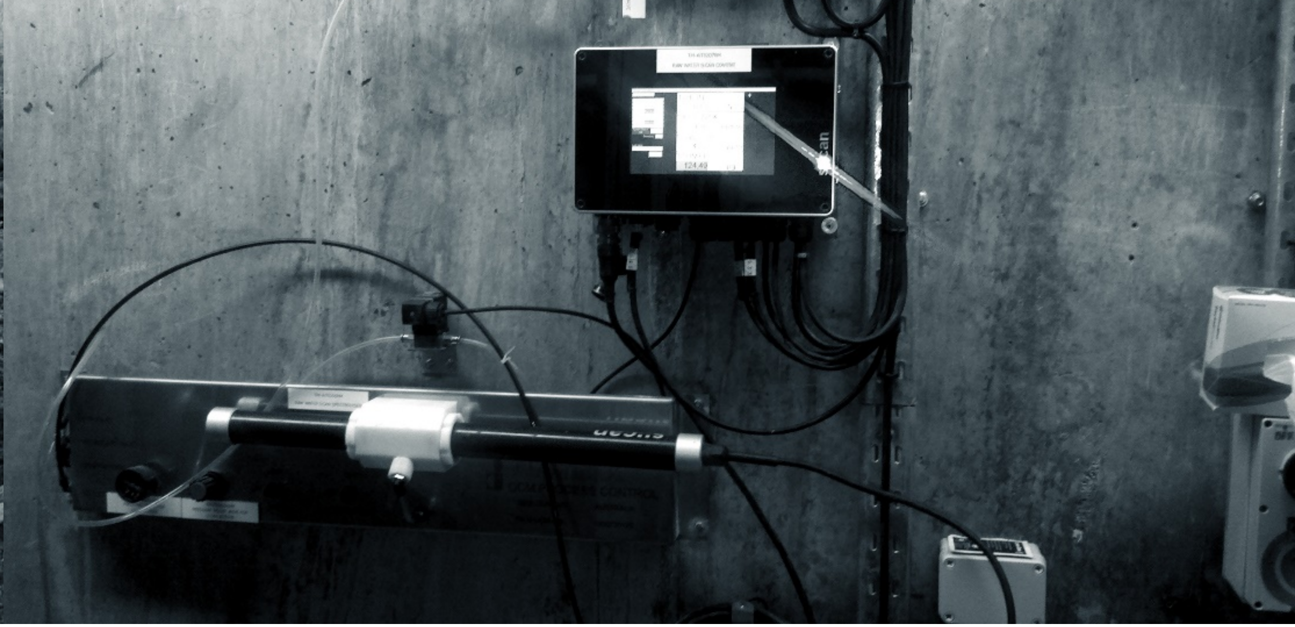
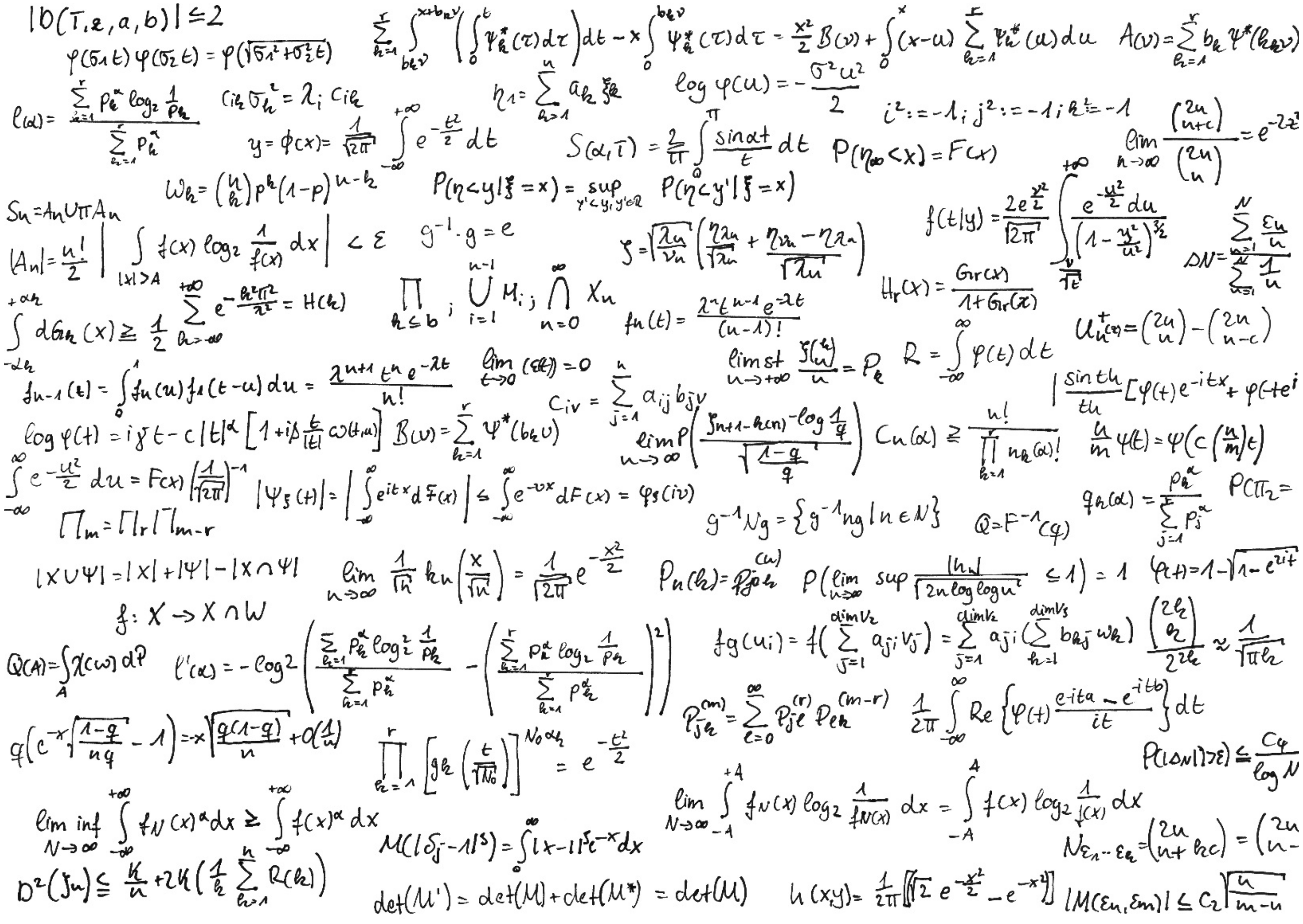


