Sulfide control in sewers by intermittently dosing acidified nitrite: from scientific discovery to application

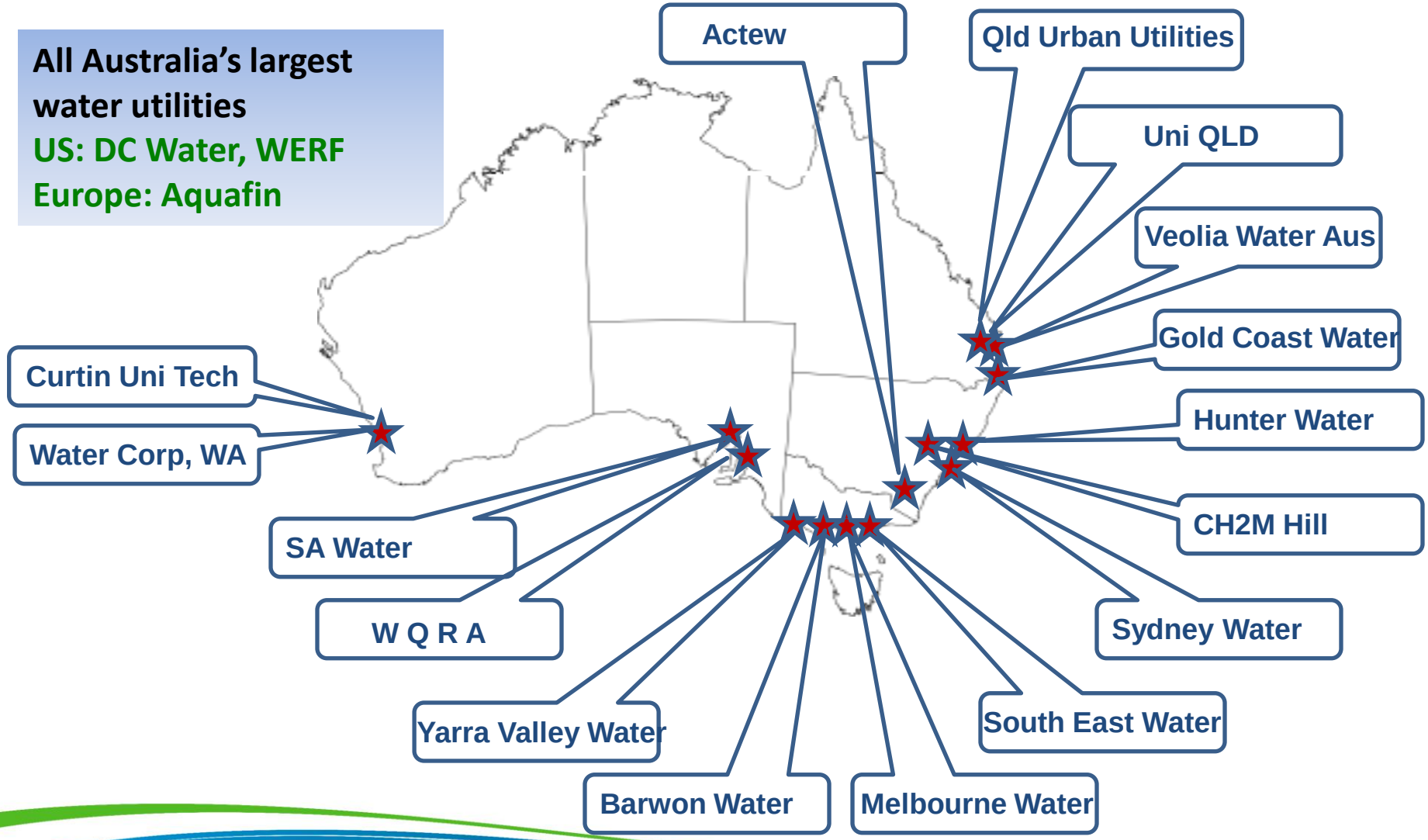
Zhiguo Yuan

Co-authors

- Guangming Jiang - Advanced Water Management Centre, The University of Queensland, Australia
- Tony Keating - UniQuest Pty Limited, The University of Queensland, Australia
- Shaun Corrie - CWE Corrie Water and Environment, Australia
- Lam Nguyen - US Peroxide, USA
- Kelly O'Halloran - Gold Coast City Council, Australia

The SCORe Project

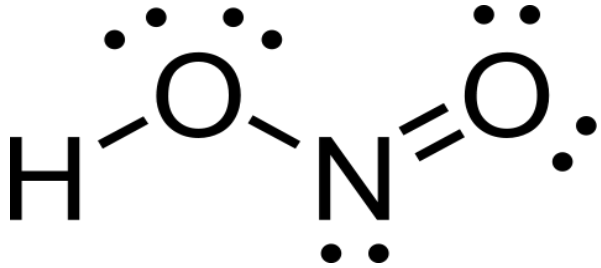
All Australia's largest water utilities
US: DC Water, WERF
Europe: Aquafin



Background

- Corrosion and odour are major issues for sewer management
- Chemical dosing is a commonly used mitigation strategy
  - MHL, iron salts, nitrate and oxygen
  - 24/7
- Intermittent dosing is desirable
  - pH shock
  - **Effective, low costs, environmentally benign**

Free nitrous acid (FNA)



