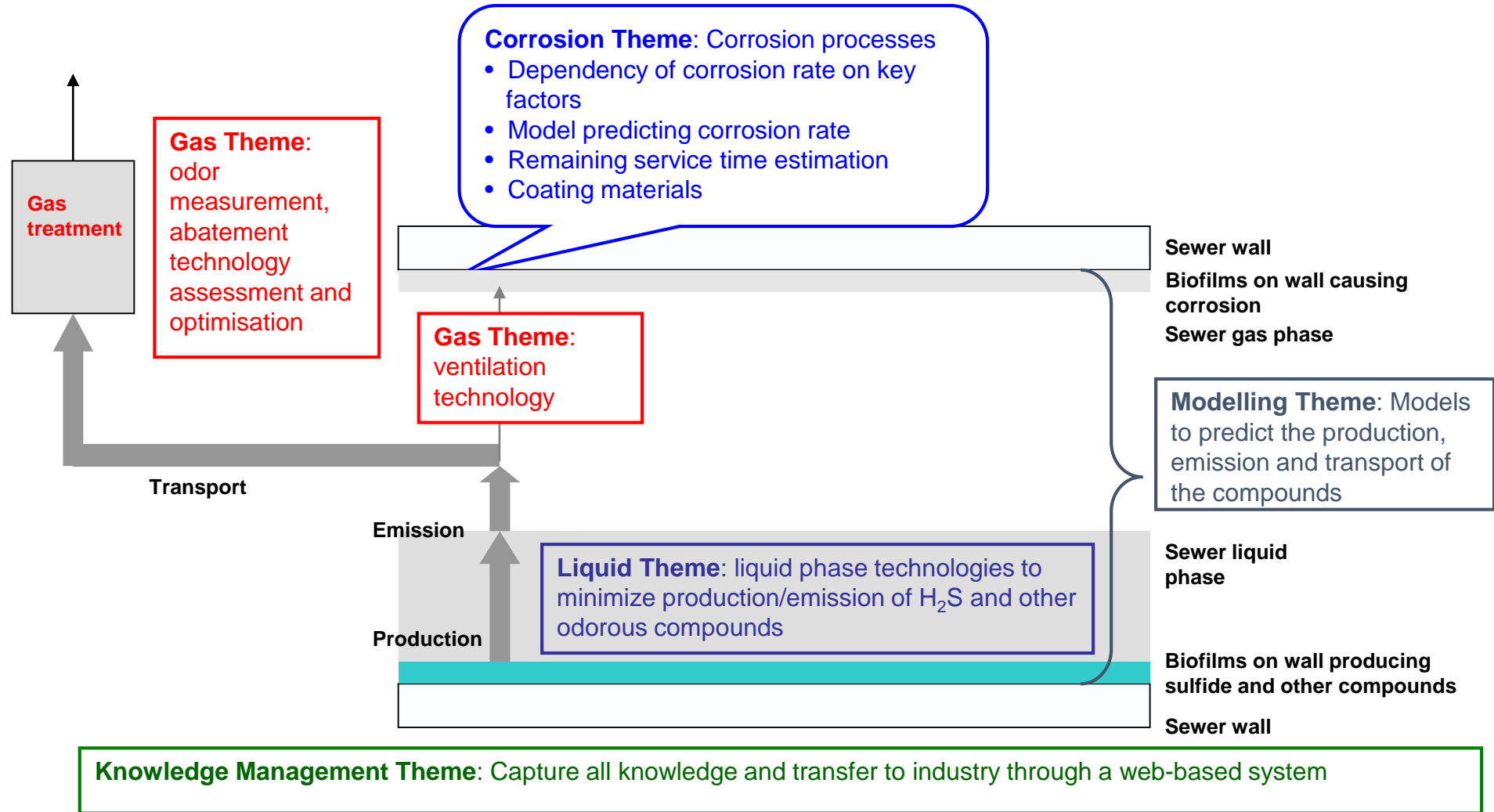


13 year research on sewer corrosion and odour

- ~\$30m research since 2003
- > \$400m cost savings by the Australian water industry
- Australian industry partners collectively serve 2/3 of the Aus. population, also overseas partners
- Two spin-offs (SeweX and Cloevis)
- > 100 papers including one in Science
- Several prestigious awards