PERFORMANCE OPTIMISATION AND COST REDUCTION THROUGH ADVANCED PROCESS CONTROL

Basic Process Control

- Flow pacing
- Feedback control using PID loops
    - pH
    - Free available chlorine

Advanced Process Control (APC)



APC Examples

- Feed forward control
- Indirect sensors
- Sequential logic control
- Model predictive control

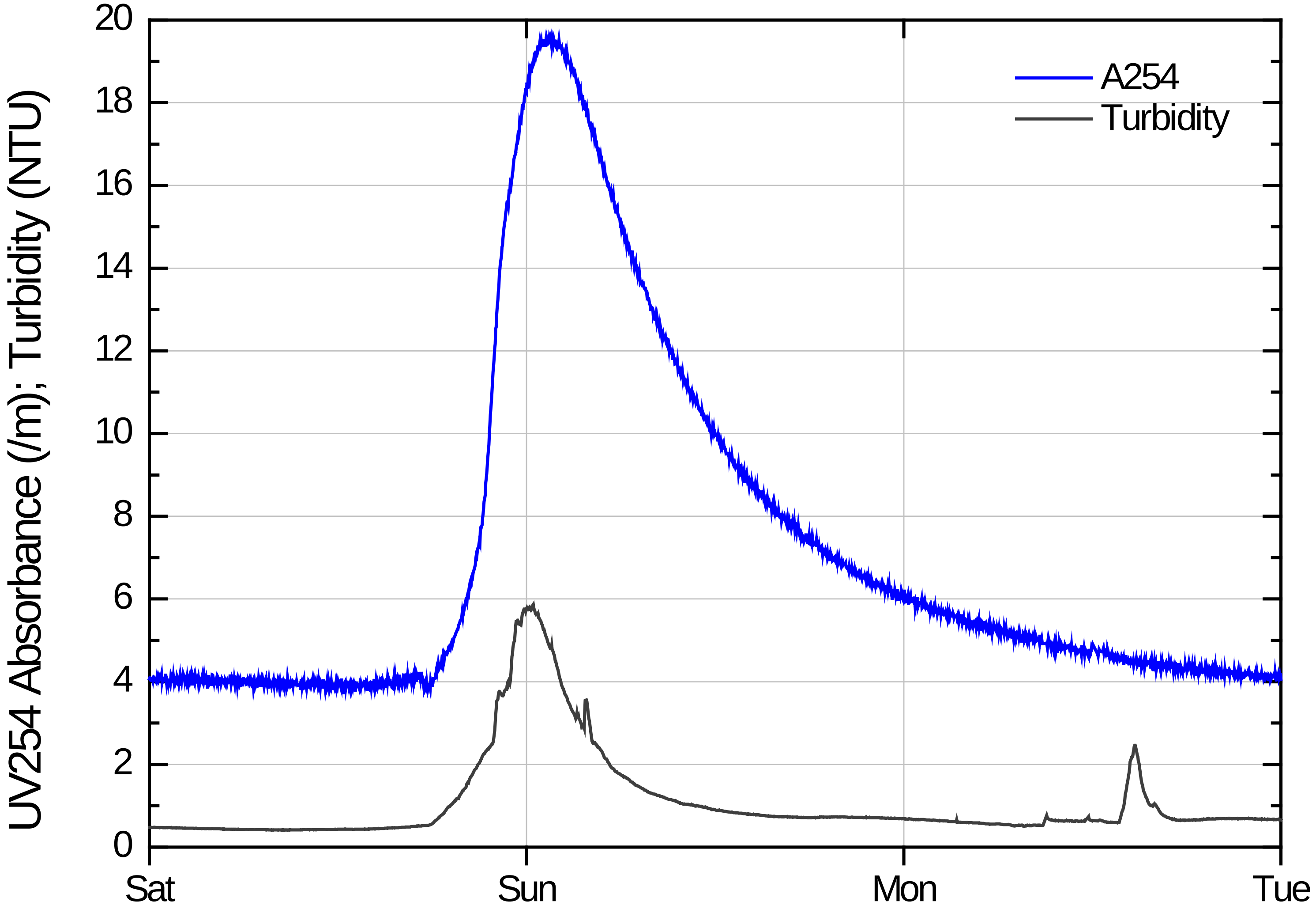
Challenges at the Plant

- Very hands on
- Overdosing of chemicals
- High production costs

Goals for the Project

- Improve control reliability
- Reduce production costs
- Reactive to proactive

Coagulant Dose Control

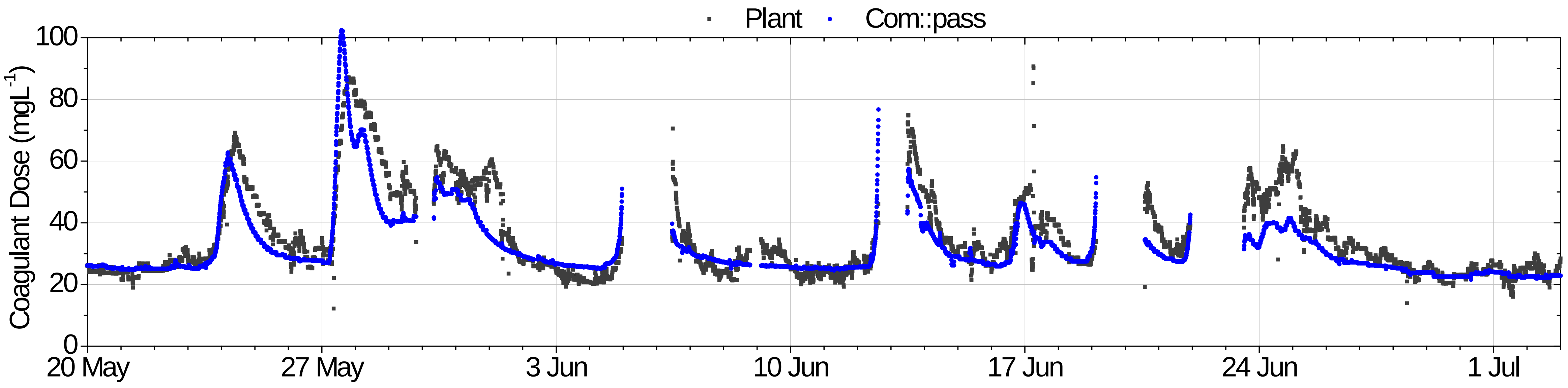



Boltac
1000
500
JarTech
JarSt*r
JarTech


STREAMING CURRENT CONDITION
POWER
PROBE ALARM
LOW LIMIT ALARM
HIGH LIMIT ALARM
LOW LIMIT ADJUST
LOW LIMIT SET POINT (PUSH)
HIGH LIMIT SET POINT (PUSH)

