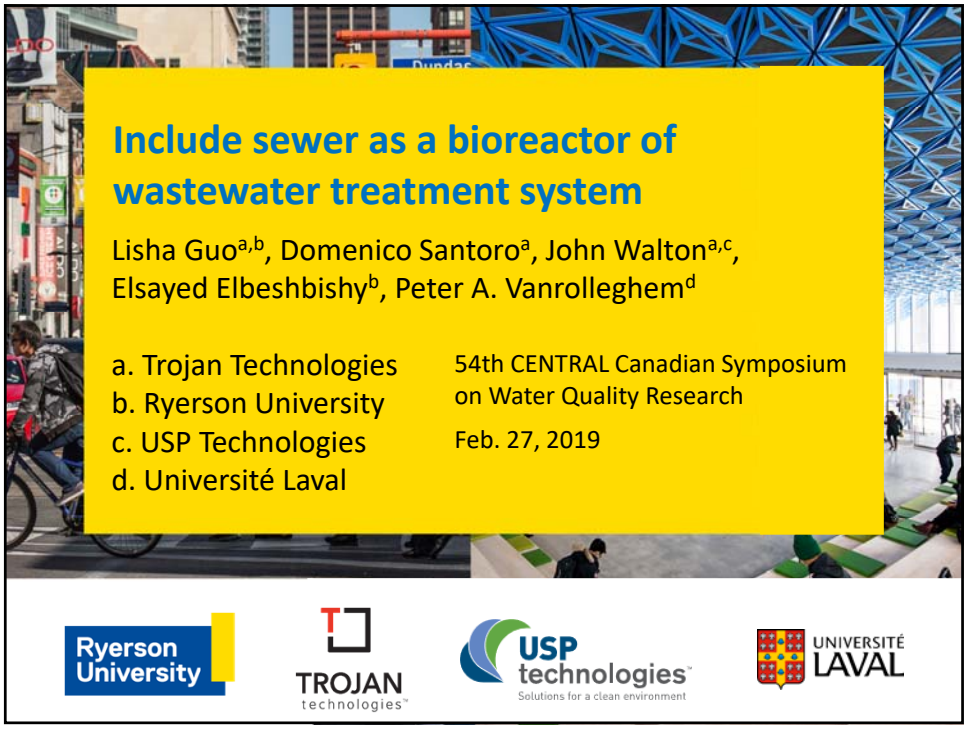

Include sewer as a bioreactor of wastewater treatment system

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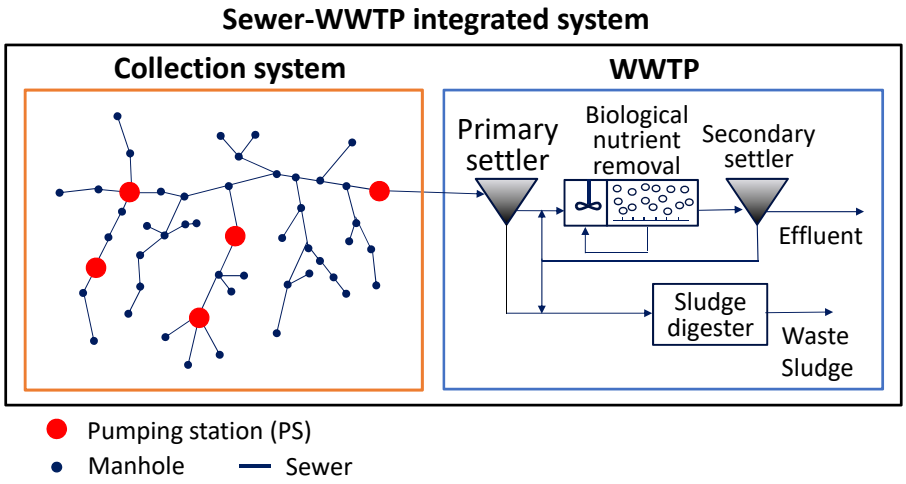
Table of content

- Background and Modelling tool
- Case study
- Design of chemical dosing and field test result
- Sewer-WWTP integrated assessment
- Take-home messages

Integrated management of sewer and WWTP



Integrated management of sewer and WWTP

Global warming,
Extreme weather condition,
Water shortage



Water quantity:
- Storm water, flood
- Peak inflow and TSS to WWTP

Water quality:
- Improve nutrient removal by system-wide management
- User sewer as a bioreactor