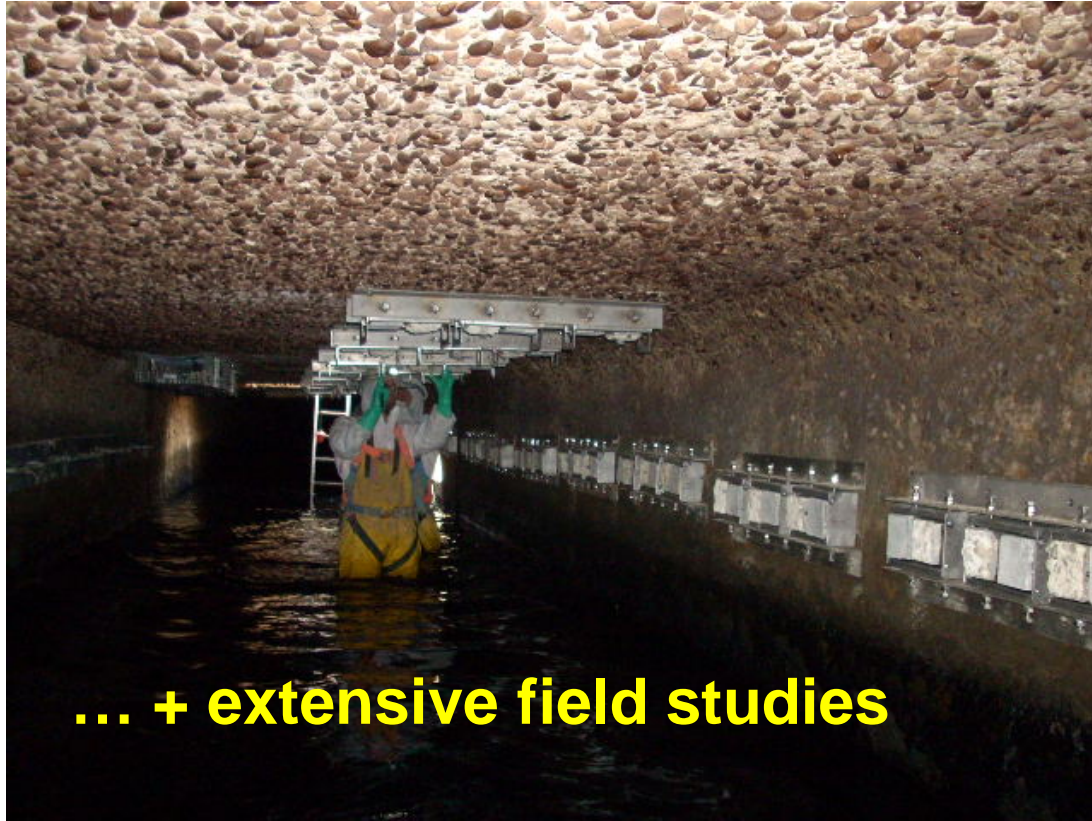
Sewer research scope



An integrated research approach



An integrated research approach



An integrated research approach

2 gravity mains: L=300m, $\Phi=250\text{mm}$

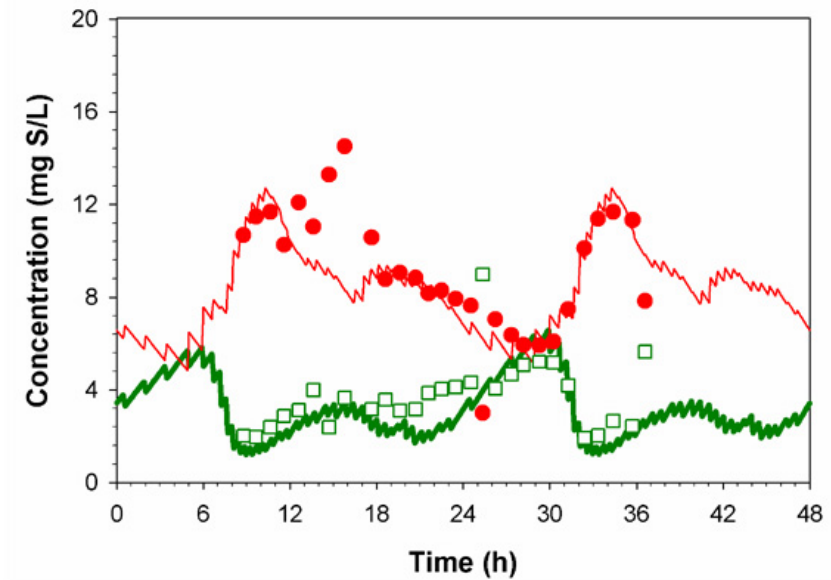
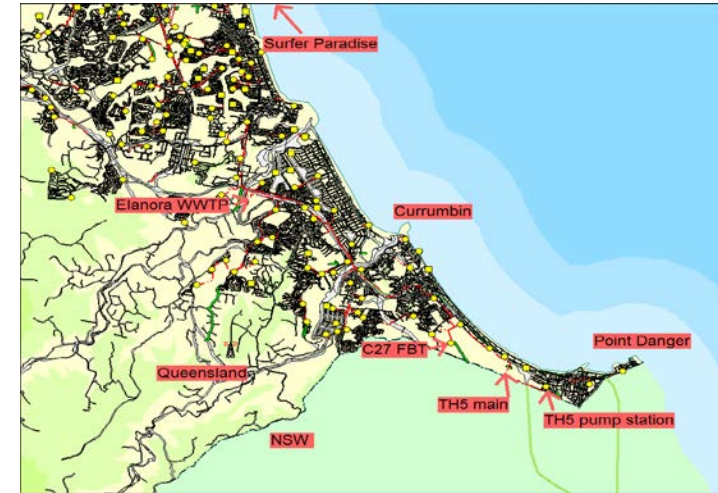
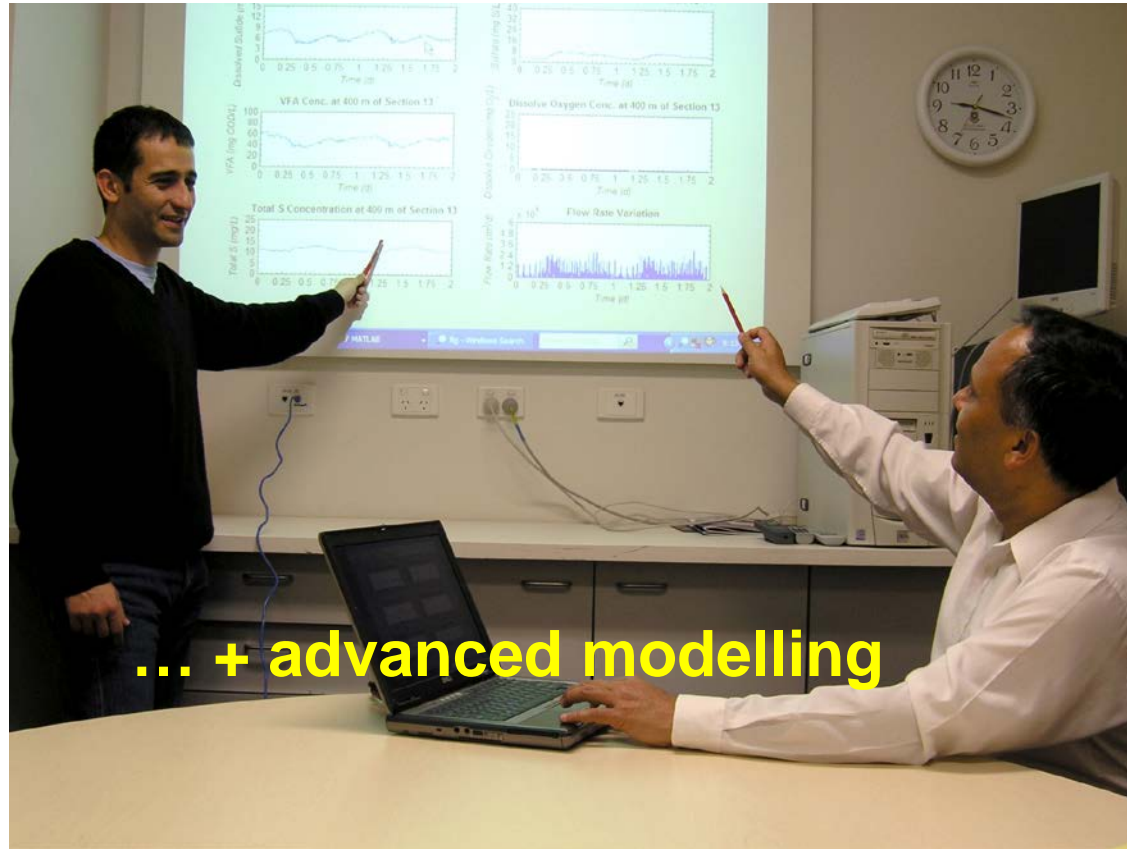


Innovation Center @ Luggage Point WWTP,
Brisbane

2 rising mains: L=300m,
 $\Phi=100\text{mm}$

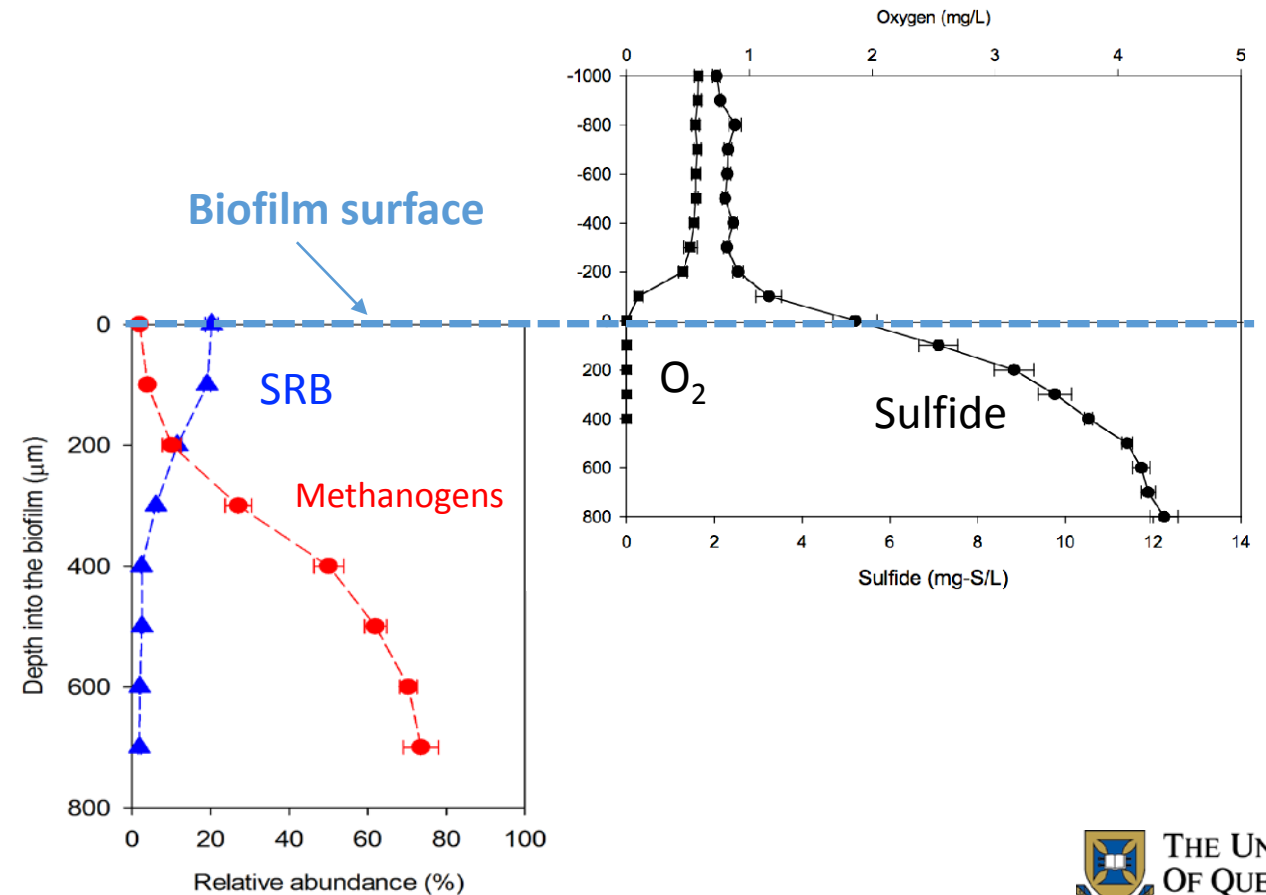
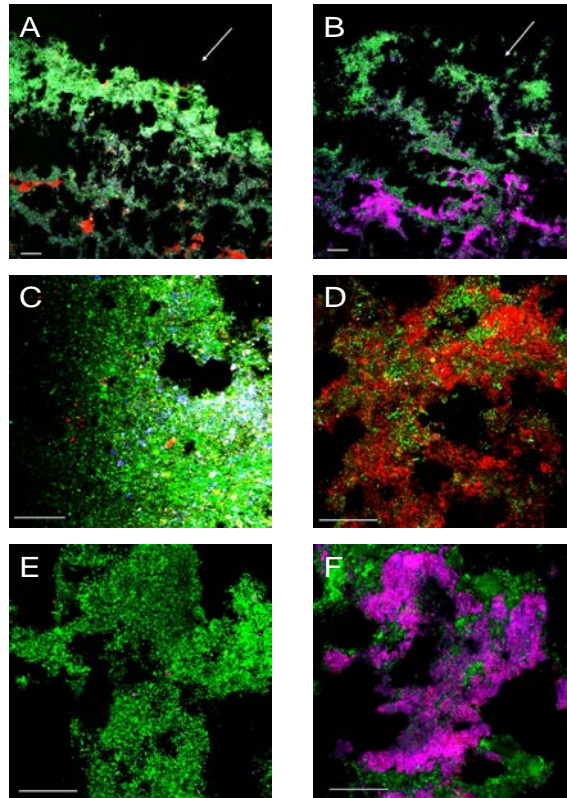