Coagulant Dose Control

- Coagulant and Lime reductions
- Filter performance improved
- More reliable



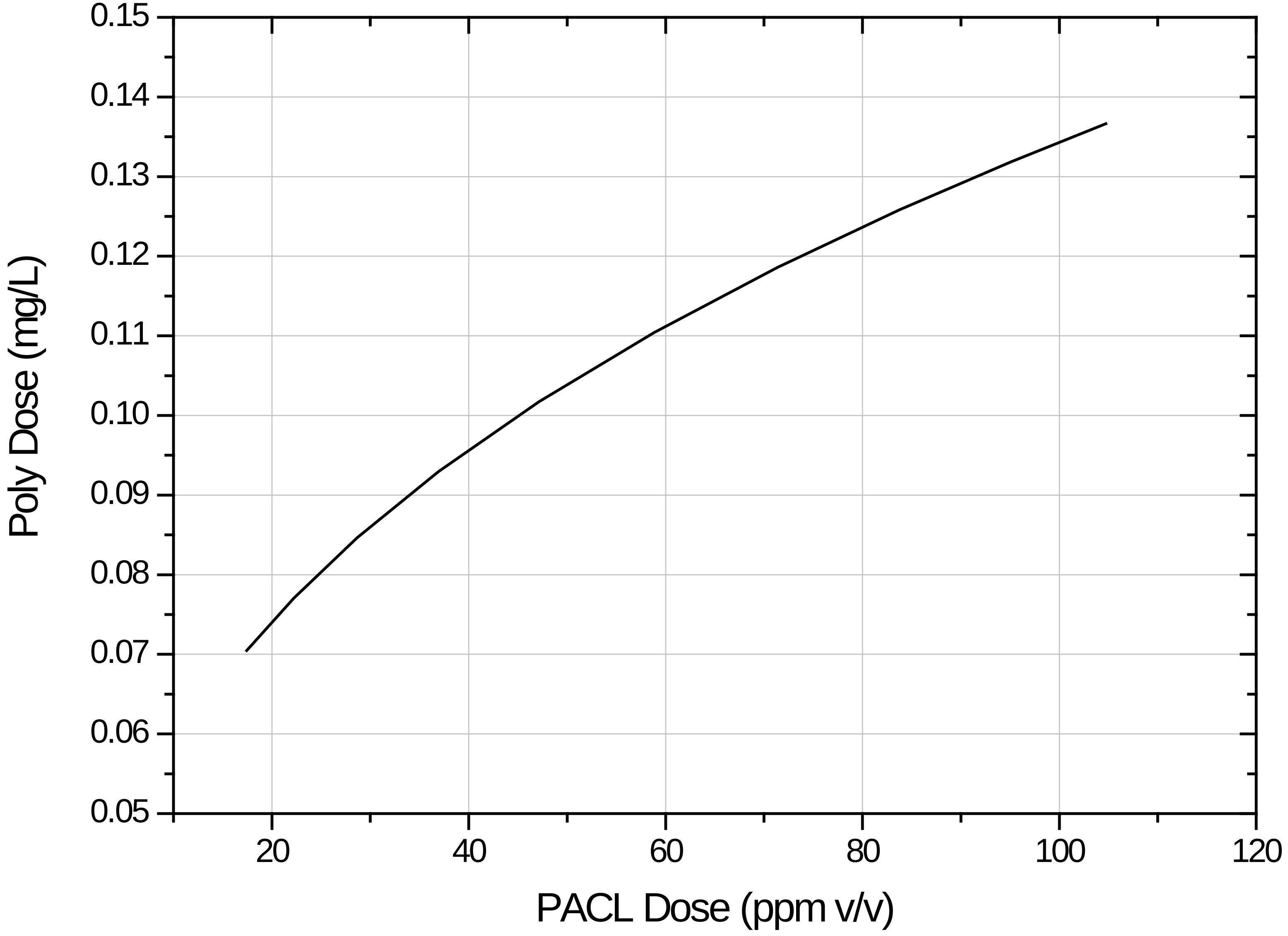
Polymer Dosing

- Setpoint control
- Too high - Carryover and filter cracking, short runtimes
- Too low – turbidity spikes
- Expensive when overdosing

To

- Automated dosing slaved off coagulant dose

Polymer Dosing



Clarifier De-sludge Control

- Time based de-sludge
- Variable solids load
- Wasting water or poor clarifier performance

To

- Load based de-sludge

Production Cost Tracking

- Bulk delivery & stock-takes
- Poor understanding
- Low transparency

To

- Online realtime production costs

Online Costs

- Chemical Costs

Equation	Description	Units
Q_{TW}	Treated water flow-rate	$m^3/h_{treated\ water}$
$cost_{hypo} = \$360.40$	Product cost	$\$/m^3_{product}$
Q_{hypo}	Product flow-rate from SCADA	$L_{product}/h$
$acost_{hypo,CWT} = \frac{24 \cdot Q_{hypo,CWT} \cdot cost_{hypo}}{100 \cdot Q_{TW}}$	Actual treatment cost	$c/m^3_{treated\ water}$

