Liam Tamplin and Craig White

Research Undertaken to Improve Sustainability and Reduce Costs of BNR Plants

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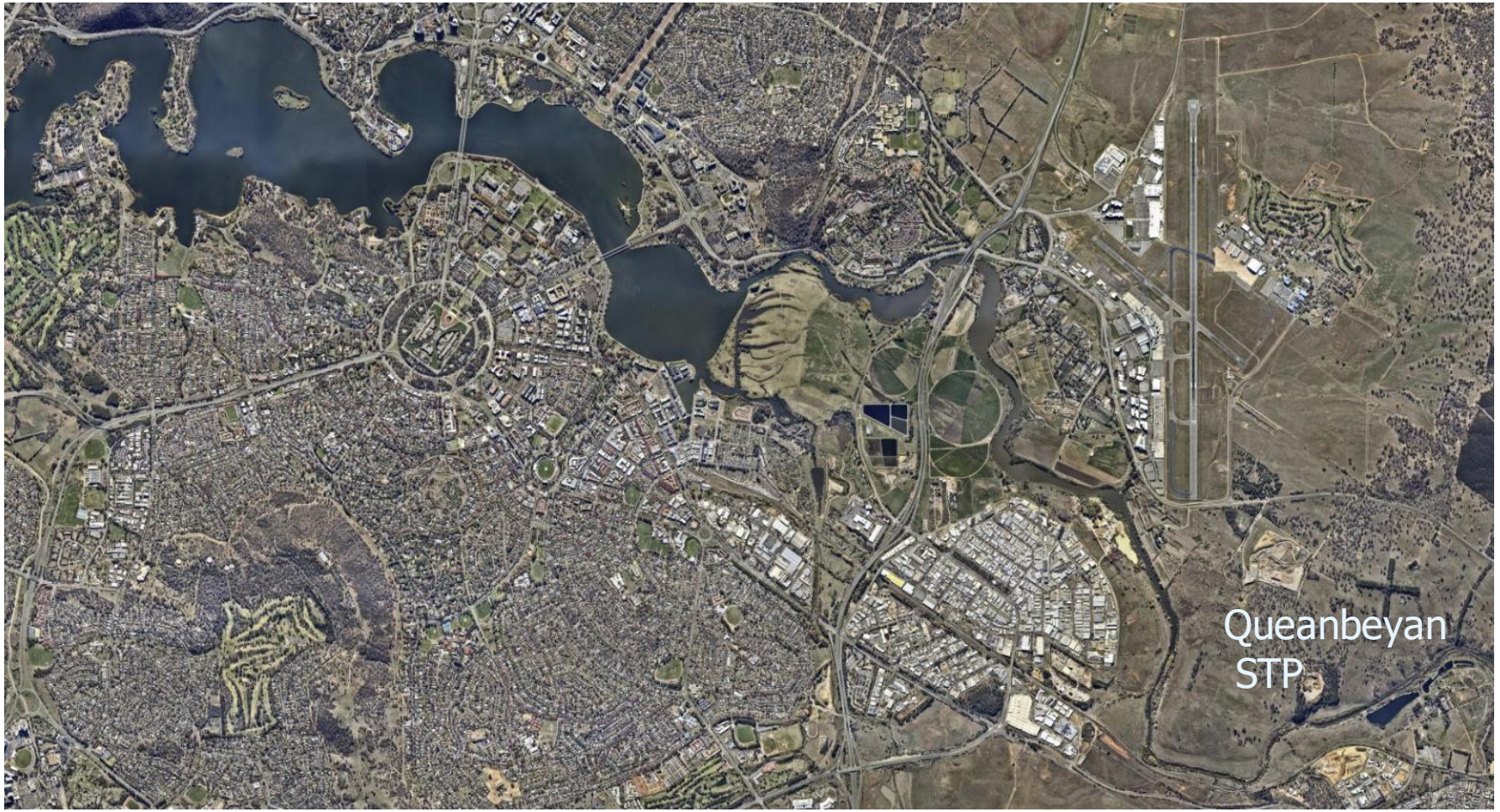
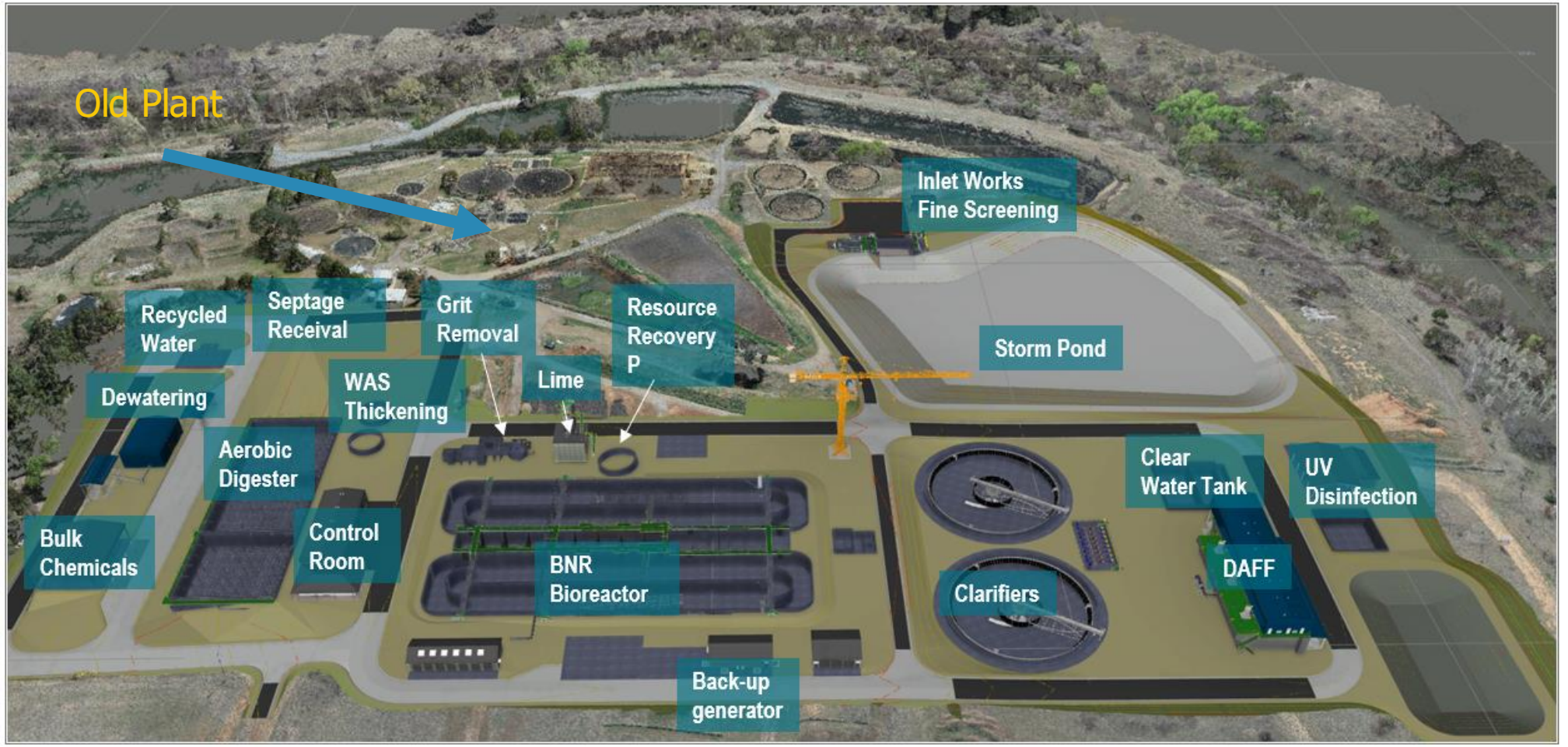
An Interesting Discharge Location