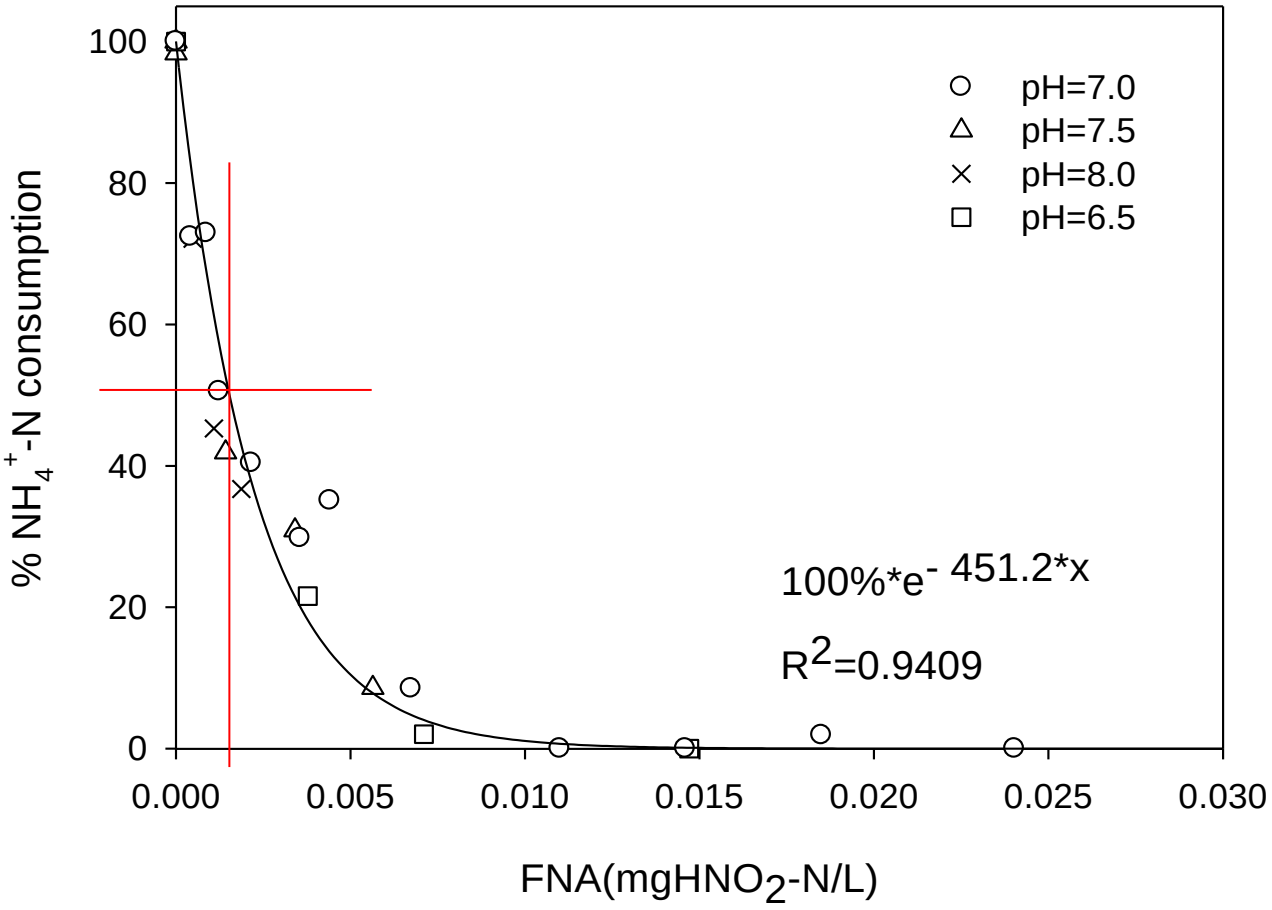
$$HNO_2 \leftrightarrow NO_2^- + H^+$$

pKa=3.398 @ 25^oC

0.35 mgNO_2^-N/L ➔0.001 mg HNO_2-N/L @ pH 6.0

100 mgNO_2^-N/L ➔0.26 mg HNO_2-N/L @ pH 6.0

FNA at ppb levels is inhibitory to a broad range of microorganisms



Ye et al. (2010)