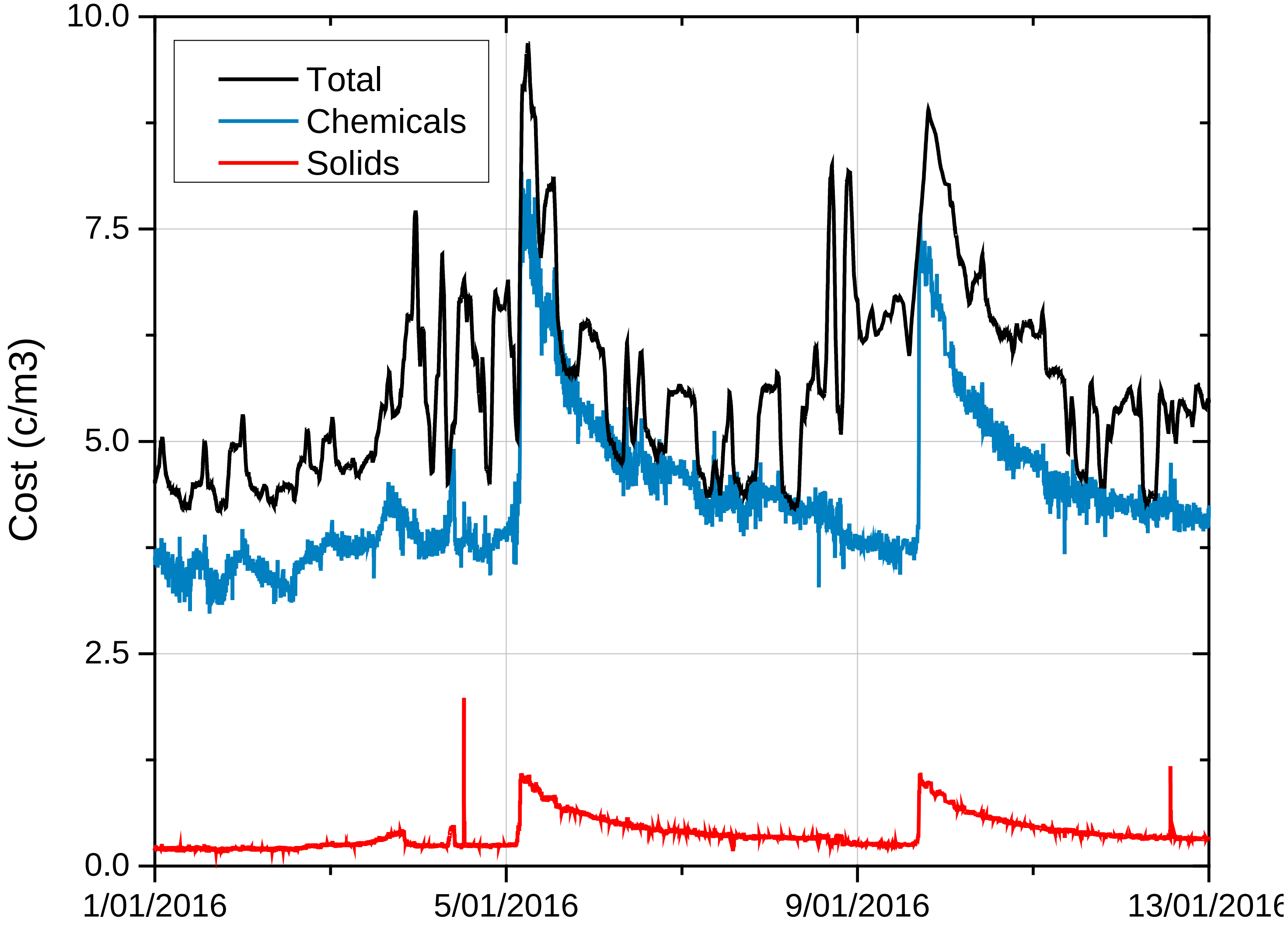
Online Costs

- Power costs

Online Costs

- Sludge disposal costs

Online Costs

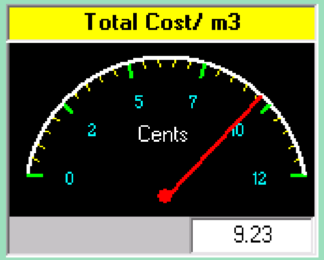


Predicted Costs & Cost Sentinel

- River and inlet monitoring
- Deviation alarms
- Cost decisions

Te Marua Online Costs

	Dose Rate	Bulk Cost	Inst.Rate	Predict Rate	Last 30min	Last 24hr
CO2 Stream 1	14.830 g/m3	383.68 $/Ton	0.581 c/m3	0.460 c/m3	0.587 c/m3	0.587 c/m3
Lime Stream 1	12.423 g/m3	322.76 $/Ton	0.409 c/m3	1.232 c/m3	0.404 c/m3	0.316 c/m3
Poly Stream 1	0.12 g/m3	10360.00 $/Ton	0.123 c/m3	0.207 c/m3	0.120 c/m3	0.109 c/m3
Stream 1 PAC	0.00 g/m3	2750.00 $/Ton	0.000 c/m3	3.300 c/m3	0.000 c/m3	0.000 c/m3
Coag Stream 1	43.553 c/m3	738.22 $/Ton	3.937 c/m3	3.480 c/m3	4.620 c/m3	3.220 c/m3
CO2 Stream 2	0.000 g/m3		0.000 c/m3		0.000 c/m3	0.000 c/m3
Lime Stream 2	0.000 g/m3		0.000 c/m3		0.000 c/m3	0.000 c/m3
Coag Stream 2	0.000 g/m3		0.000 c/m3		0.000 c/m3	0.000 c/m3
Poly Stream 2	0.000 g/m3		0.000 c/m3		0.000 c/m3	0.000 c/m3
Total Pre-Treatment			5.180 c/m3		5.731 c/m3	4.233 c/m3
Caustic	15.16 g/m3	599.13 $/Ton	0.971 c/m3	0.719 c/m3	0.942 c/m3	0.953 c/m3
Chlorine Gas	0.84 g/m3	2964.26 $/Ton	0.248 c/m3	0.080 c/m3	0.252 c/m3	0.251 c/m3
Hypochlorite	0.00 g/m3	334.950 $/Ton	0.000 c/m3	0.037 c/m3	0.000 c/m3	0.000 c/m3