Discharge to water way not land

Out of Capacity and Dilapidated Asset

Queanbeyan BNR Plant – 75,000



Four Sustainable Research Projects from the One Design Project – Queanbeyan STP Detail Design

- Enhanced Chemical Phosphorus Removal
- Low energy mixing
- Improved storm treatment
- Enhanced oxidation ditch operation

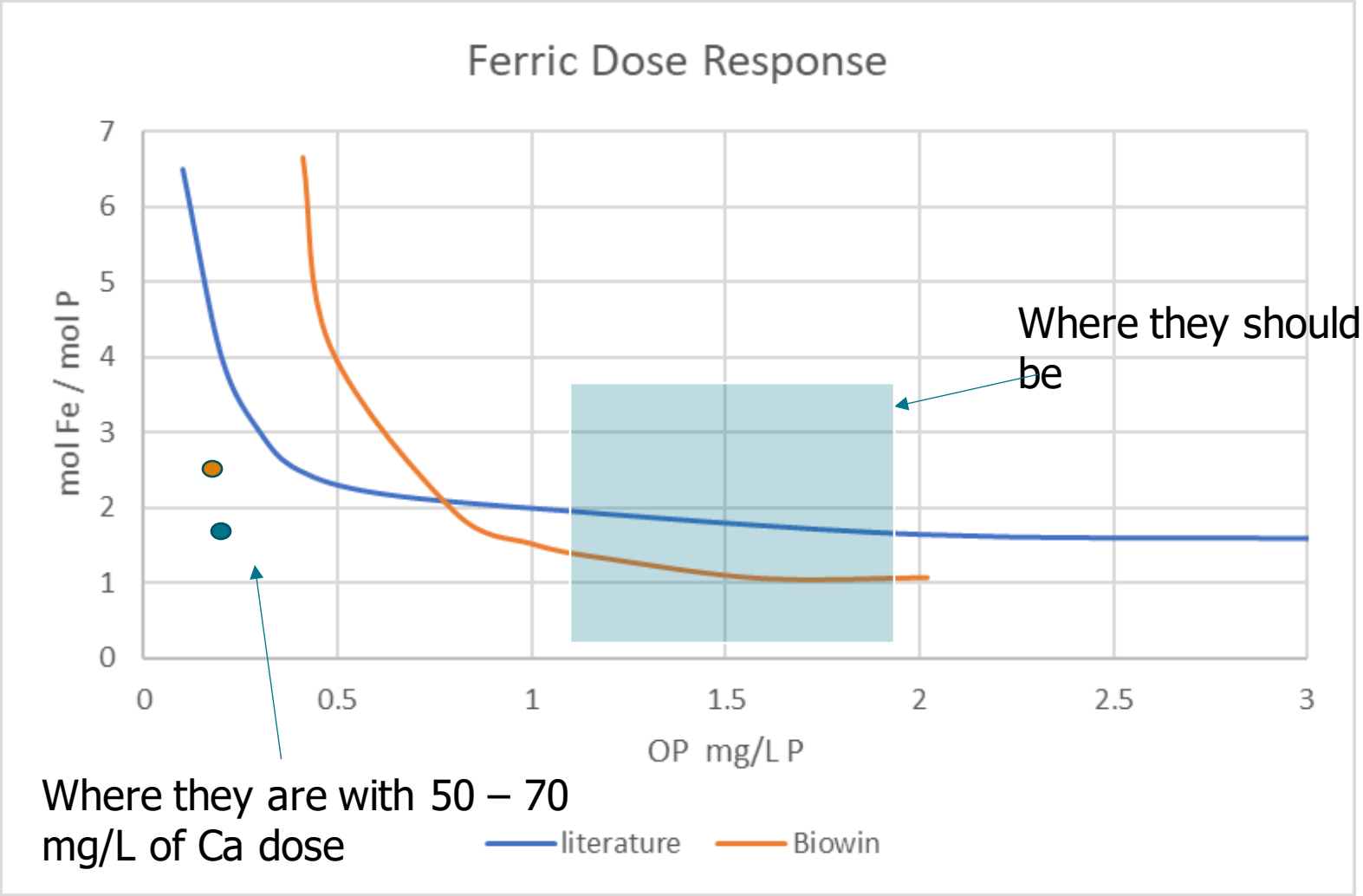
Enhanced Chemical Phosphorus Removal

500,000 EP

50,000 EP

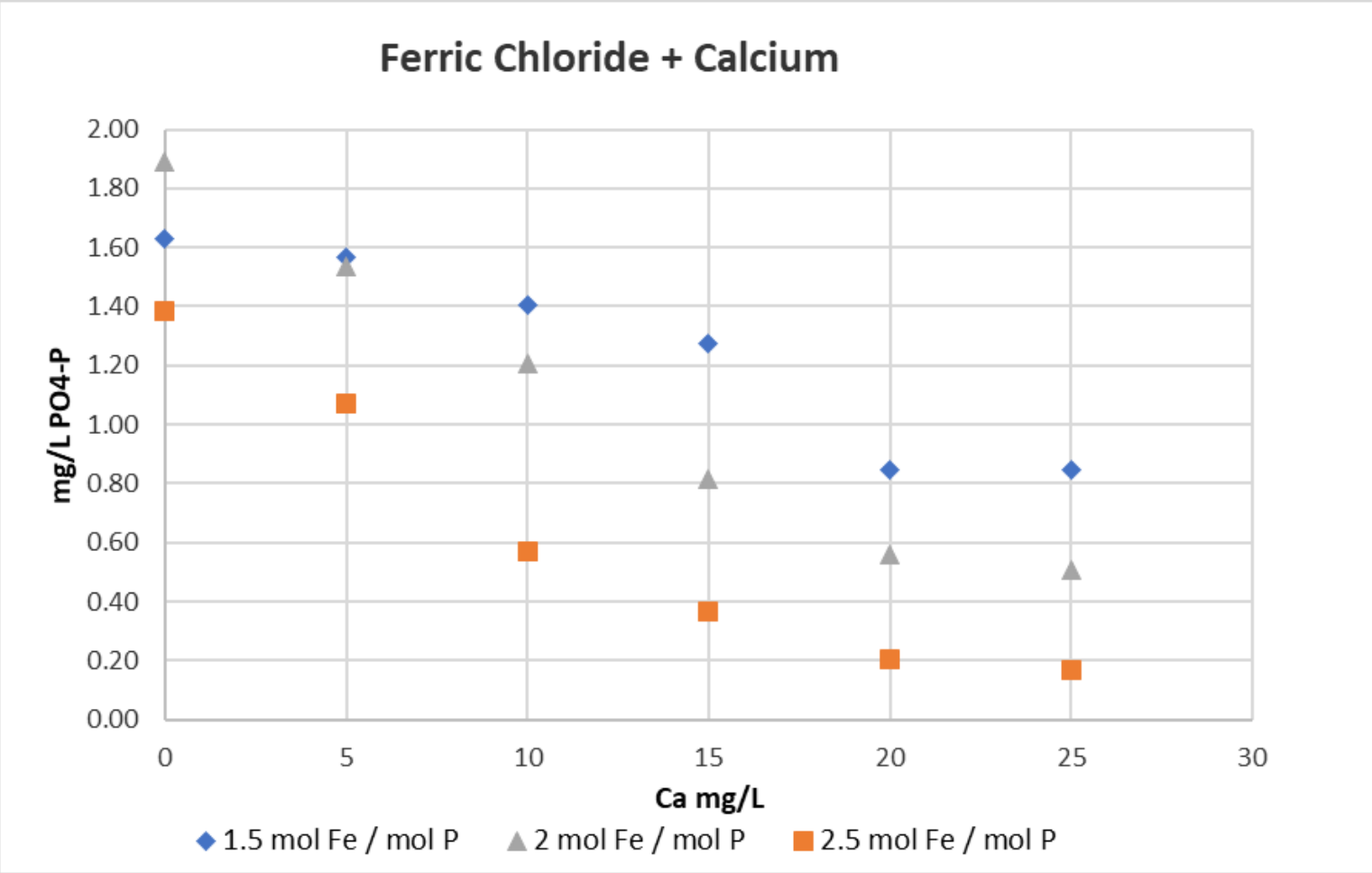
Two existing plants running for many years achieve very low TP with a fraction of the normal chemical cost.