Water quality modelling of sewer

SeweX biochemical model

Founded in Australia, widely used in local and international projects

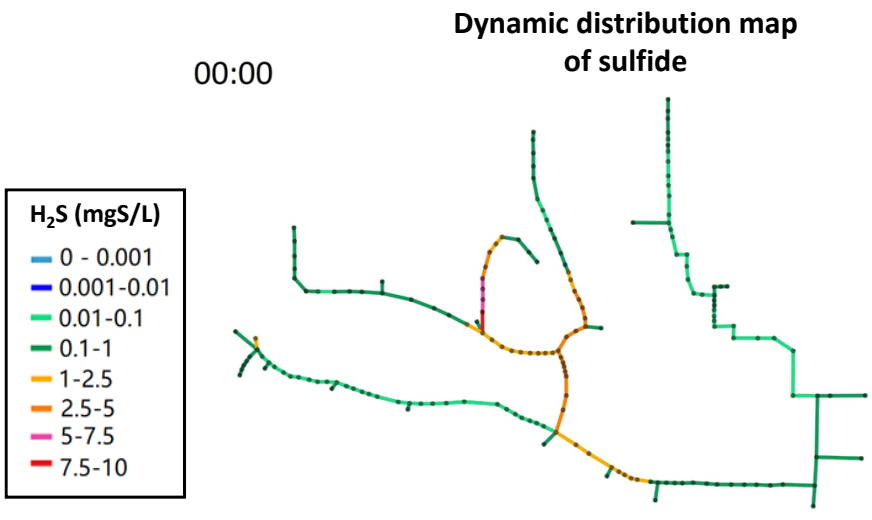
In-sewer processes:

- Transformations of sulfur species: sulfate reduction, sulfide oxidation, etc.
- Fermentation
- Hydrolysis
- Methane production
- Bacteria metabolism: growth and decay

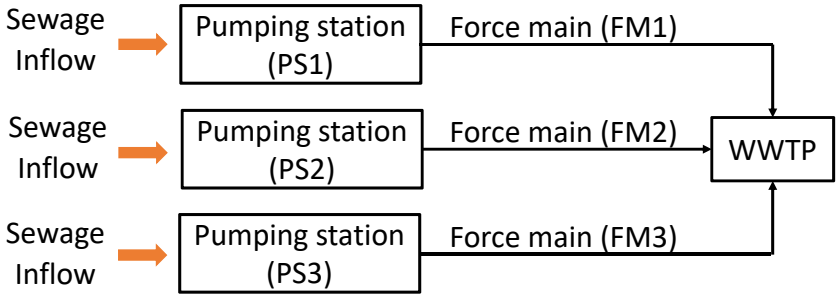
Modelling tool

Assessment Control Learning

Dynamic distribution map of sulfide



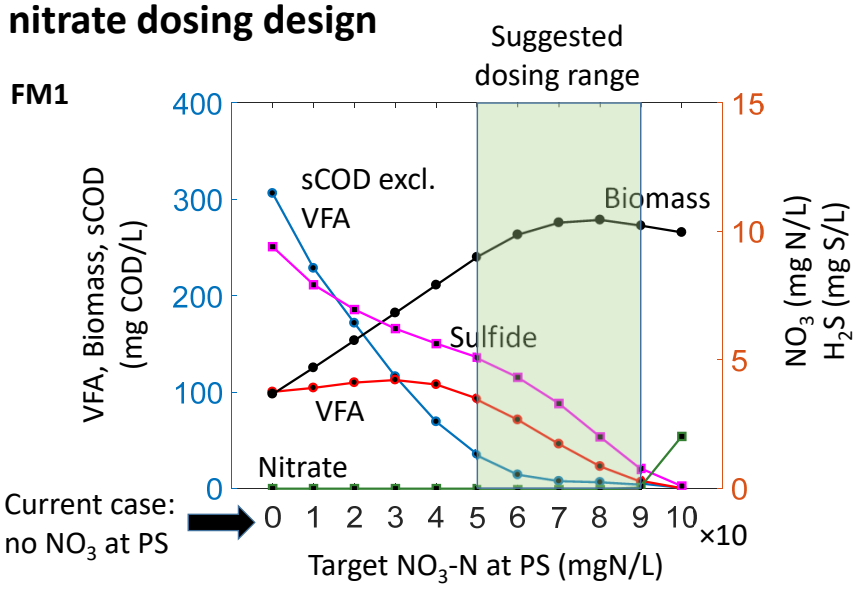
Case study – VFA and H_2S control by nitrate dosing



Main goals of this case study:

- Investigate sewer response (especially VFA and H_2S) under nitrate (i.e. NO_3) dosing
- Compare NO_3 and iron (Fe) dosing for sewer-WWTP integrated system

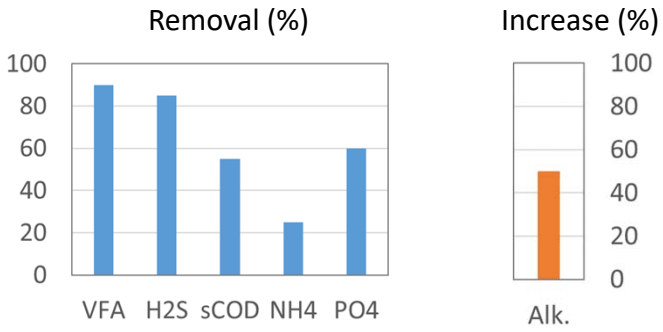
Model-based nitrate dosing design



Model-based nitrate dosing design

	NO_3 usage (gal/day)	Ave. at Headwork VFA (mg/L)	Ave. at Headwork H_2S (mg/L)
FM1	400	48	3.4
FM2	2500	43	2.6
FM3	1500	42	2.8