Fluoride	0.801 c/m3	1650.00 $/Ton	0.134 c/m3	0.179 c/m3	0.134 c/m3	0.136 c/m3
Total Post Treatment			1.351 c/m3		1.328 c/m3	1.340 c/m3
Hutt River Predicted				0.000 c/m3	0.000 c/m3	0.000 c/m3
Plant Intake Predicted				10.751 c/m3	10.701 c/m3	9.610 c/m3
Inlet Dried Solids	15.817 g/m3					
Thickner Poly			0.033 c/m3		0.032 c/m3	0.023 c/m3
Centrifuge Poly			0.251 c/m3	0.000 c/m3	0.243 c/m3	0.173 c/m3
Solids Disposal		110.00 $/Ton	0.888 c/m3		0.861 c/m3	0.612 c/m3
Power Price	11.41 c/kWhr					
Plant Power			0.473 c/m3		0.447 c/m3	0.565 c/m3
Boost Pumps			1.056 c/m3		0.958 c/m3	0.854 c/m3
Treatment Pumps			0.000 c/m3		0.000 c/m3	0.000 c/m3
PAT Saving			0.000 c/m3		0.000 c/m3	0.000 c/m3
Totals						
Total Chemical			6.532 c/m3		7.059 c/m3	5.573 c/m3
Total Power			1.509 c/m3		1.406 c/m3	1.419 c/m3
Total Solids			1.144 c/m3		1.136 c/m3	0.808 c/m3
All Cost Total			8.941 c/m3		9.601 c/m3	7.800 c/m3



Typical Dose Rates

CO2	PAC	CL2	FL
12.000 %/vol	12.000 g/m3	0.800 g/m3	0.750 g/m3

Calibration Factors

Lime Feeder A	1.0700
Lime Feeder B	1.0700
Lime Feeder C	
Poly Strength	0.30 %w/vol
Hypo Strength	0.77 %w/vol
Plant Recovery	98.0 %
Thickner Dose	2.0 kg/TonDS
Cent. Dose	15.0 kg/TonDS
Sludge Cake DS	20.00 % w/v