Actual Performance versus Theory



- LMWQCC
- QSTP

Jar Testing Results



A small calcium dose significantly improved phosphorus removal. ~ 25 not 50 to 60 mg/L

pH control was not important.

What is the Mechanism?

- Not calcium carbonate
- Not calcium hydroxyapatite
- Surface chemistry larger floc size and greater positive charge

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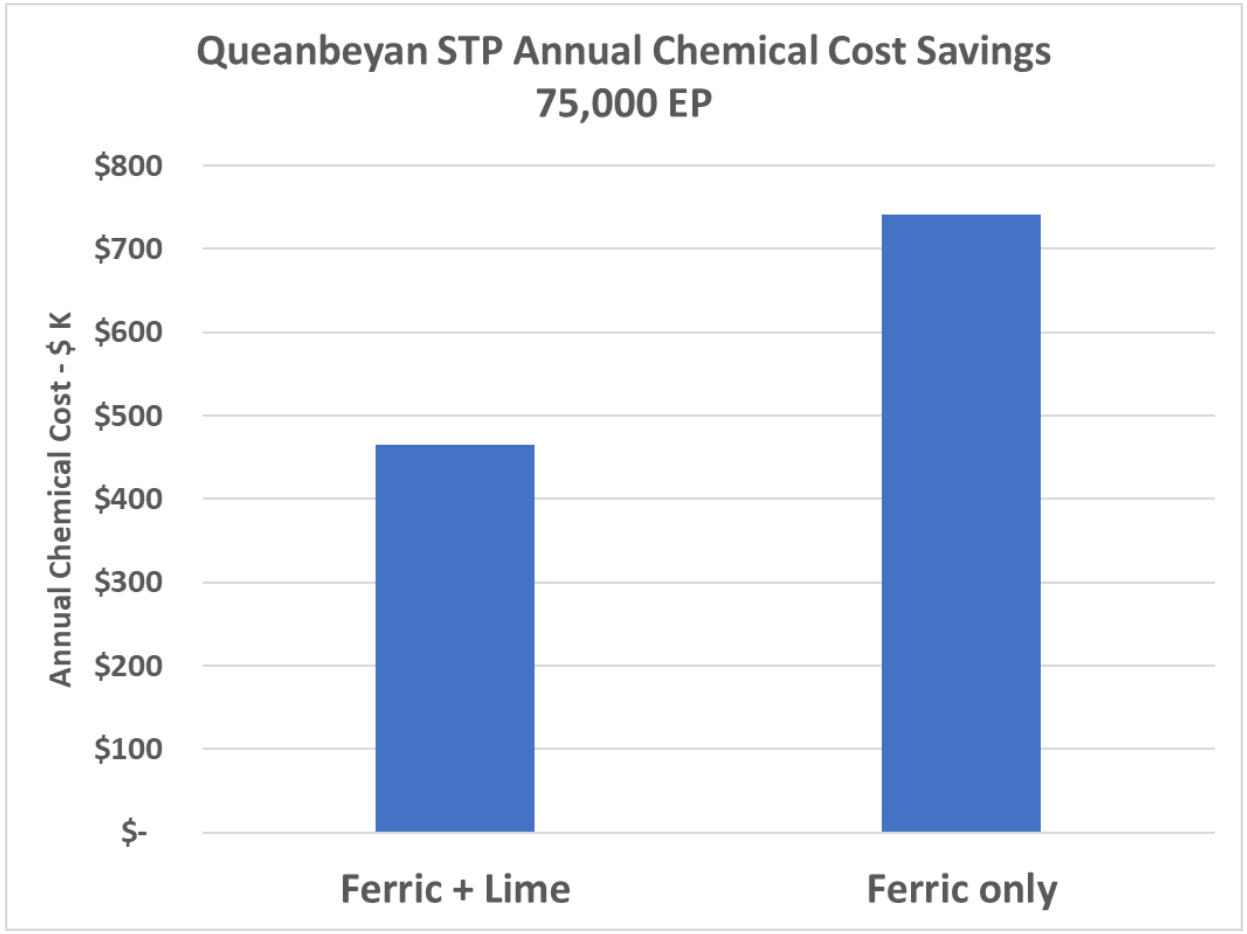
Enhance Chemical P Removal Benefits