An integrated research approach



Outcomes: new knowledge

- Reactions in sewer biofilm
 - ▶ Submerged biofilms & processes
 - ▶ 'Corrosion' biofilms & processes



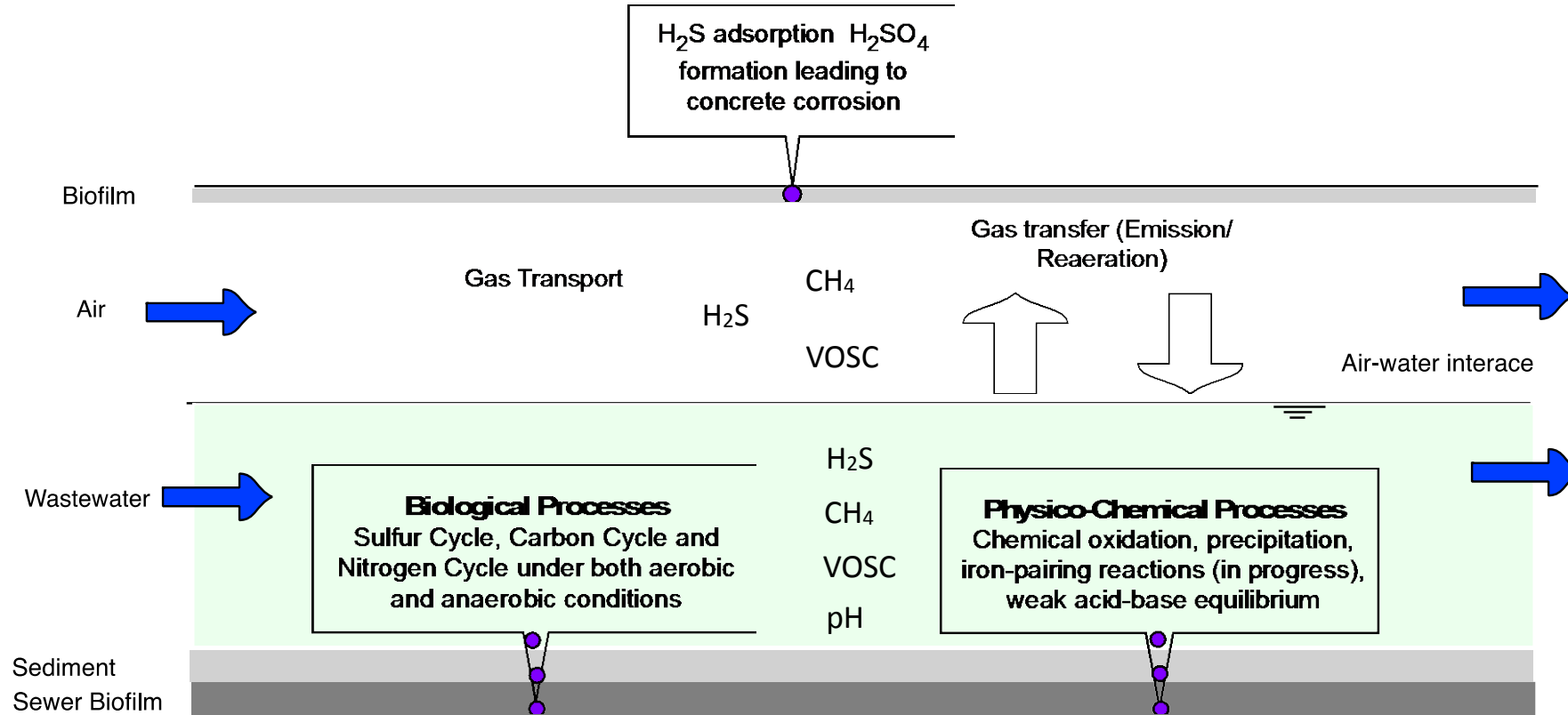
Outcomes: new knowledge

- Reactions in sewer biofilm
 - Submerged biofilms & processes
 - ‘Corrosion’ biofilms & processes
- How the commonly used chemicals work
 - ▶ Oxygen, nitrate, iron salts, $\text{Mg}(\text{OH})_2$, caustic
 - ▶ Guidelines
- Composition of odorous sewer air
 - ▶ Largest datasets
 - ▶ Performance of odour treatment units

Outcomes: new tools

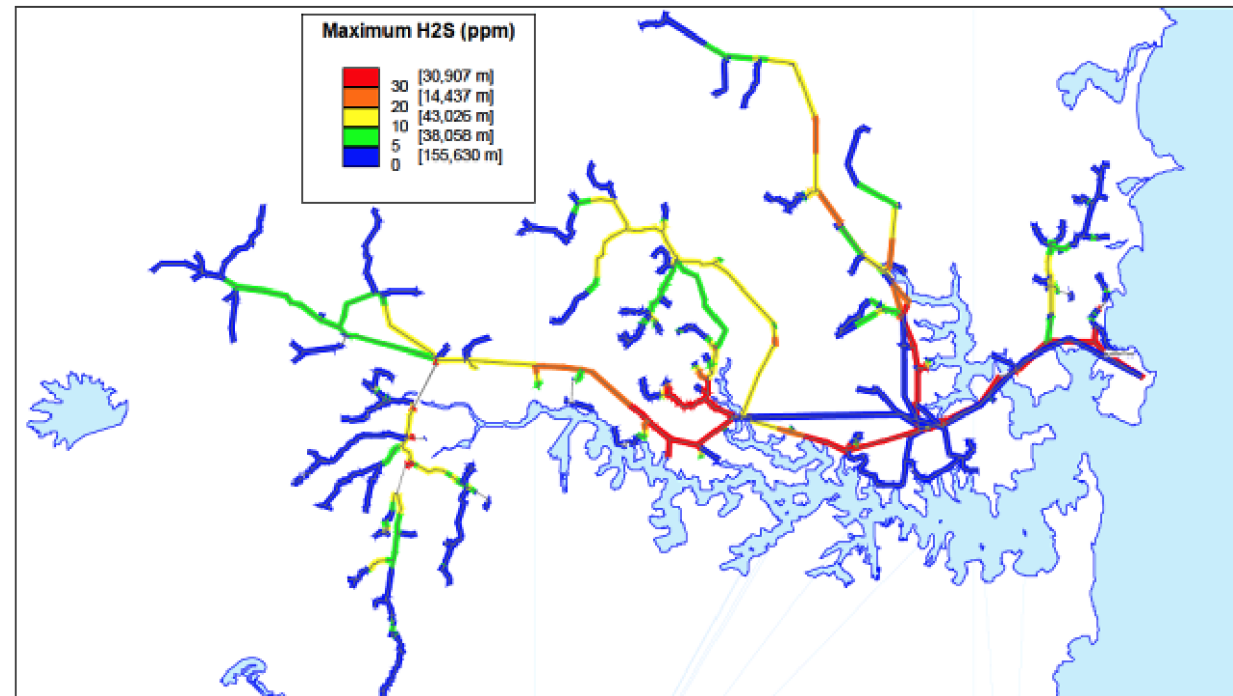
- Models
 - ▶ SeweX model as a planning and optimisation tool
 - ▶ Corrosion model to predict corrosion rate
 - ▶ SeweX and corrosion model to balance between corrosion and mitigation costs
- SCORE-CT for chemical testing
- Corrosion chambers
- Analytical tools
 - ▶ Reliable chemical analysis of sulfur species
 - ▶ On-line dissolved sulfide sensor
 - ▶ On-line dissolved methane sensor