Trends

- Plant Volumes
- Stream 1
- Stream 2
- Post Treatment
- Solids
- Power
- Totals

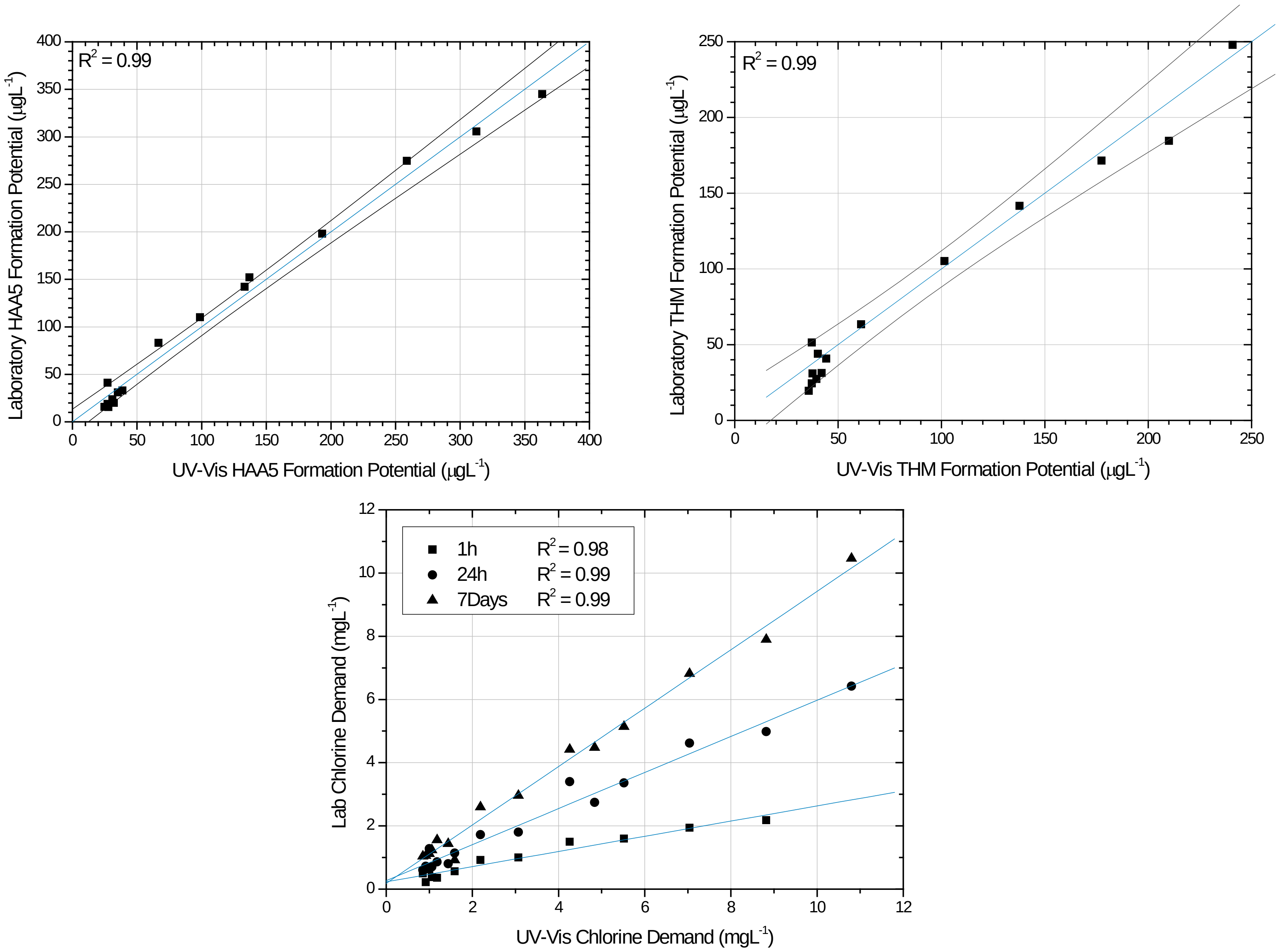
Alkalinity Control

- Manual CO_2 dose control
- Variable treated water alkalinity

To

- Feed forward alkalinity control