40% Chemical cost saving

10 % reduction in biosolids

Lower residual P then straight ferric or alum

Similar performance observed with alum

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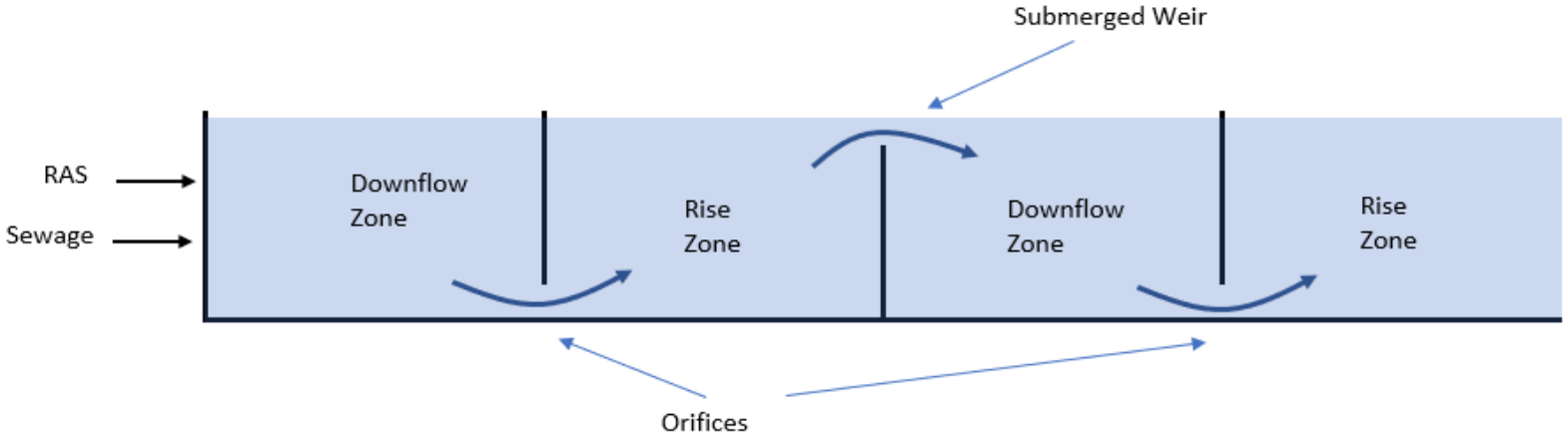
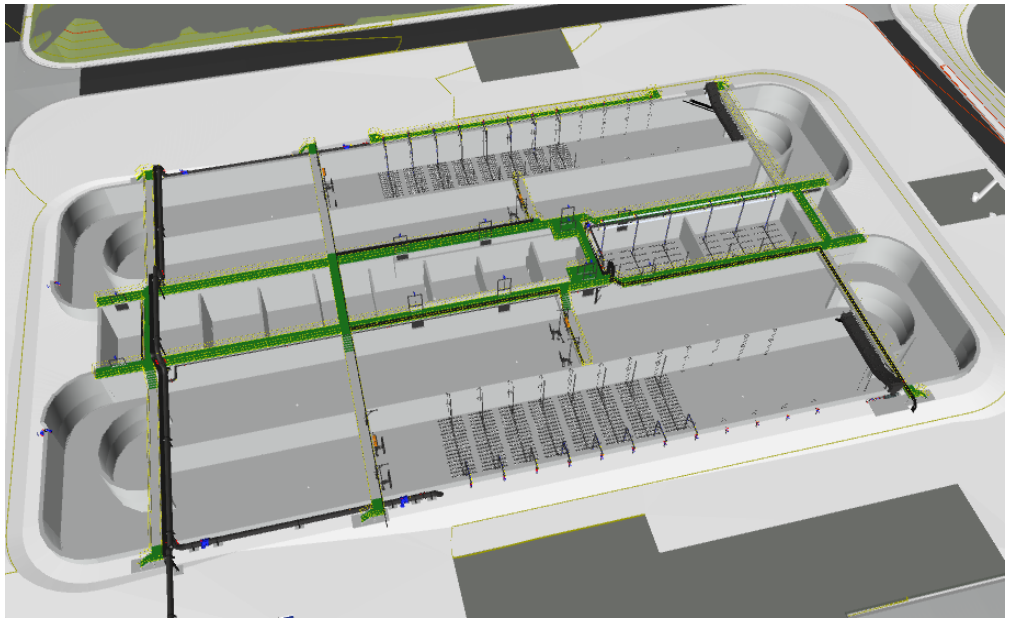
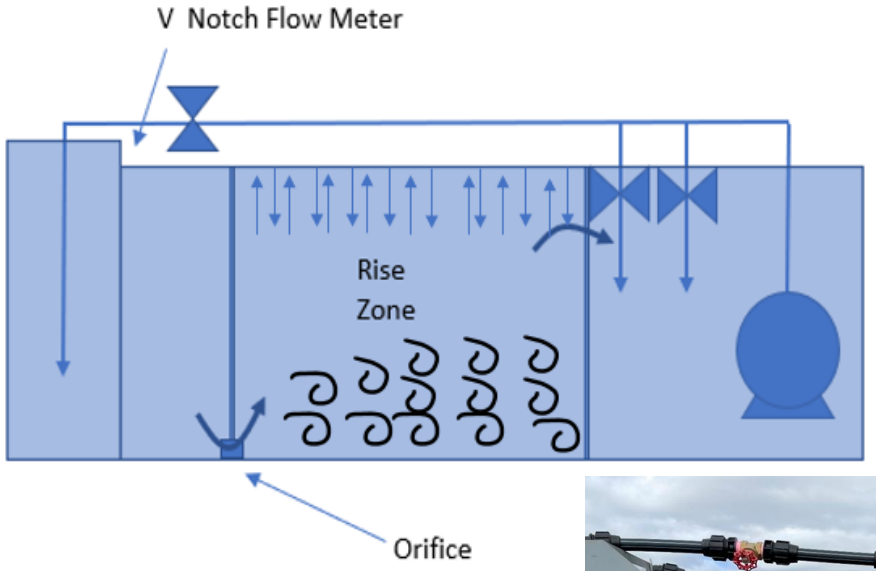
Hydraulic Mixing of Unaerated Zones
(using the energy already in the feed and return streams)