Field test results – NO_3 dosing



- VFA and H_2S removal: above 80%
- sCOD and PO_4 removal: above 50%
- NH_4 removal: above 20%
- Alkalinity increase: about 50%

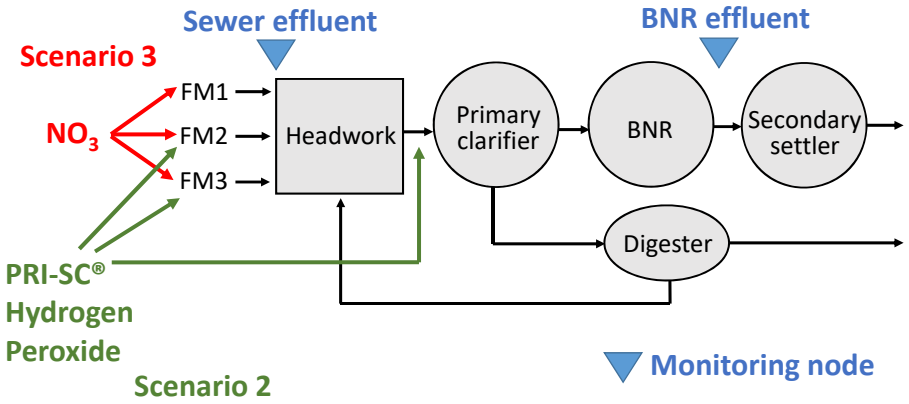
Use sewer as a bioreactor

System-wide assessment: NO_3 vs Fe

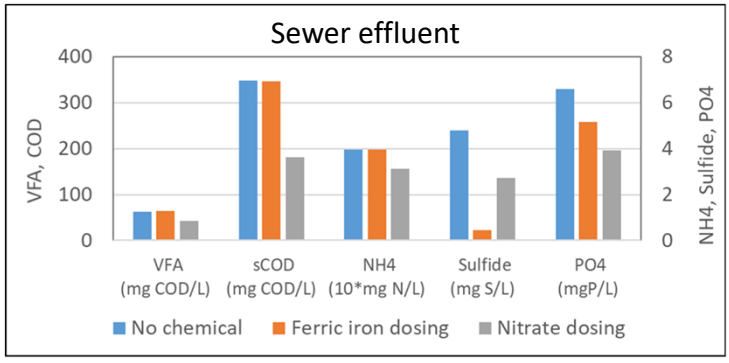
Scenario 1: no chemical dosing

Scenario 2 : ferric dosing at FM2 and FM3 line and at PC inlet

Scenario 3 : nitrate dosing at all three force mains

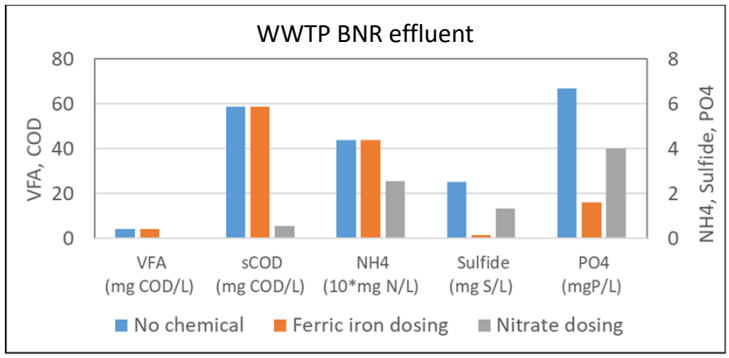


System-wide assessment: sewer



- Iron dosing is more effective on H_2S removal than NO_3
- NO_3 dosing decreases VFA, sCOD (denitrification) and NH_4
- PO_4 is reduced by both chemicals, through:
  - Precipitation in iron dosing (Chemical process)
  - Nutrient uptake in NO_3 dosing (Biological process)

System-wide assessment: WWTP



- Low VFA and sCOD under NO_3 dosing scenario
- NH_4 also decreases, because nitrification process is promoted
- Iron dosing at primary clarifier further precipitates PO_4

Take-home message

- Model is a useful tool for chemical-dosing **design**, **scenario analysis** and large-scale and system-wide **assessment**
- It is important to have **sewer** simulation results reflecting **both dynamics and spatial variations**
- Sewer and WWTP should be managed as an **integrated system**
- **NO_3** enhances denitrification process in sewer, with a general improvement on **nutrient removal** through **biochemical processes**
- **Fe** effectively removes **H_2S and PO_4** through **chemical reactions**

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