Outcomes: new tools



Outcomes: new tools

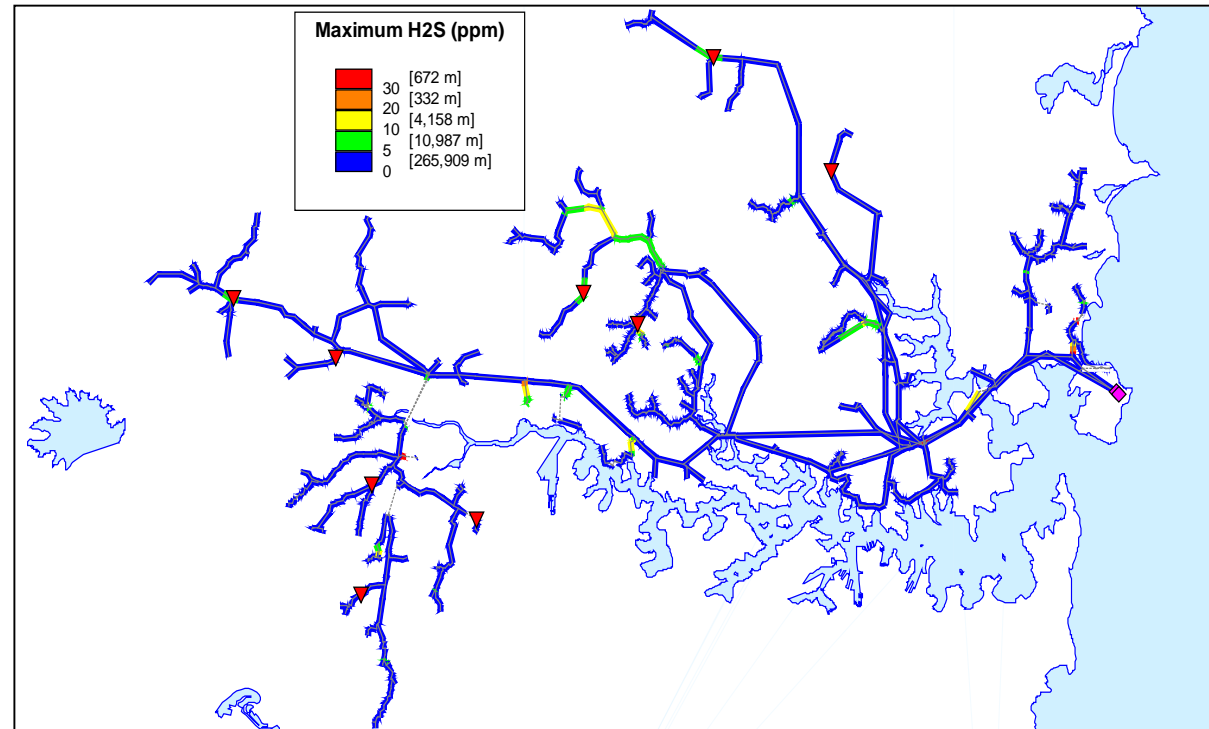
Application of the SeweX model to one catchment
saved SWC \$90 millions



SEWEX
Sulfide modelling and control in sewers.

Outcomes: new tools

Application of the SeweX model to one catchment
saved SWC \$90 millions

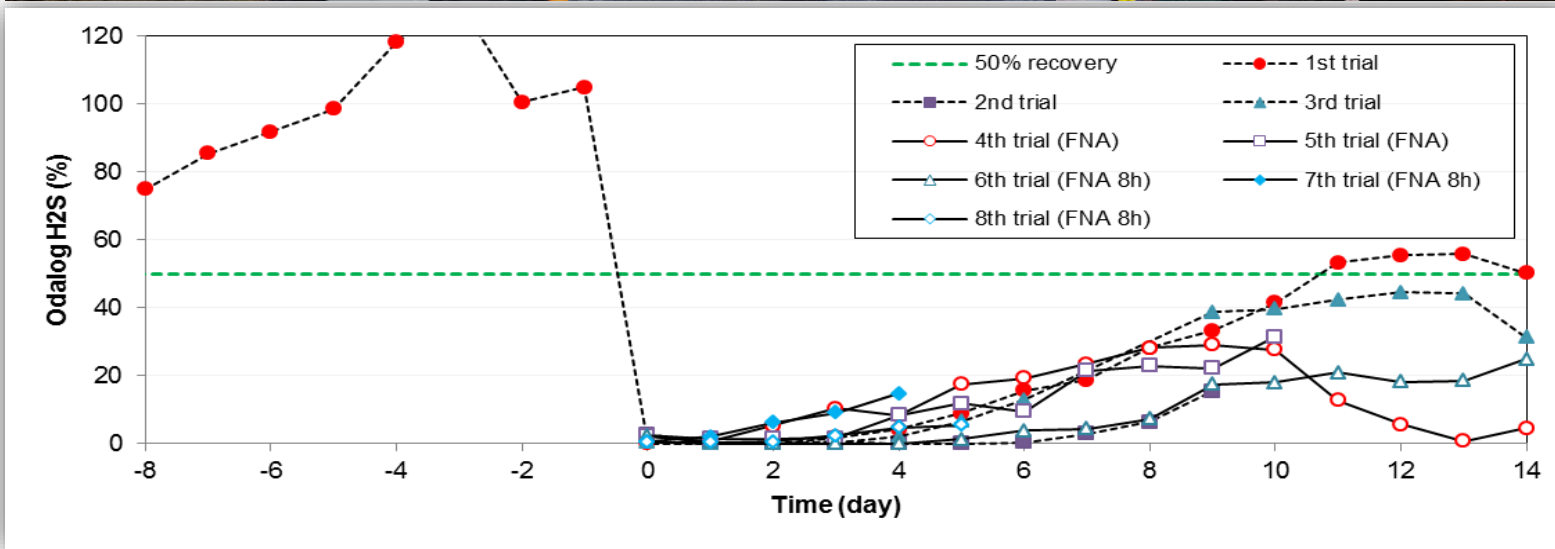


SEWEX
Sulfide modelling and control in sewers.

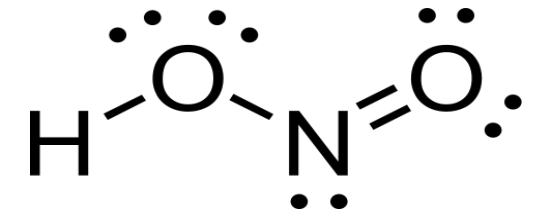
Outcomes: new technologies

- Cloevis
- Chemical free methods
- On-line control of chemical dosing
 - ▶ Easy 15 – 40% savings in chemical consumption
- ...