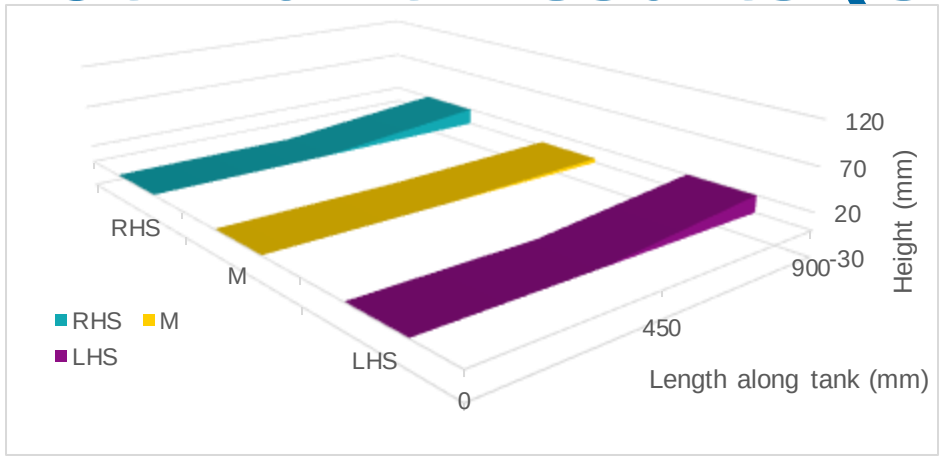


How to we Design for Mixing Hydraulically?

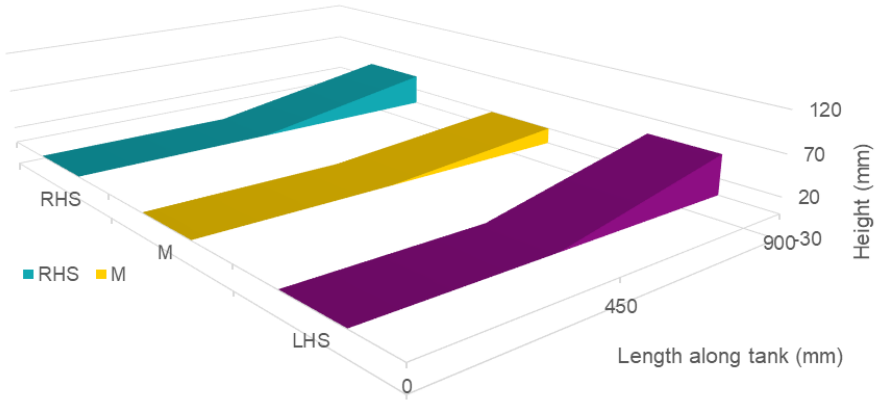


- Pilot plant was run to explore the plant extremes
- Low MLSS (high settling)
- Low diurnal flows
- What is required to mix?

Pilot Plant Results (sludge accumulation)



1000 mg/L , 0.2 m/s orifice, 7 m/h up flow



1000 mg/L , 0.1 m/s orifice, 7 m/h up flow

- A relatively low acceleration velocity was needed of 0.1 m/s and a up flow of 7 m/h to stop sludge accumulation at low flow and MLSS concentrations
- Some accumulation could be beneficial due to increased fermentation from Slowly Biodegradable organics to Readily Biodegradable organics

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Conventional Mixing Power vs Hydraulic Mixing Power

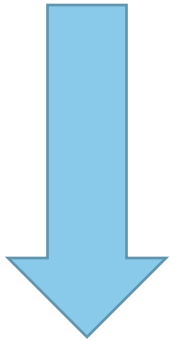
- Conventional Mixing Power - 24 hr
- Hydraulic Mixing Power - Higher head (0.8 m peak, 0.3 m average)

Mixing Type	Power Consumption (W/m^3)	Greenhouse Gas Emissions (Scope 2) (kg CO2-e/m^3/year)
Conventional mechanical	8	8.4*
Hydraulic	0.28	0.29*

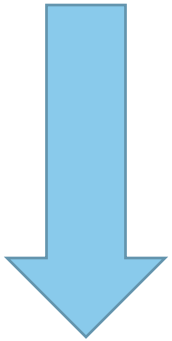
*Based on the scope 2 New Zealand emissions factor of 0.12 kg COD-e/kWh.