- Tightly controlled treated water alkalinity

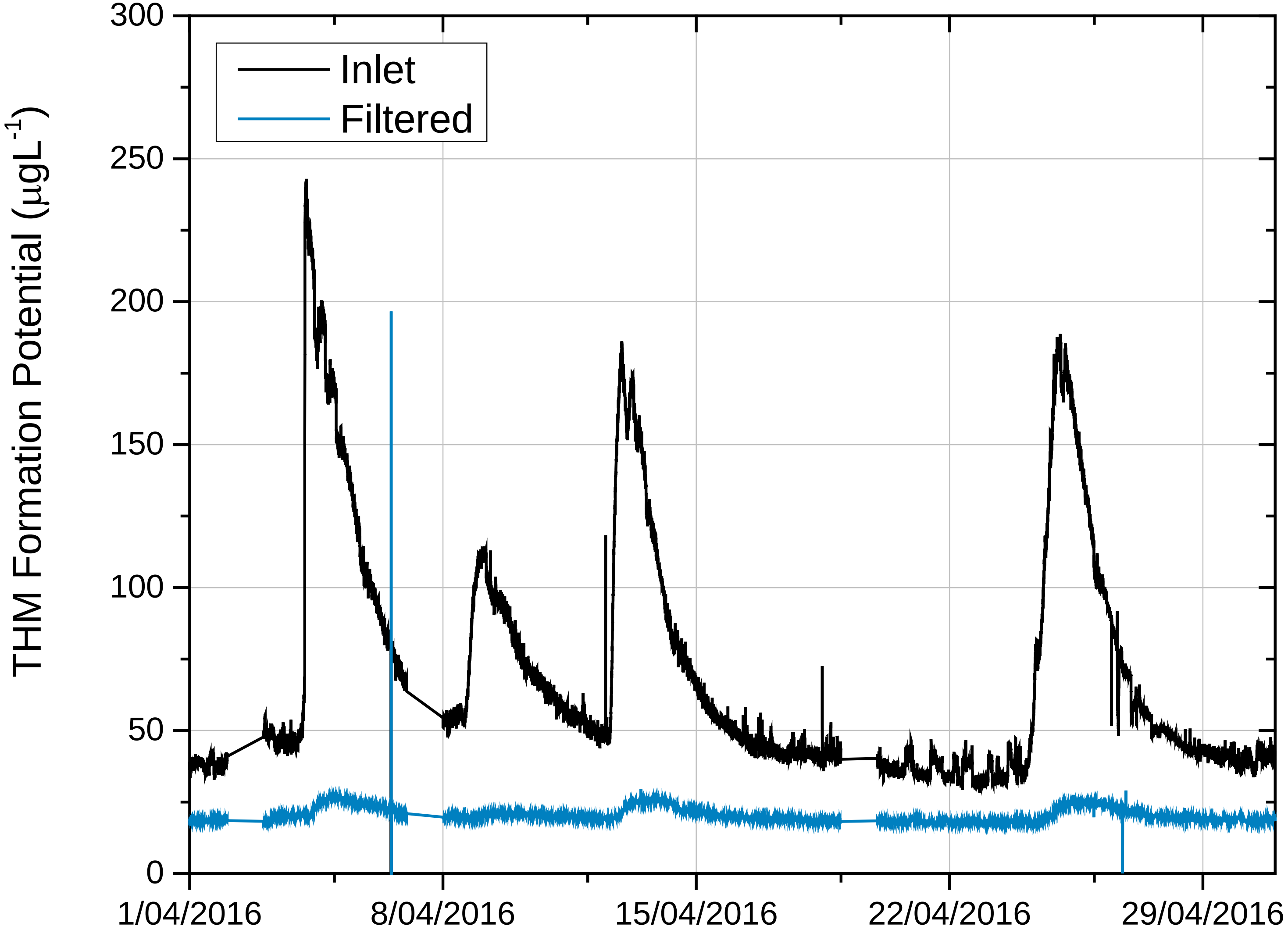
Chlorine Demand and THM/HAA FP



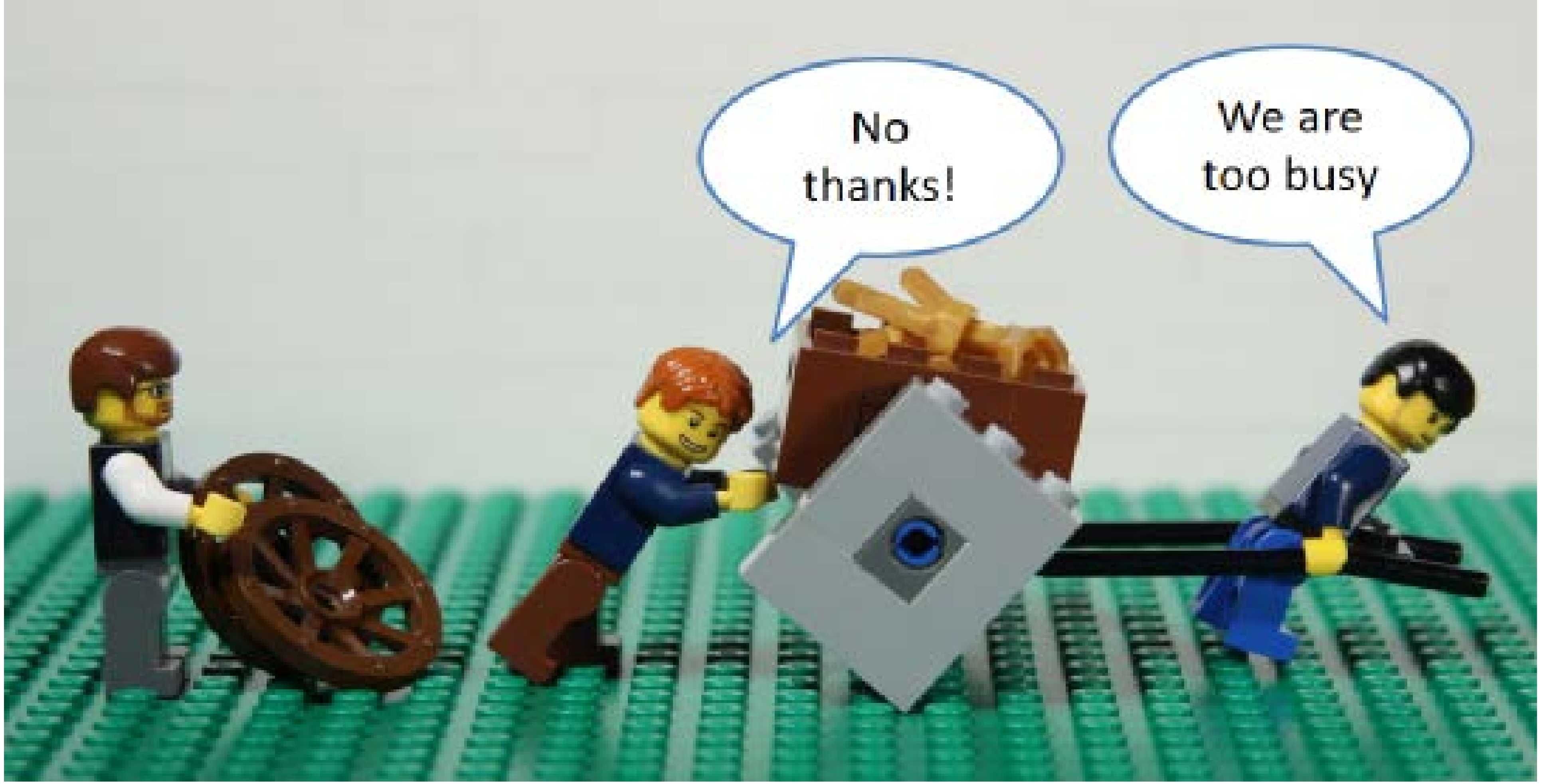
Chlorine Demand and THM/HAA FP

- Online Measurement