Outcomes: new technologies



Sulfide control through biofilm inactivation and removal



Outcomes: new technologies

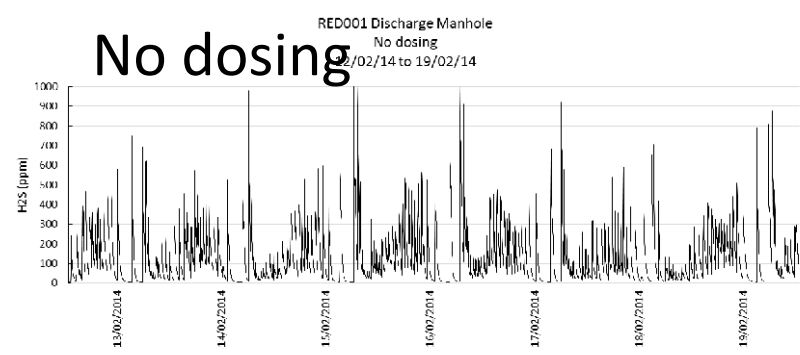


Figure 2(a) Sulfide readings (ppm) without dosing

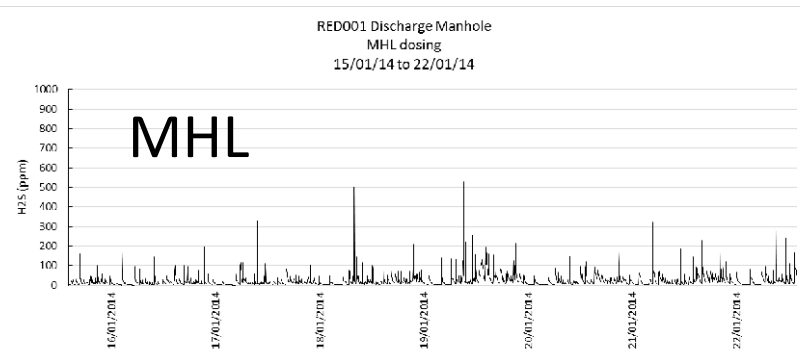


Figure 2(b) Sulfide readings (ppm) with MHL dosing

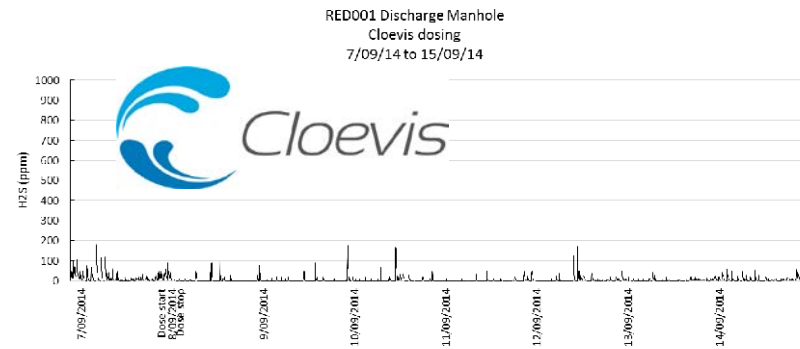


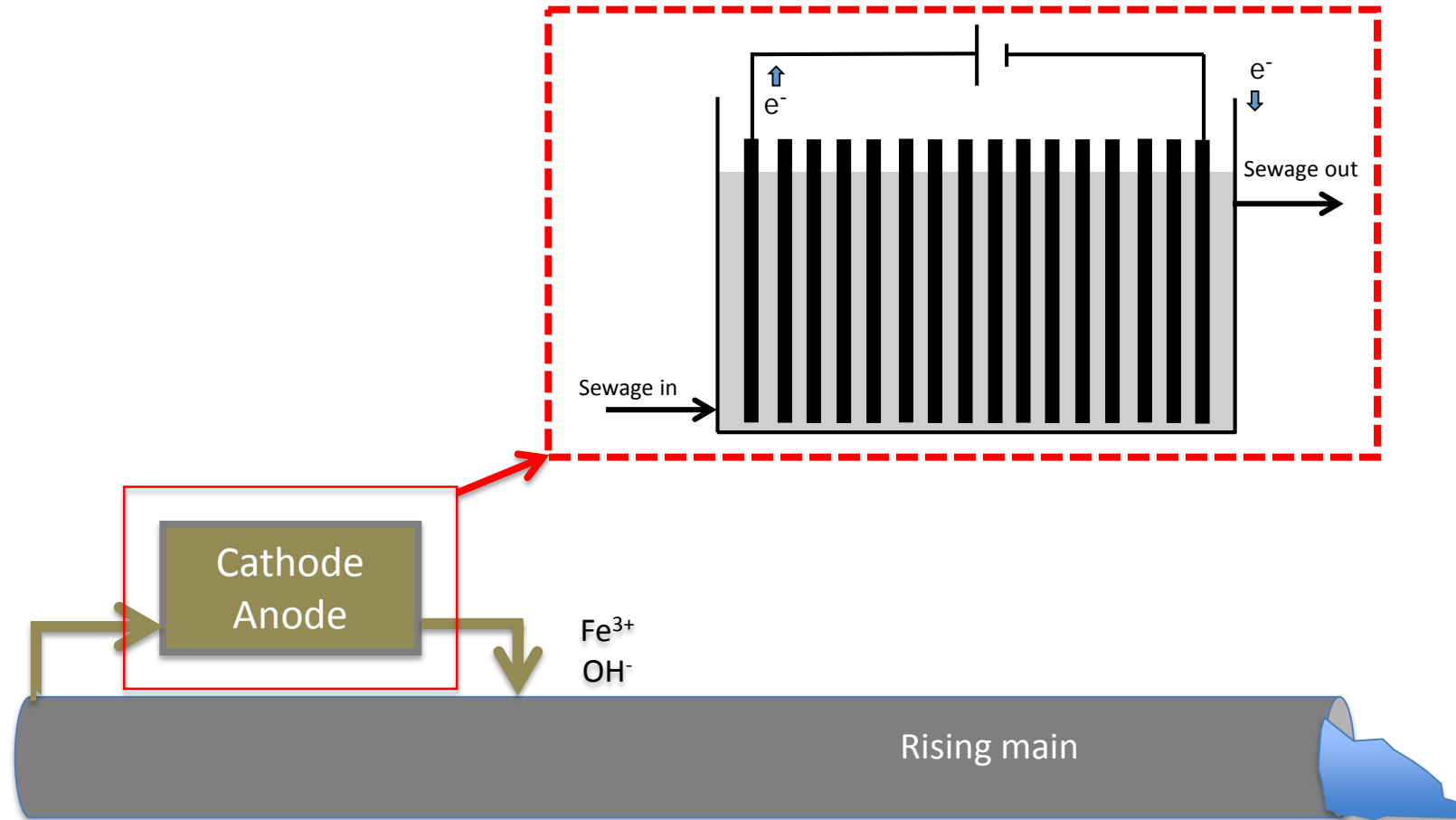
Figure 2(c) Sulfide readings (ppm) with FNA dosing for 6 hours on 08/09/2014

Second trial in Australia in 2014: Unitywater says “Cloevis solved an impossible problem”

Similar results were obtained in several case studies in the US by USP Technologies

Outcomes: new technologies

- In-situ $\text{Fe}^{2+}/\text{Fe}^{3+}$ production (on-going research)



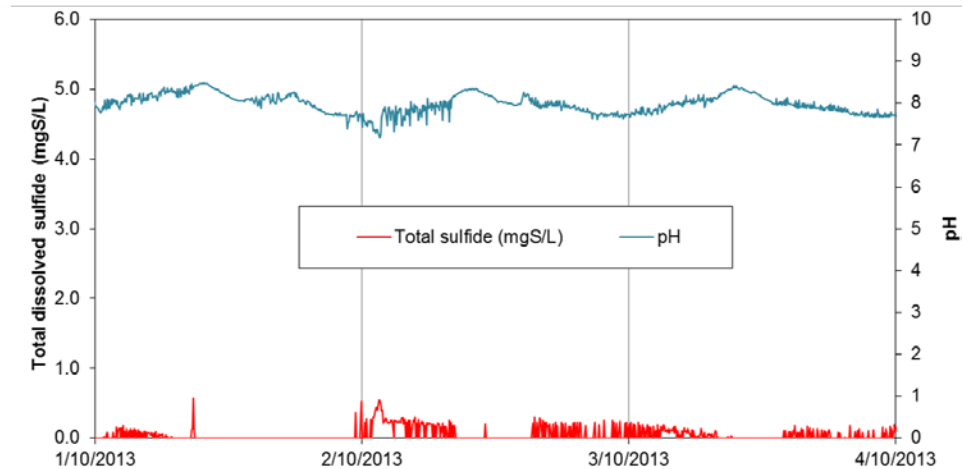
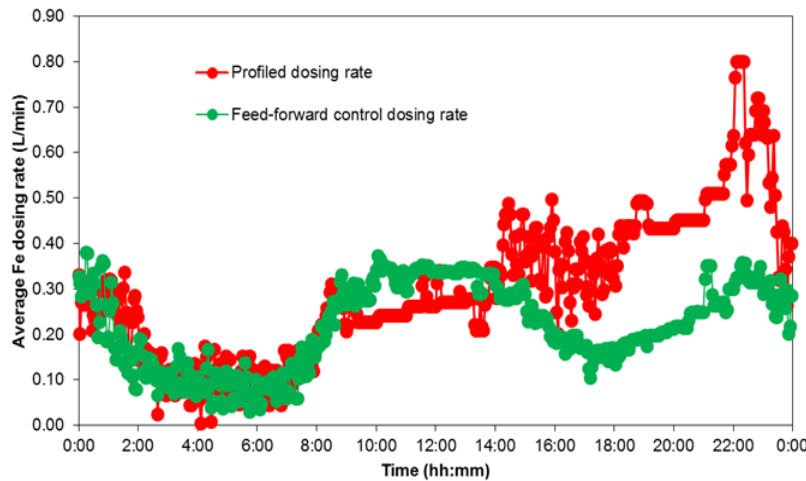
Outcomes: new technologies

- In-situ $\text{Fe}^{2+}/\text{Fe}^{3+}$ production (on-going research)



Outcomes: new technologies

- On-line control algorithms for chemical dosing (O_2 , NO_3^- , Fe_2^+/Fe_3^+ , $Mg(OH)_2$)



Parameters	No dosing	Profiled dosing	Feed-forward dosing
Sewage flow (ML/d)	21	20.9	20.9
pH	7.4 ± 0.2	7.3 ± 0.2	7.4 ± 0.2
Average TDS (mgS/L)	1.65	0.13	0.07
90% TDS (mgS/L)	3.08	0.46	0.23
Iron dosage (L/day)	0	433	318

25% chemical saving!
Annual saving can be higher due to rainfalls.

Enduring impact

The SCORE Symposium - Saving Dollars and Scents
Brisbane, July 8-9, 2013



Enduring impact

Web-based knowledge management system

Sewer Corrosion and Odour Research (SCORE) Project

Knowledge Management System (Draft)

Home

Investigate the potential odour and corrosion related issues in a new sewer system

Managing an existing sewer system


To have a better understanding of odour and corrosion issues in sewers

Shortcuts

Fact sheets

Provide feedback

Contact us



This page will guide you to explore various issues related to sewer corrosion and odour problems. The information has been collected from the reports generated by the SCORE project and other information available in the public domain.

Please select your objectives from the sidebar.