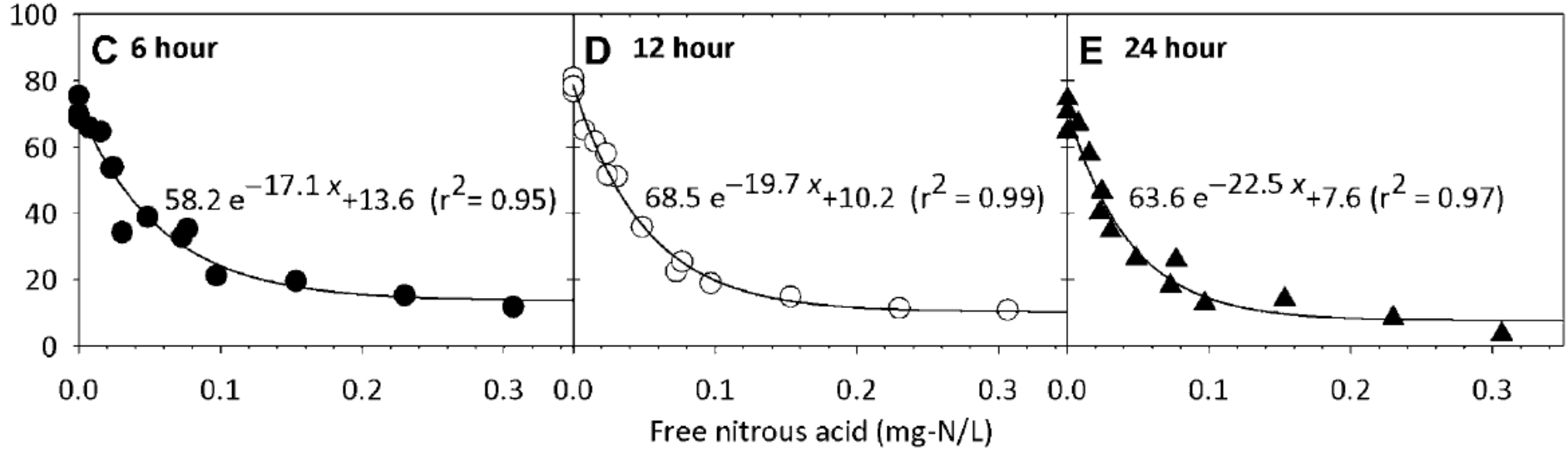
1.7 ppb (equivalent 0.6 mgNO_2-N @ pH 6)

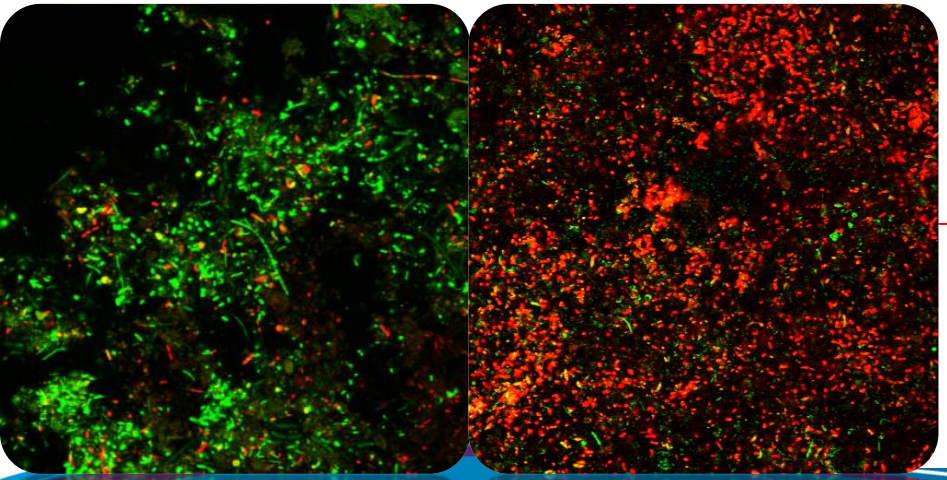
What if we increase the FNA concentration by 100 times (to sub-ppm levels)?

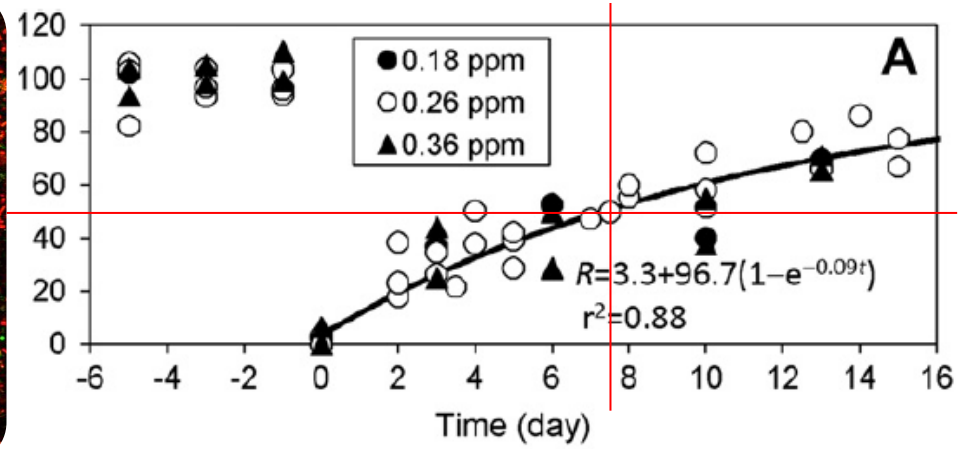
Can we kill cells in sewer biofilms?

Biocidal effect revealed in sewer reactors

Jiang et al., (2011a,b)