Operational Benefits

Compartmentalised Anaerobic Selector



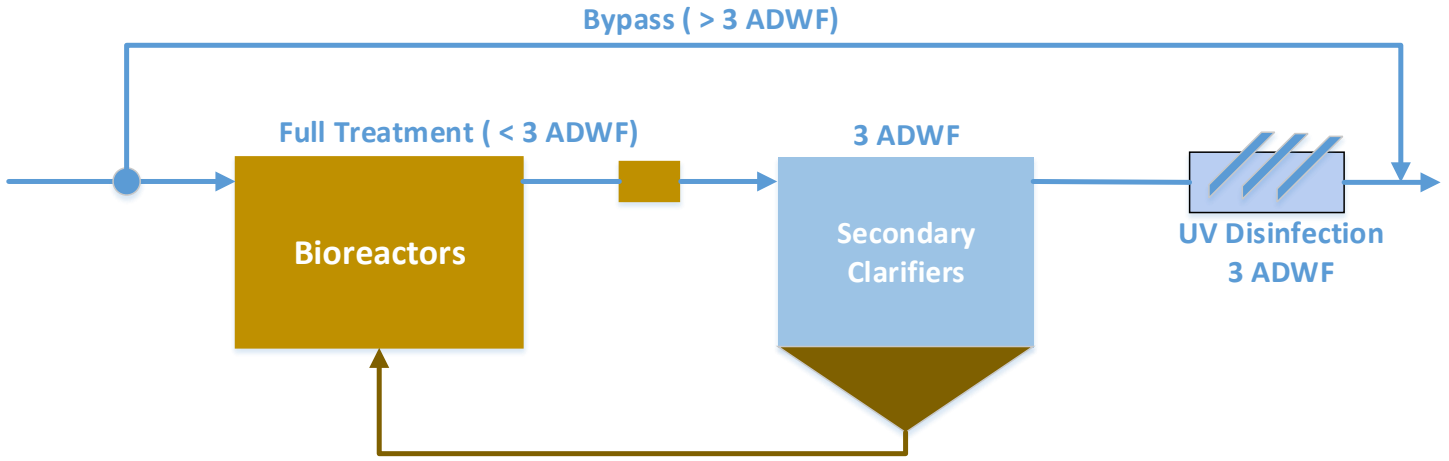
Increased Bio-P Contributing to sustaining the circular economy of phosphorus.

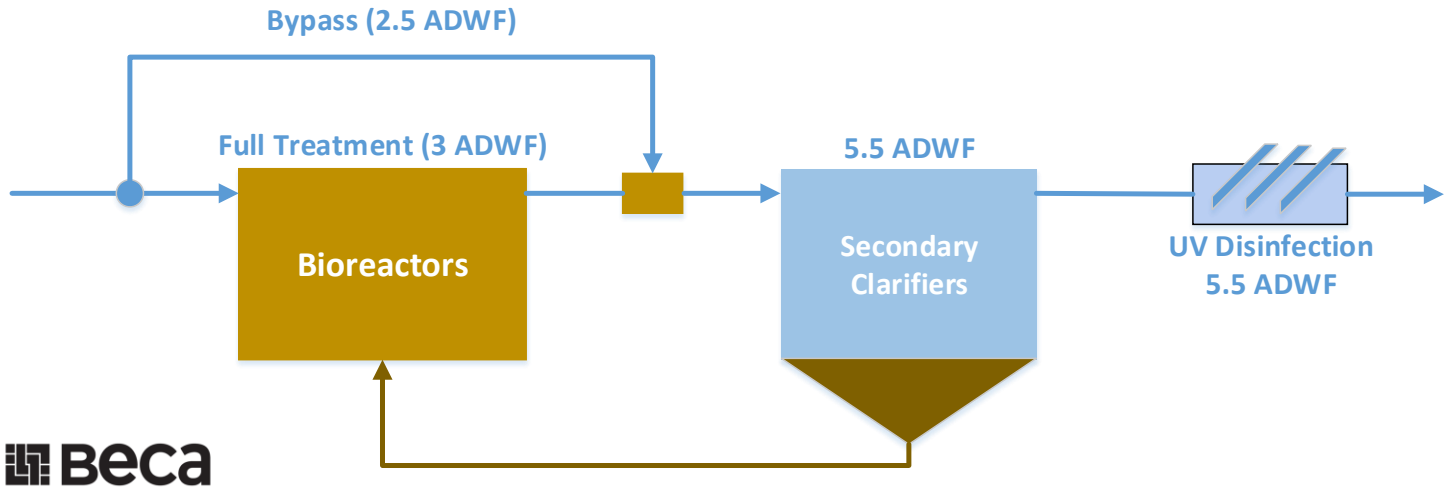


Better Settleability, hence less solids to the environment.

Capital Cost neutral – more concrete baffles vs mixers

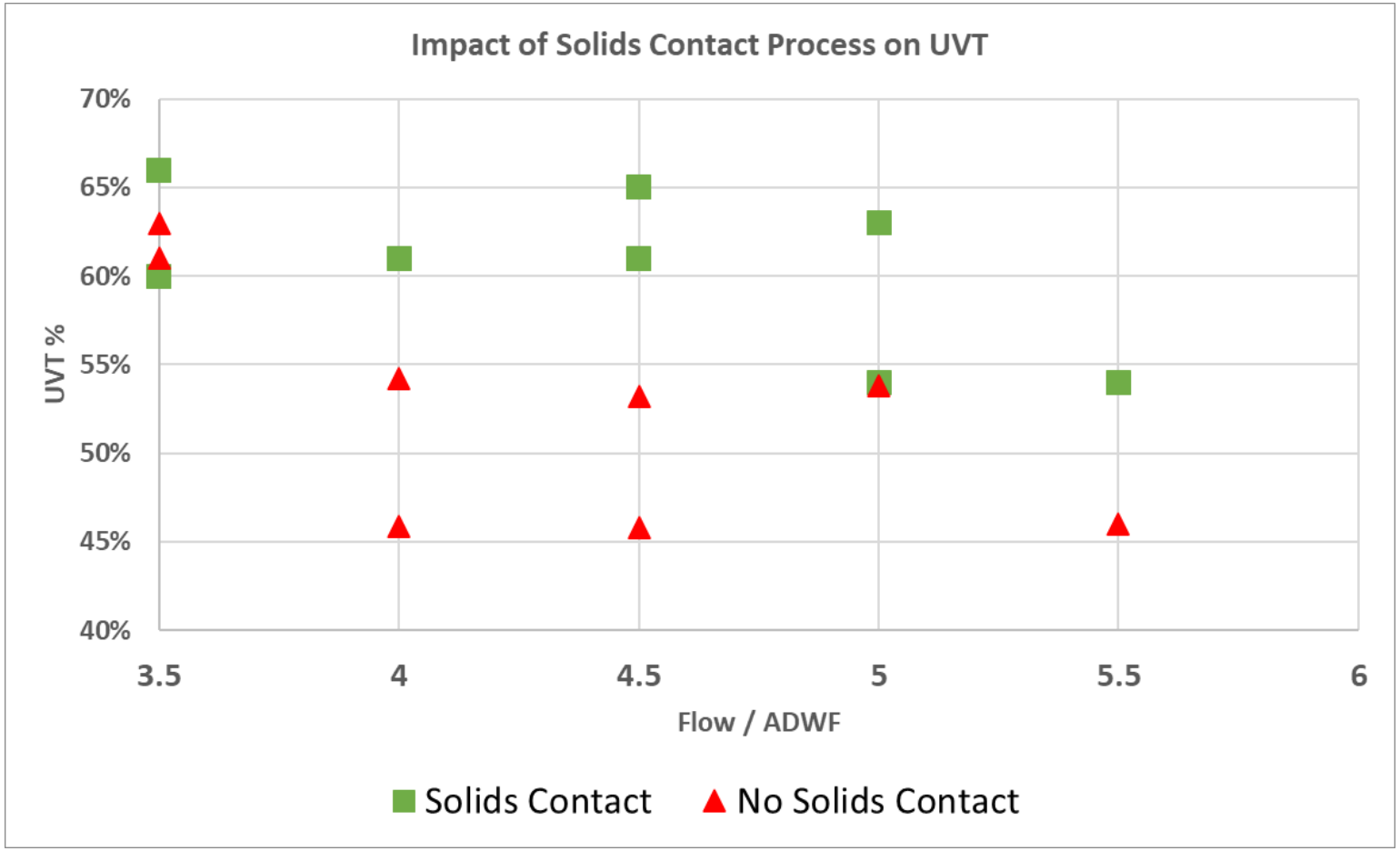
Storm Treatment
(Traditional Clarification versus Solids Contact)