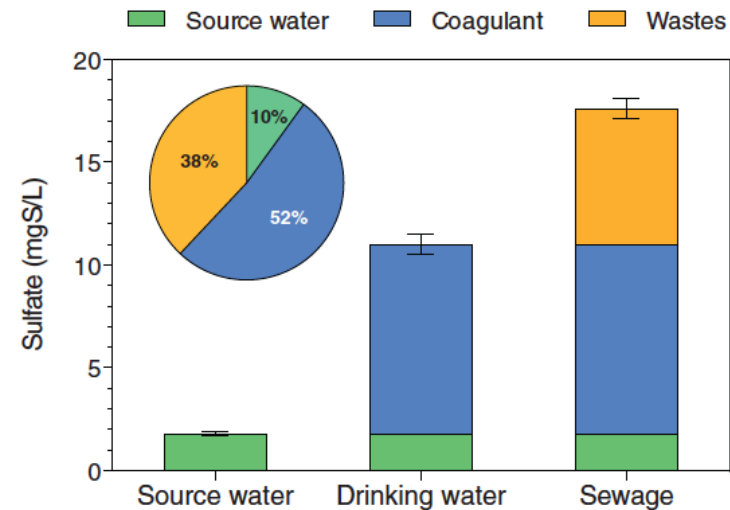
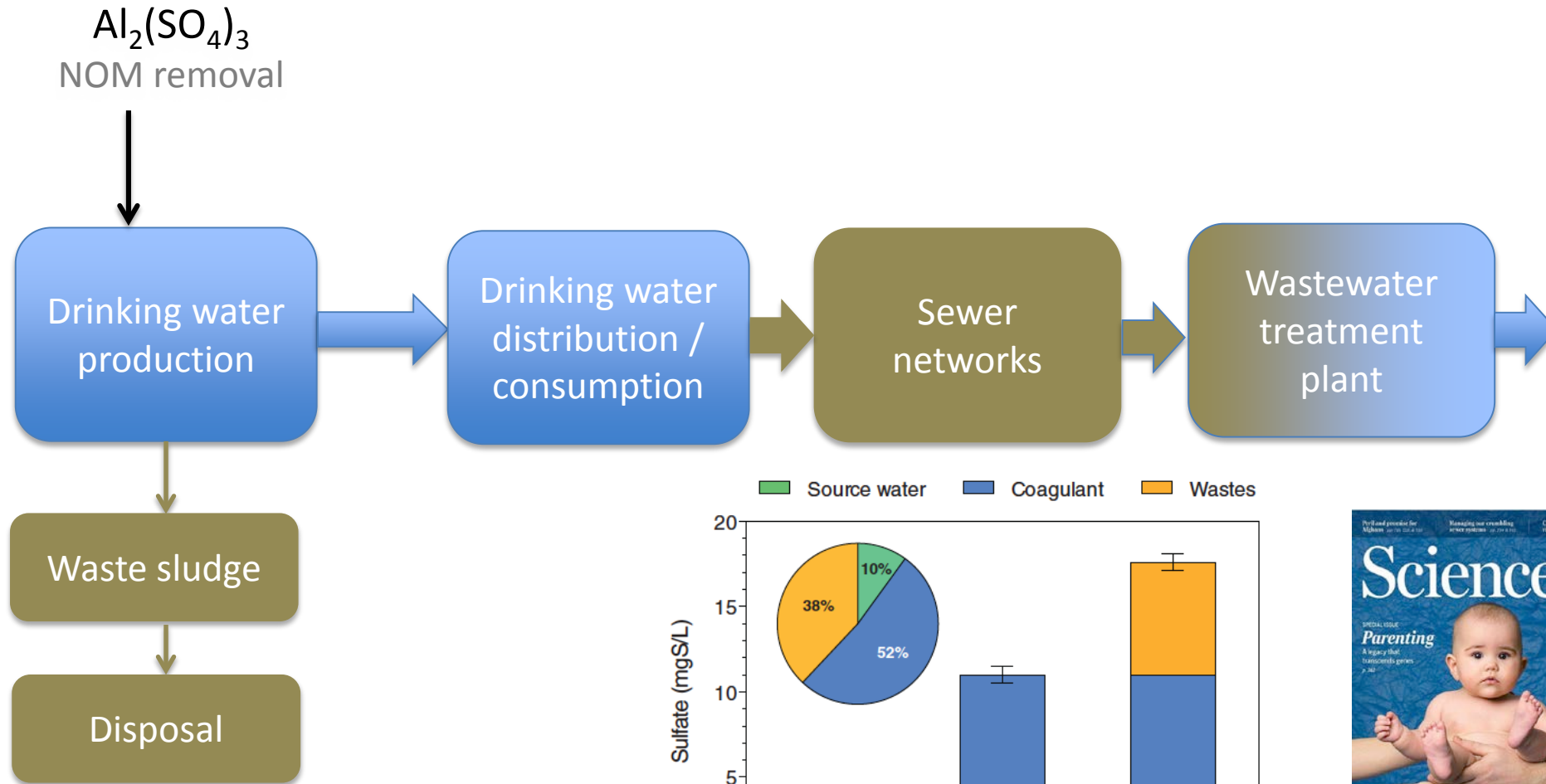
This document contains the information collected from the reports of the current SCORE project, previous ARC Linkage Project on Understanding of the In-Sewer Processes, research publications from the projects and other information available in the public domain. [Change here](#)

This page was last updated on April 29, 2011 9:15 AM.

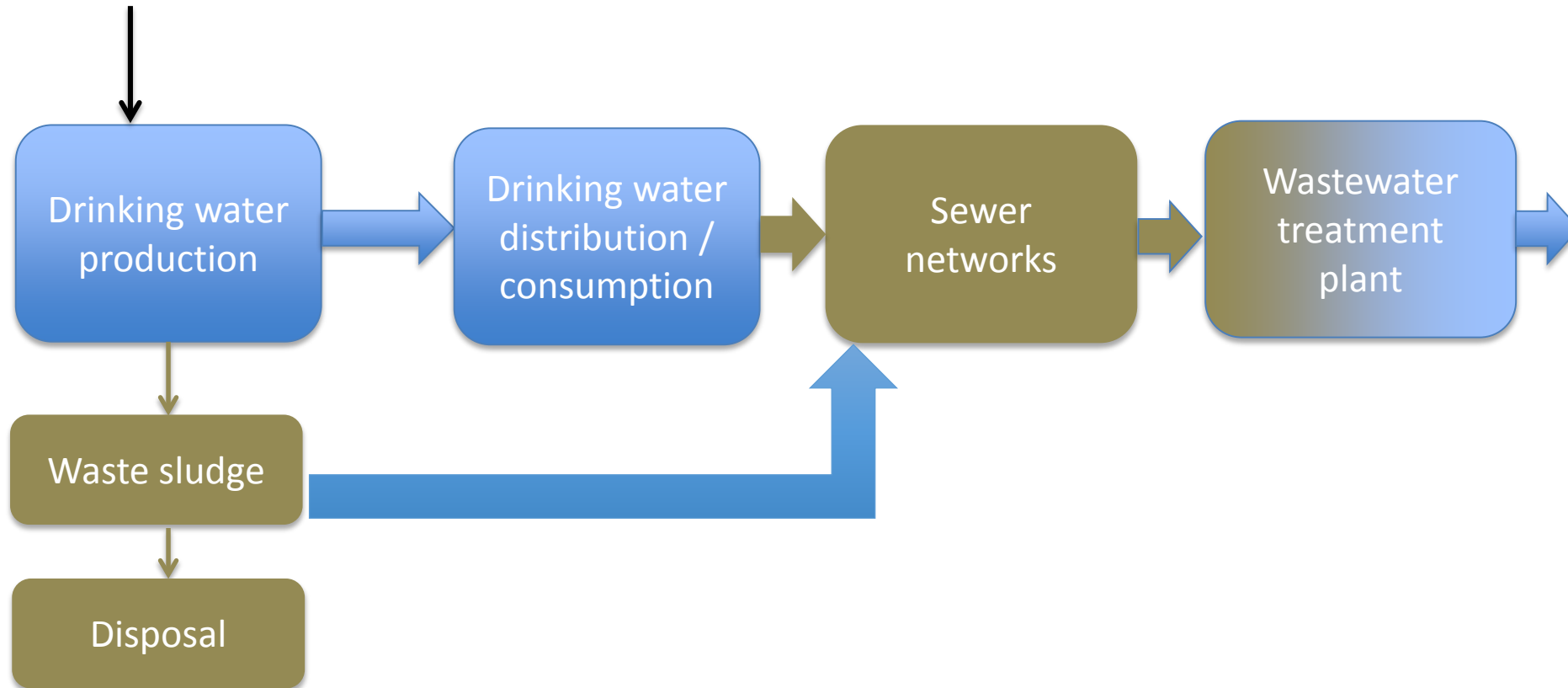
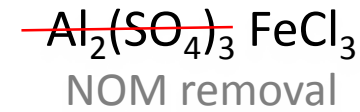
On-going activities

- Application of knowledge, tools and technologies
 - ▶ SeweX and Cloevis
- New research projects
 - ▶ An integrated approach to iron salts in urban water systems
 - ▶ Optimal integration of centralised and decentralised water and wastewater systems
 - ▶ Anti-corrosion concrete
 - ▶ Network-wide chemical dosing control
 - ▶ Sewage epidemiology