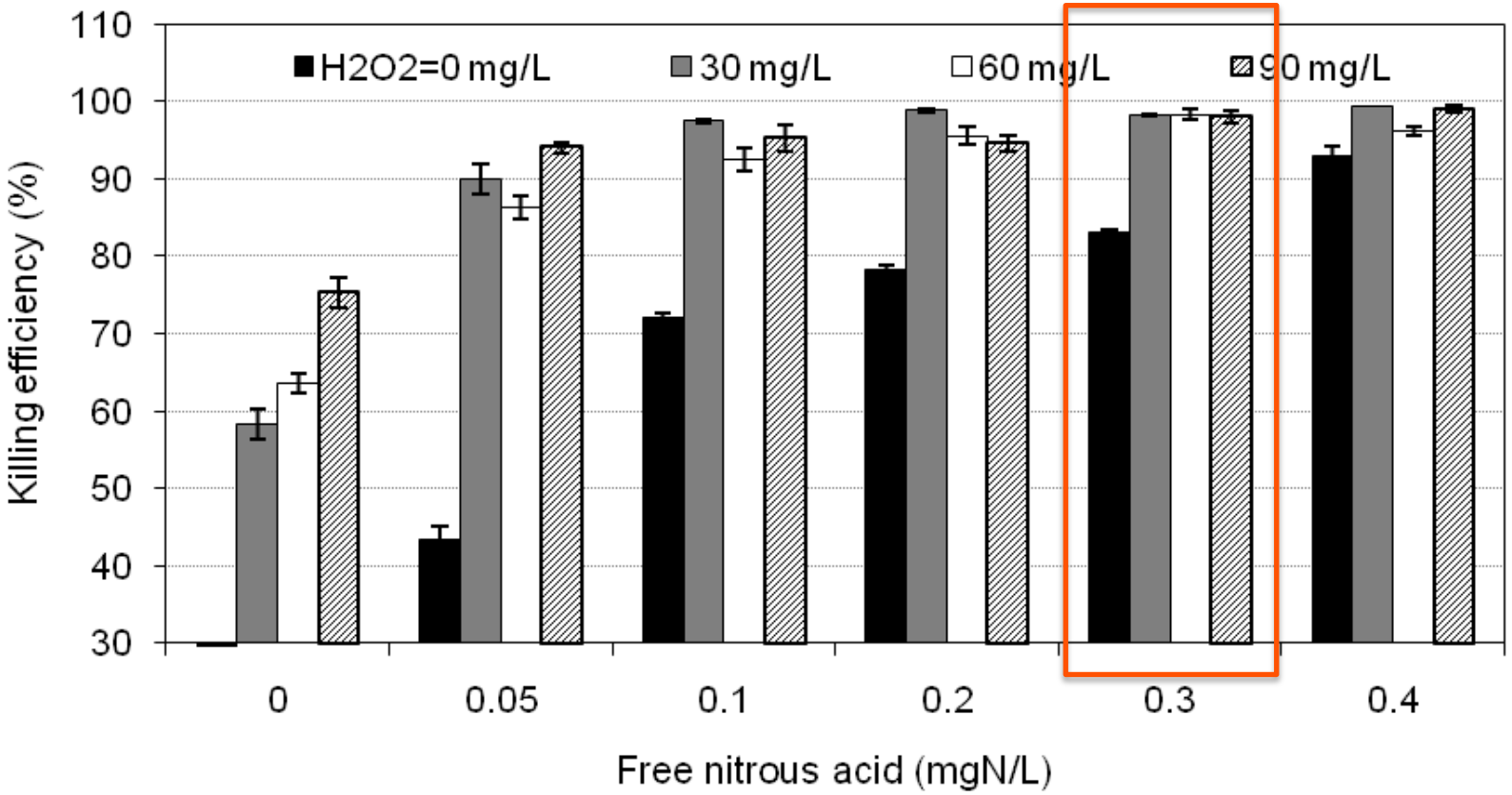






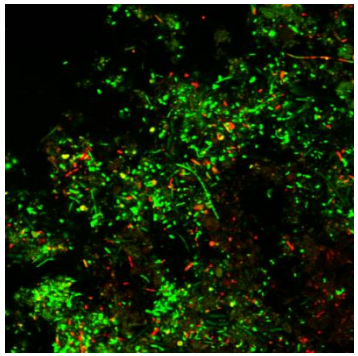
7 days

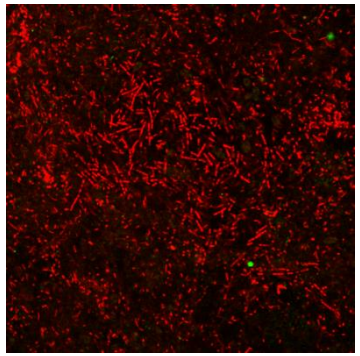
Synergistic effects of FNA and H_2O_2



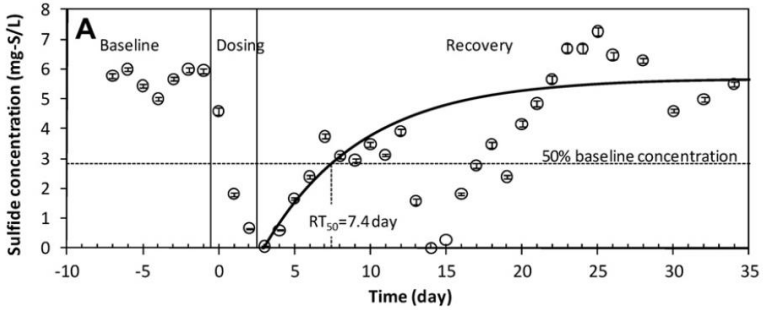
Jiang et al., (2013)