Clarifier area is governed by hindered settling (zone settling)
Clarifiers can accept much higher flows if dilute material is presented to them.

Solids Contact Experimental Results



> 10 % Increase in UVT

Solids Contact Clarifier Benefits

Improved:

- Disinfection of storm flows
- Additional nutrient removal of storm flows (RAS capture)

No additional clarifier infrastructure

For QSTP this saved ~ $8.3M (8% of project costs) in clarifier construction

Oxidation Ditch – Slow them Down!

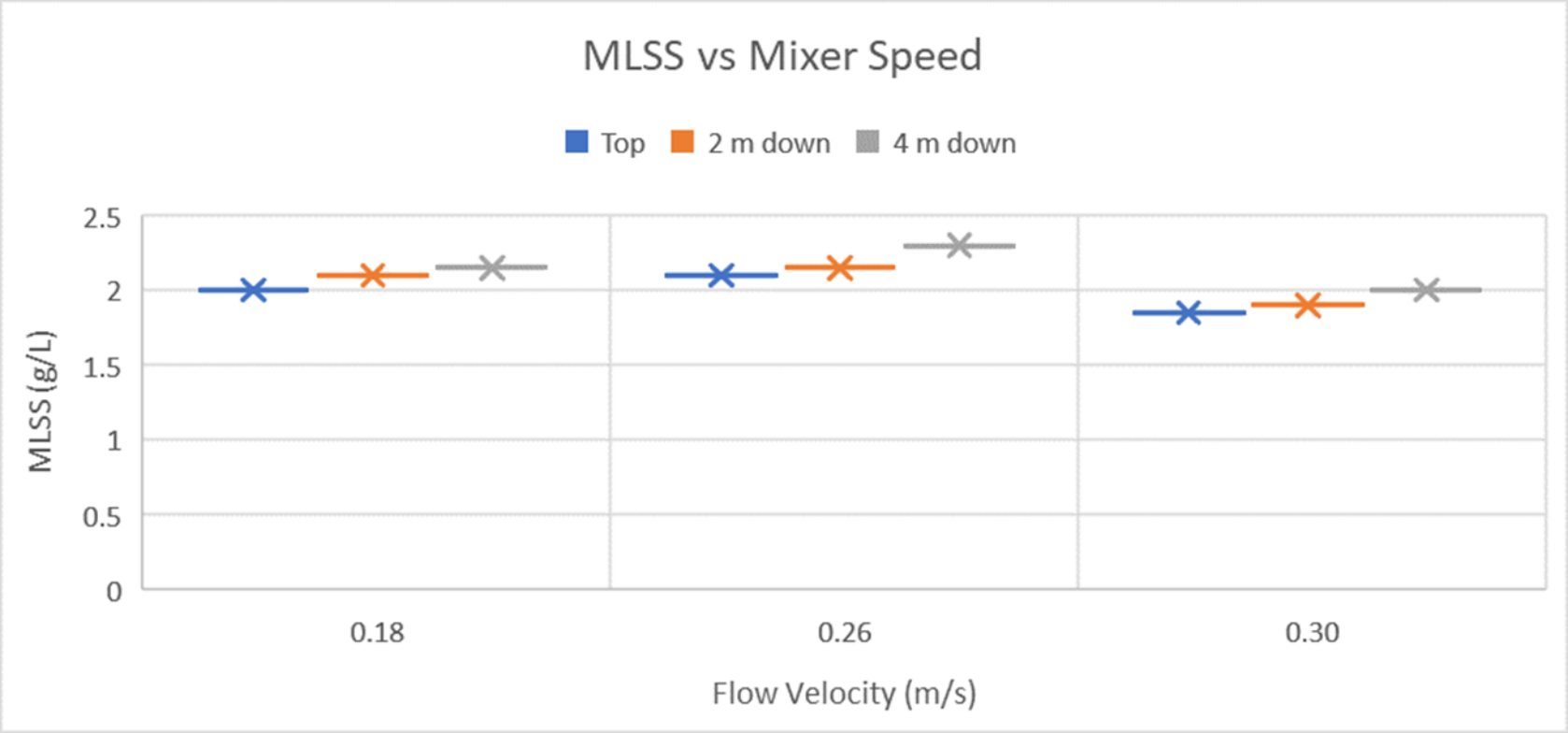
Reluctance to go below 0.3 m/s. Loss of mixing?