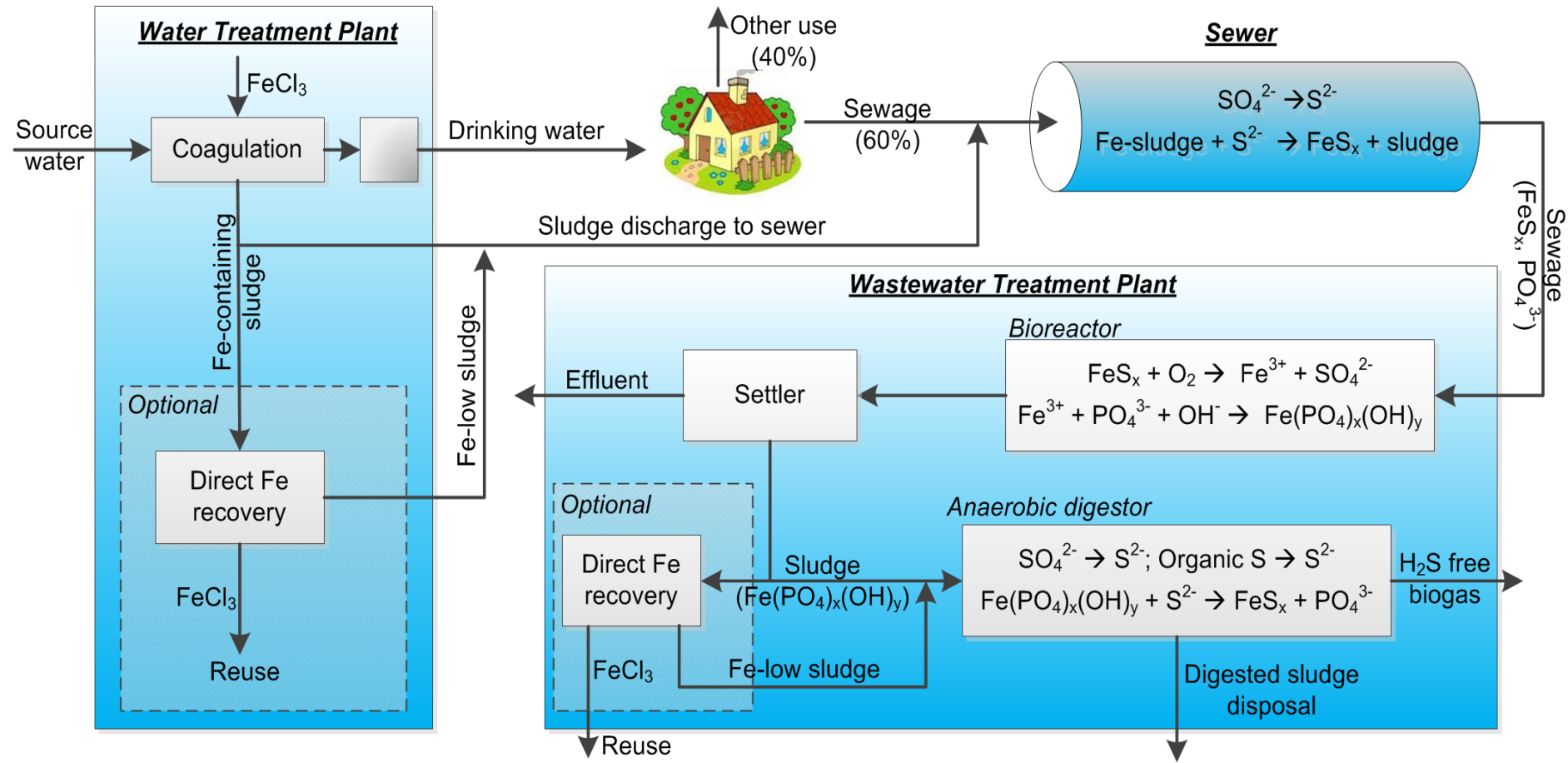
An integrated approach to iron salt use in urban water systems



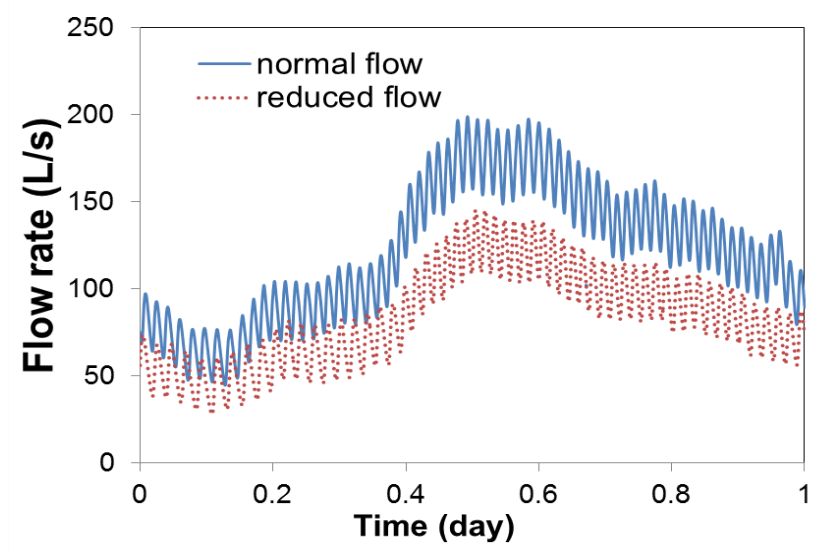
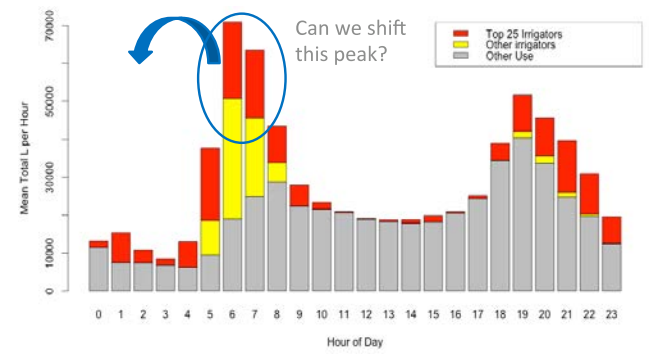
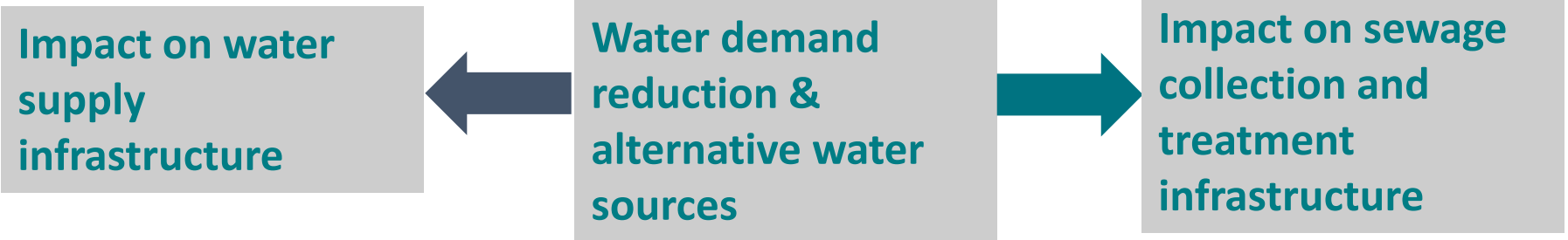
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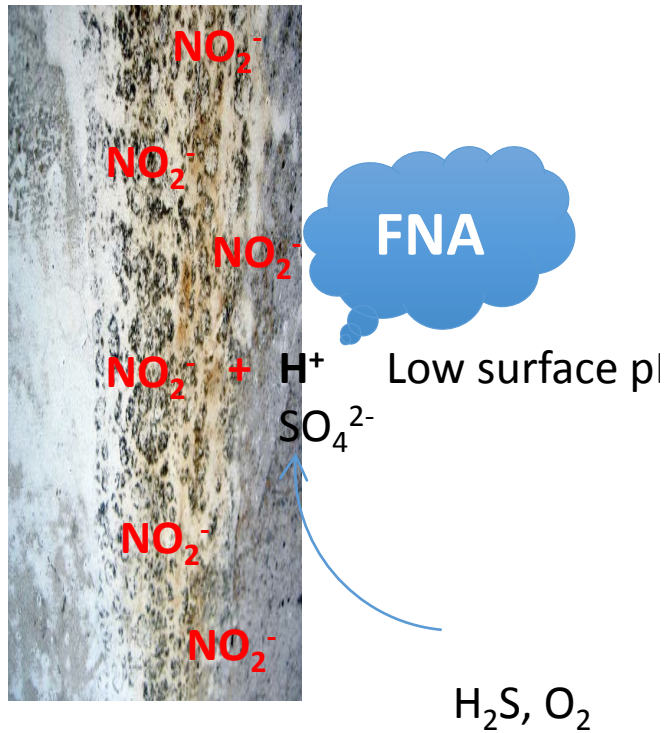
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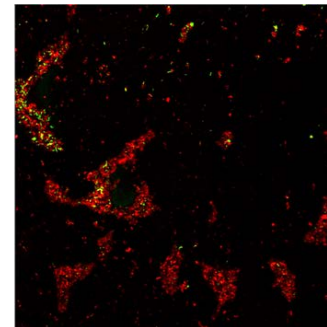
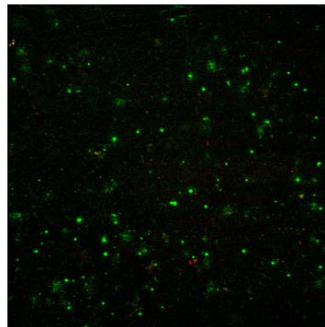
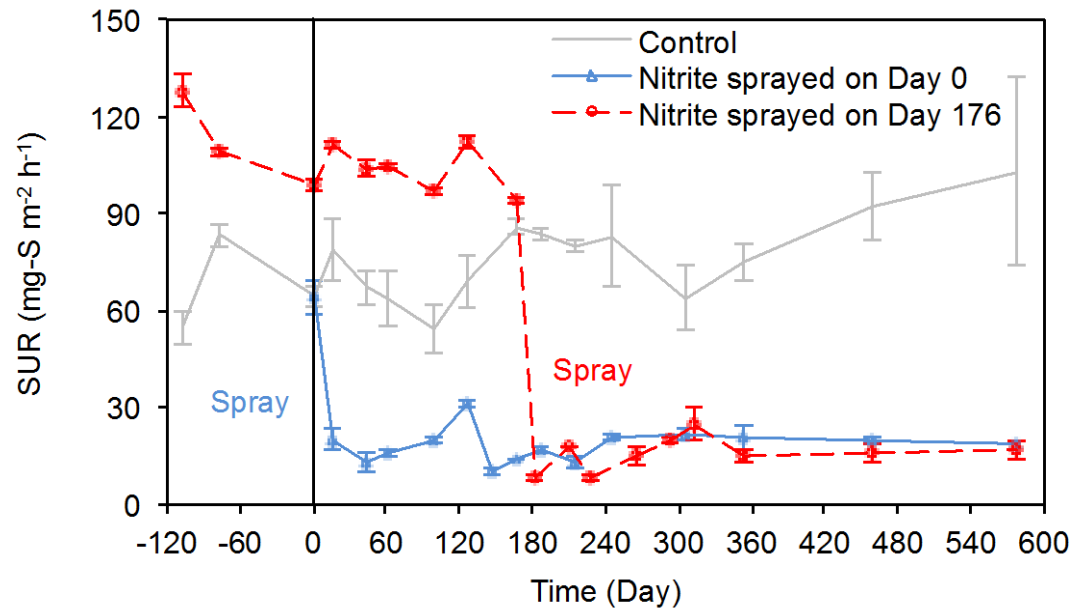
Interactions between centralised and decentralised systems