- P2 risk reduction
- Optimisation potential

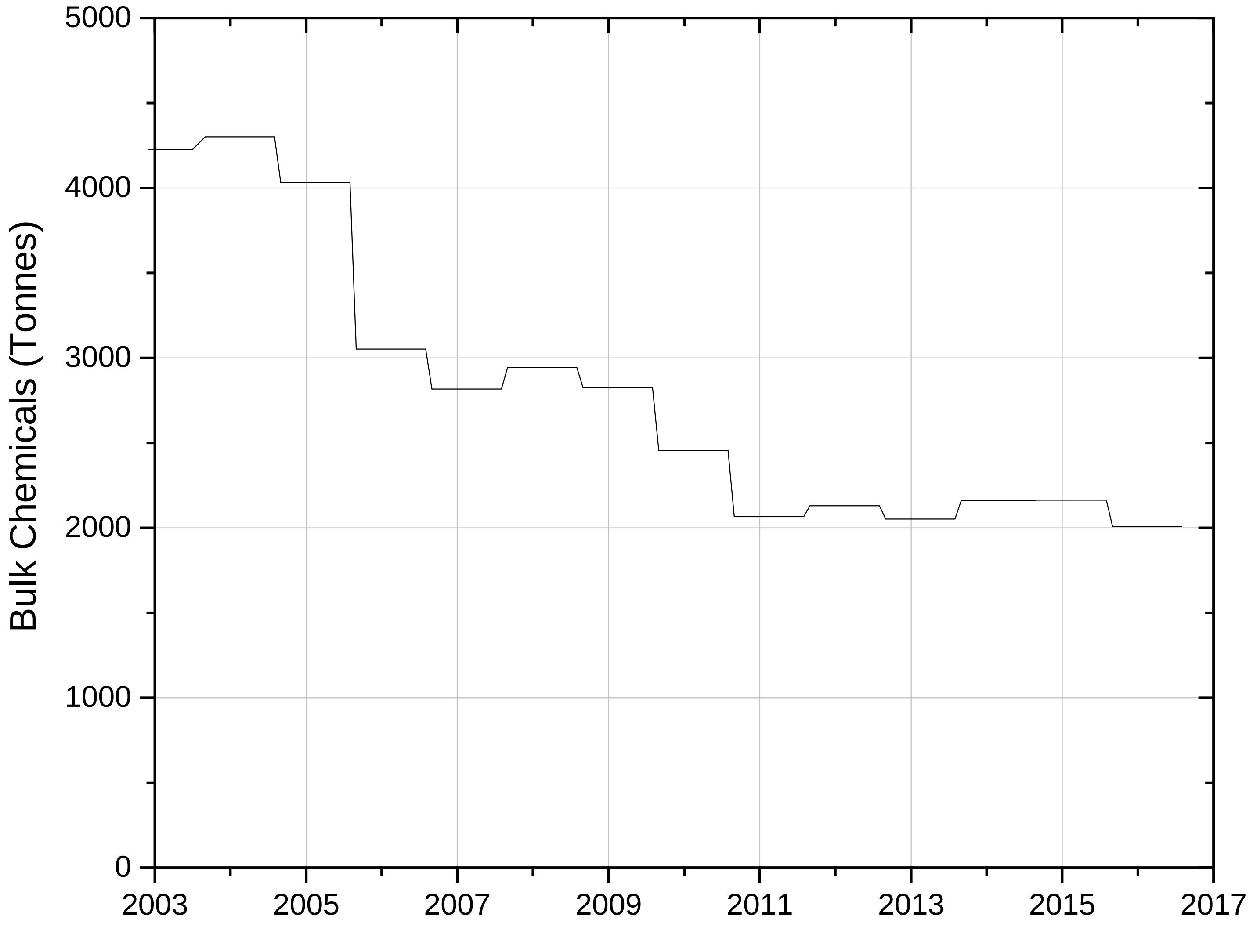
Enhanced Organics Removal



Conclusion



Conclusion



Bulk Chemicals (Tonnes)
5000
4000
3000
2000
1000
0
2003
2005
2007
2009
2011
2013
2015
2017

Questions?