Cloevis





Kills 99% of bacteria in laboratory trials



Proven in field trials to stop sulfide production

A proprietary mix of chemicals

Intermittent, once-a-week dosing

Cloevis: Field trial in Gold Coast, Australia

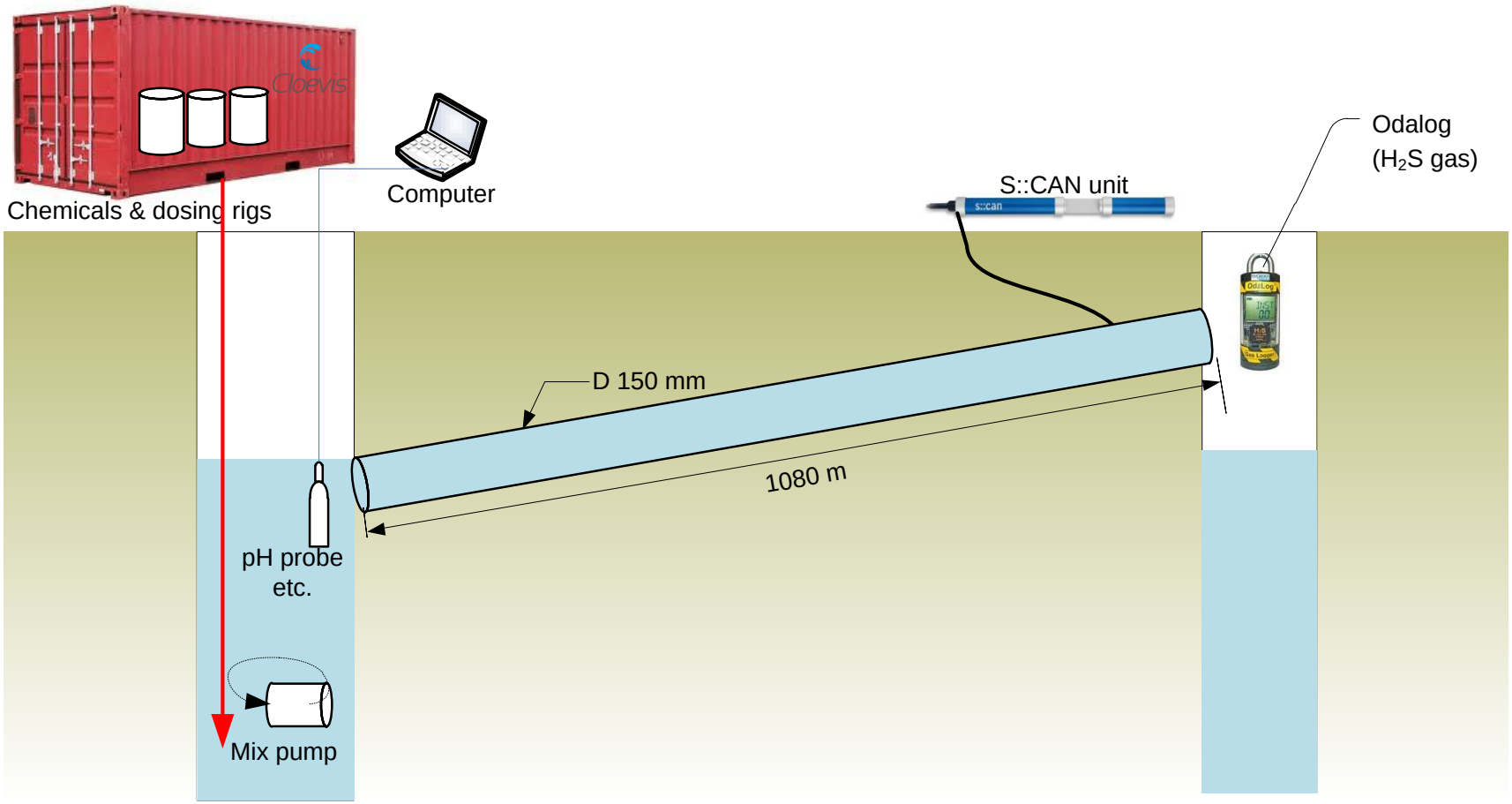
Cloevis

US Peroxide
Technologies for a clean environment

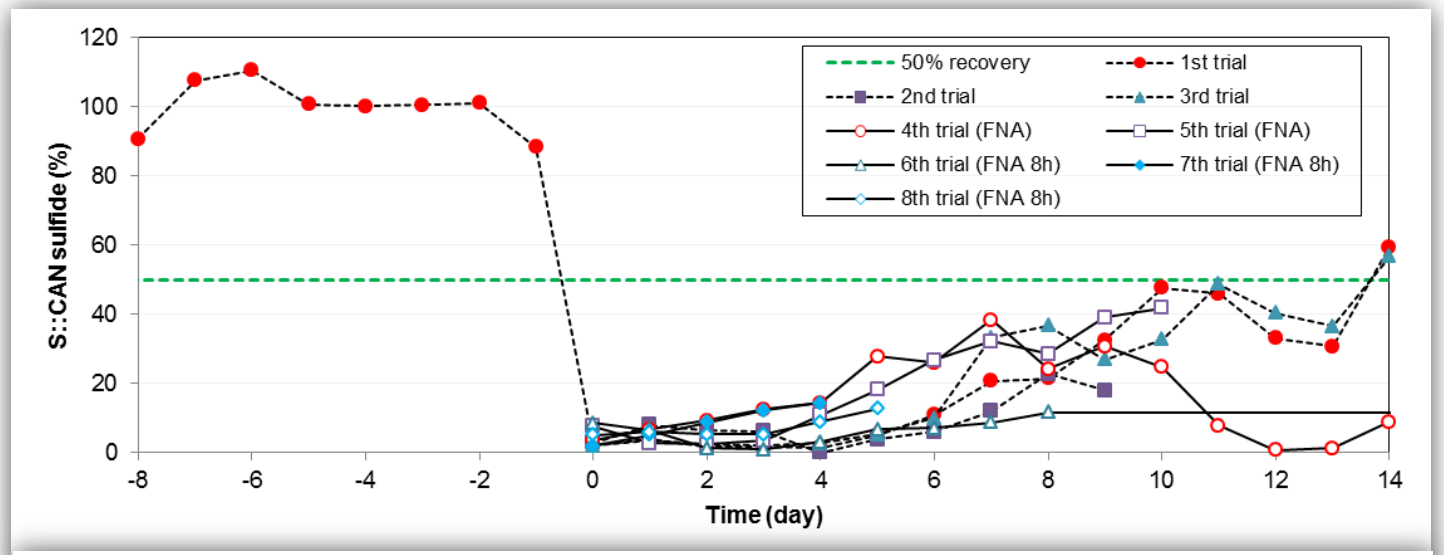
Advanced Water Management Centre

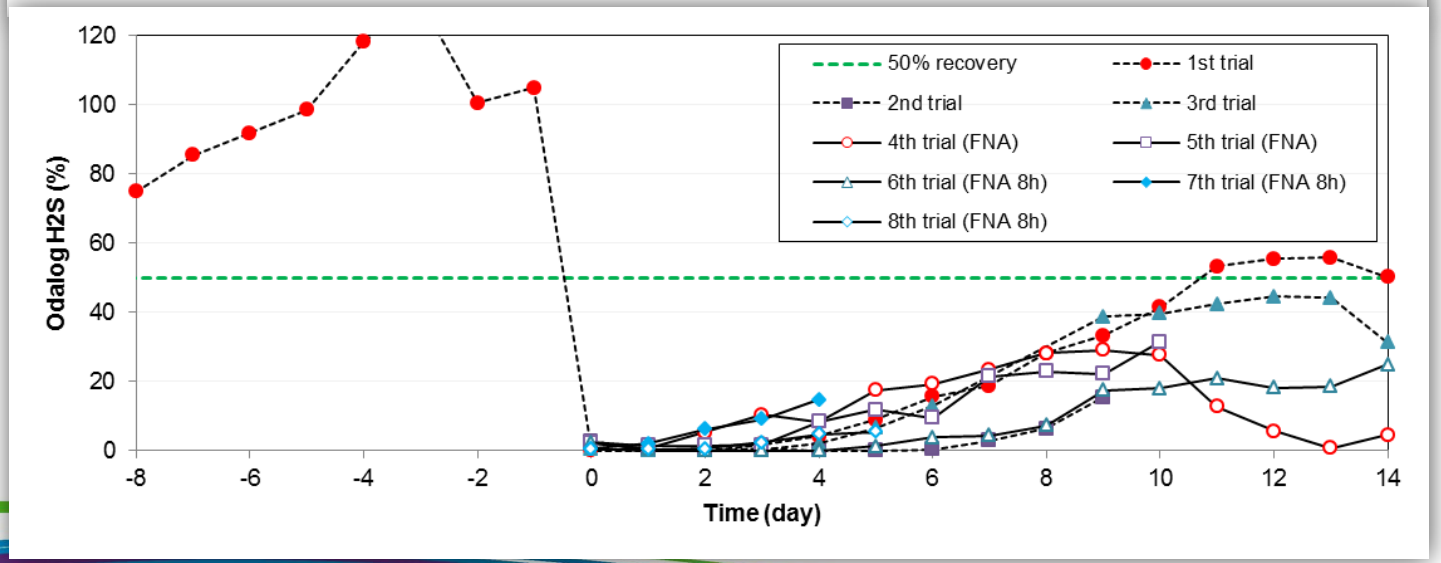
Cloevis: Field trial in Gold Coast, Australia