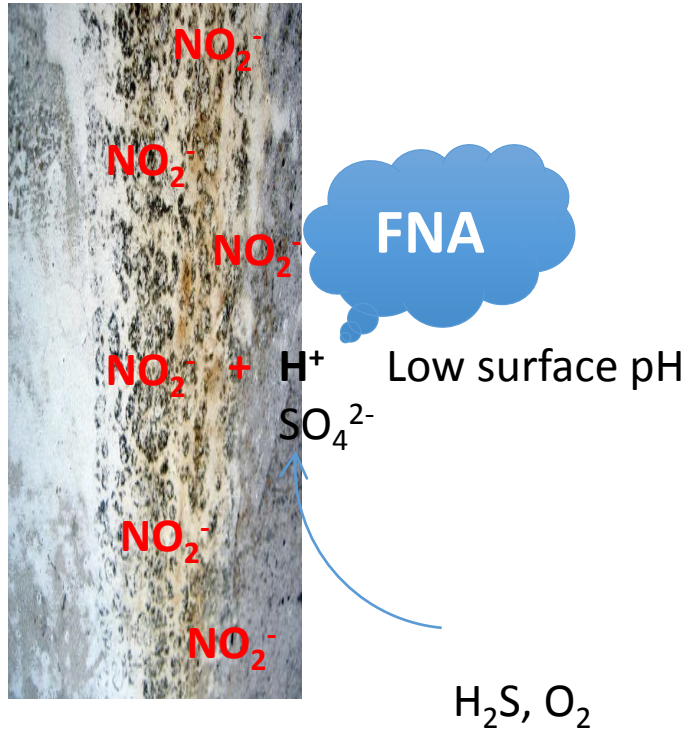
Anti-corrosion concrete



Xiaoyan Sun
Yuan/Jiang/Bond



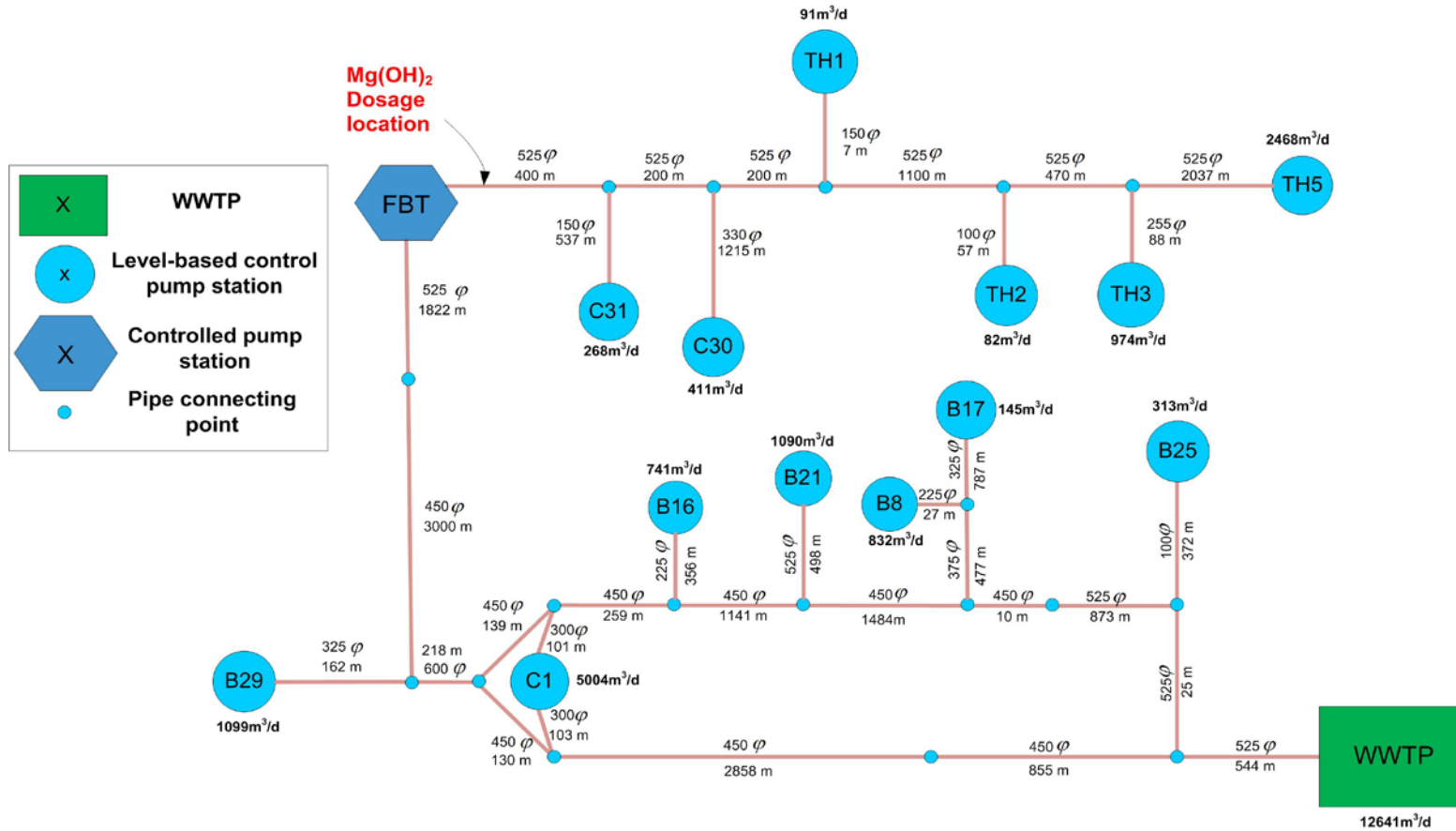
Anti-corrosion concrete



SPS176J (old Wet Well)



Network-wide chemical dosing control



Sewage epidemiology



Acknowledgements for partners' support



Australian Government
Australian Research Council

AWMC Partners, Collaborators, Clients	
University	
Industry	

● Partners outside Australia

- ▶ DC Water
- ▶ Brown & Caldwell
- ▶ USP Technologies
- ▶ Aquafin NV
- ▶ PUB, Singapore



Thank You

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