Benefits of lower velocity:

- Higher DO and nitrification in cold climates
- Greater bio P

Research at Mt St John STP on lower velocities

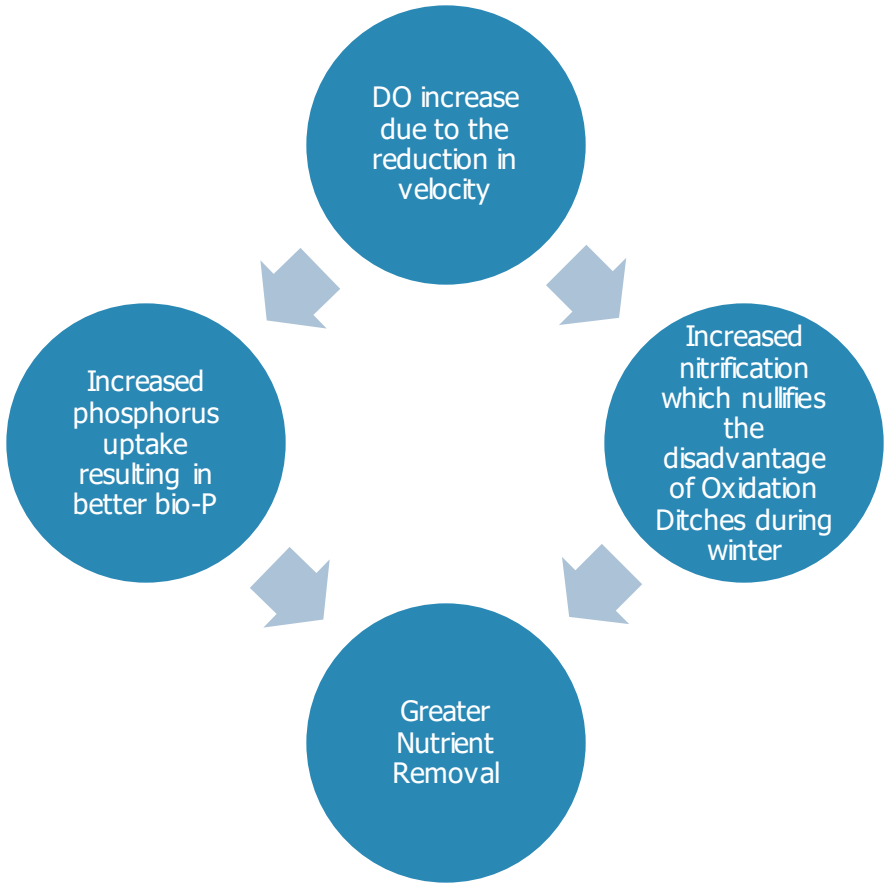
Results from Slowing Channel Velocity

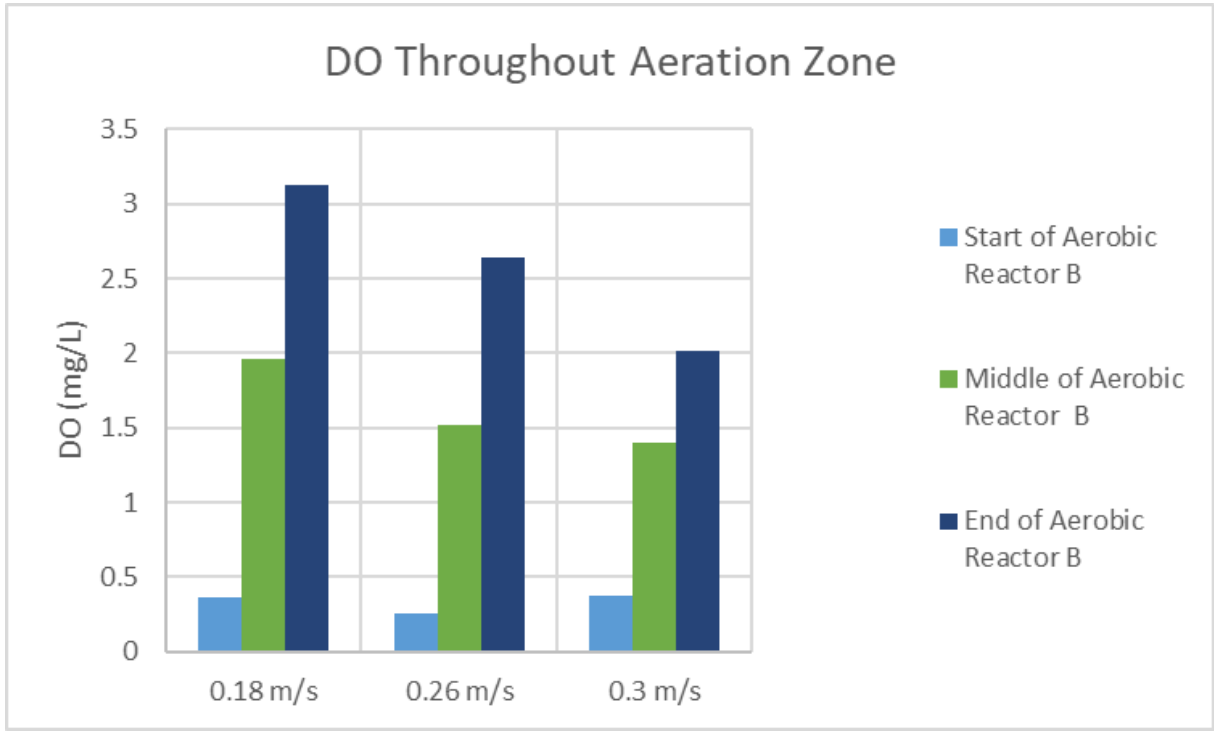


MLSS was low at 2,000 mg/L

Significant slowing possible at even low MLSS. Mixing was sustained

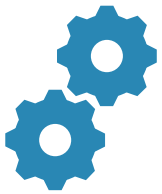
Effects of Slowing the Ditch Down





Summing it all up

Chemical phosphorus removal with a minor calcium dose resulting improved performance (40% cost reduction & 10% reduction in biosolids)



Hydraulic mixing is capital neutral and has significant power and process benefits

Storm treatment using a solids contact approach allows us to process storm flows through clarifiers without increasing required area.

Slowing of oxidation ditch velocity (40%) is possible to increase the DO and stimulate greater phosphorus and nitrogen removal.

Questions?

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