- Dosing, control, and monitoring



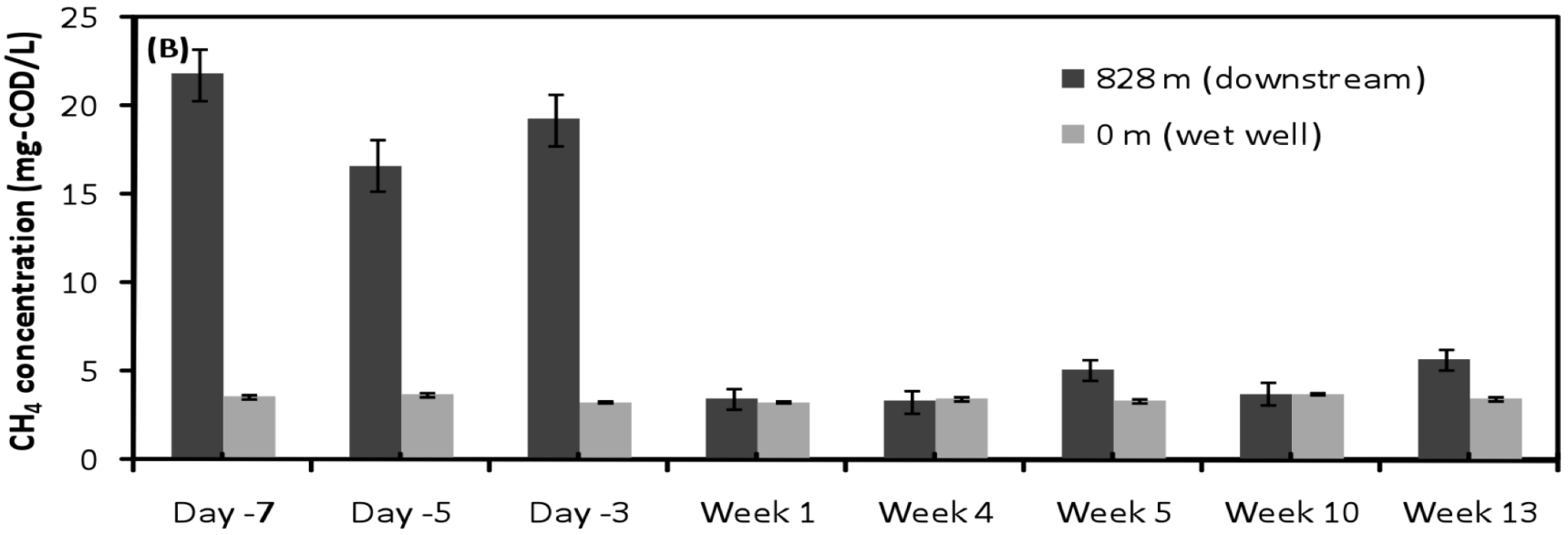
Cloevis: Field trial in Gold Coast, Australia





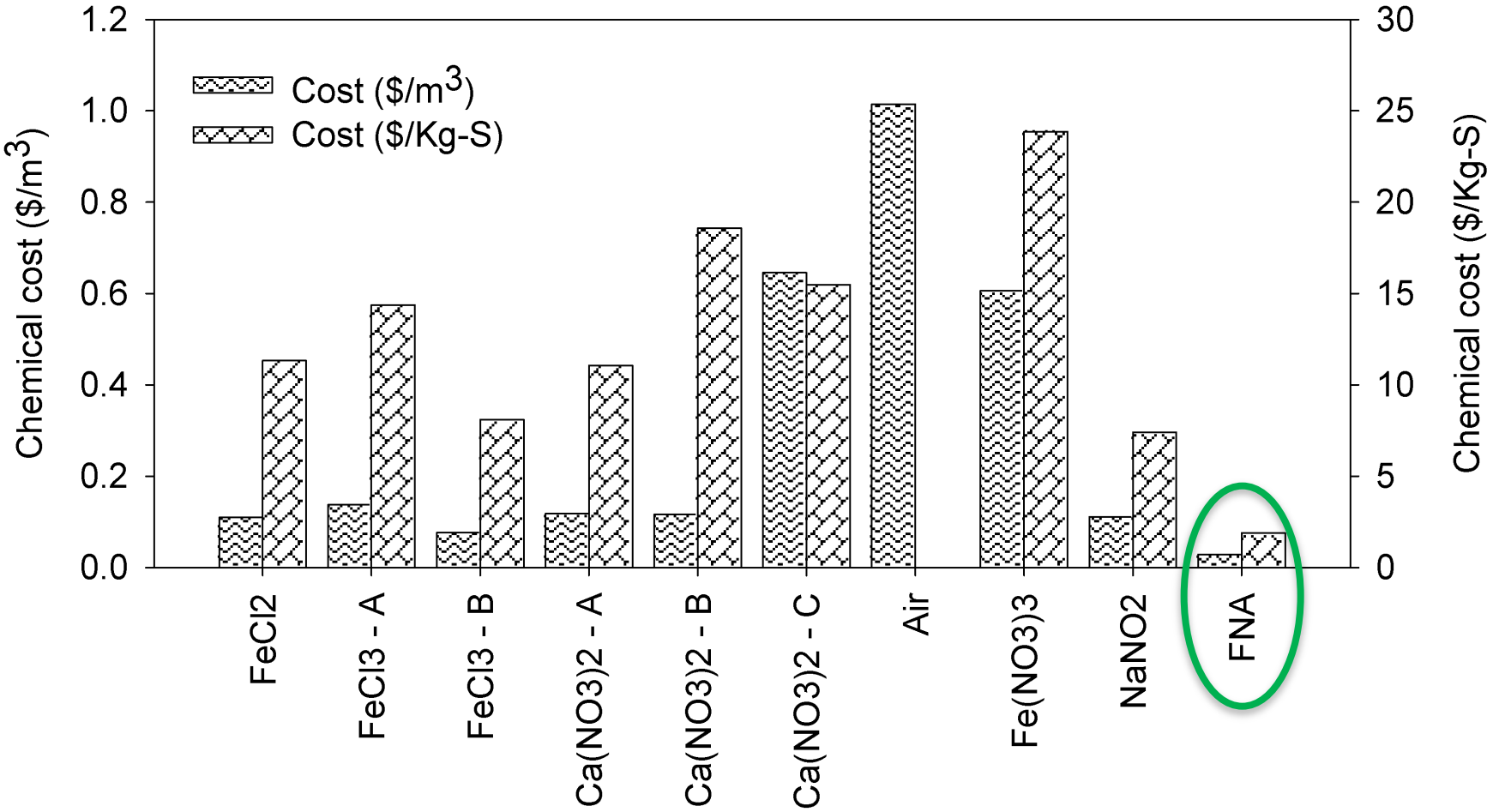
Jiang et al., (2013)

Methane control



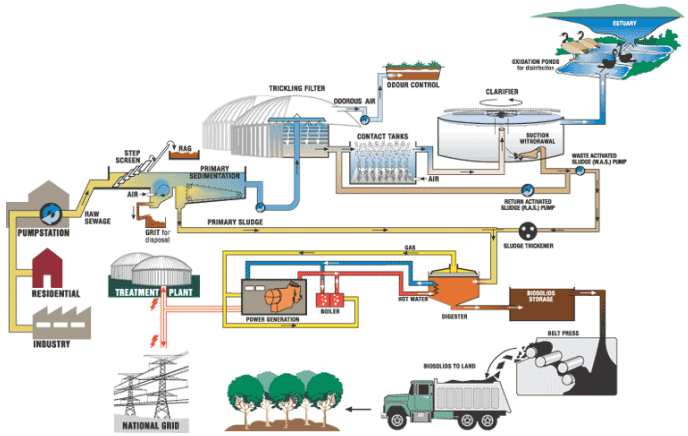
Jiang et al., (2010)

Economic Analysis



Environmental effects

LOW RISK



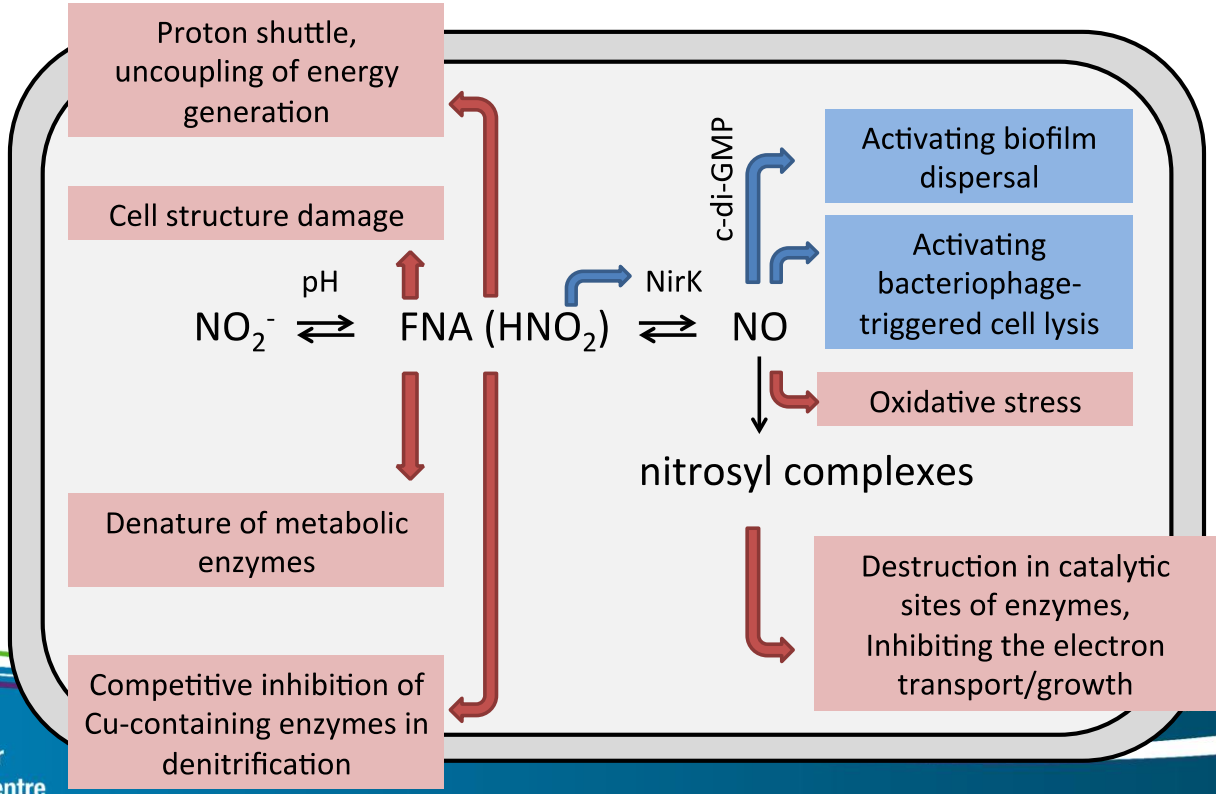
Biodegradable

Little change to existing infrastructure and progressive roll-out

Improved wastewater treatment processes

On-going work

- Commercial trials in Australia and in the US
- Other applications (e.g. sludge treatment)
- Mechanism studies



Acknowledgements

- All FNA team members – past and present
  - BNR: Vel Vadivelu, Yan Zhou, Maite Pijuan, Liu Ye
  - Sewer: Janani Mohanakrishnan, Oriol Gutierrez, Guangming Jiang
  - Sludge: Qilin Wang, Liu Ye, Maite Pijuan
  - Membrane: Marc Pidou, Pengzhe Sui, Ludwika Nieradzik
  - Microbiology: Frances Slater, Ahmad Rosli, Phil Bond
  - Commercialisation: Tony Keating, Howard Leemon, Shaun Corrie
- ARC and utility partners for funding
- USP as a commercial partner
- GCCC for assisting with field testing