Reuben Bouman – co-authored by John Crawford and Claire Scrimgeour

Pond Upgrade or Plant Rebuild

The Pros and Cons

Beca

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Contents

Pond or Plant? - That is the Question

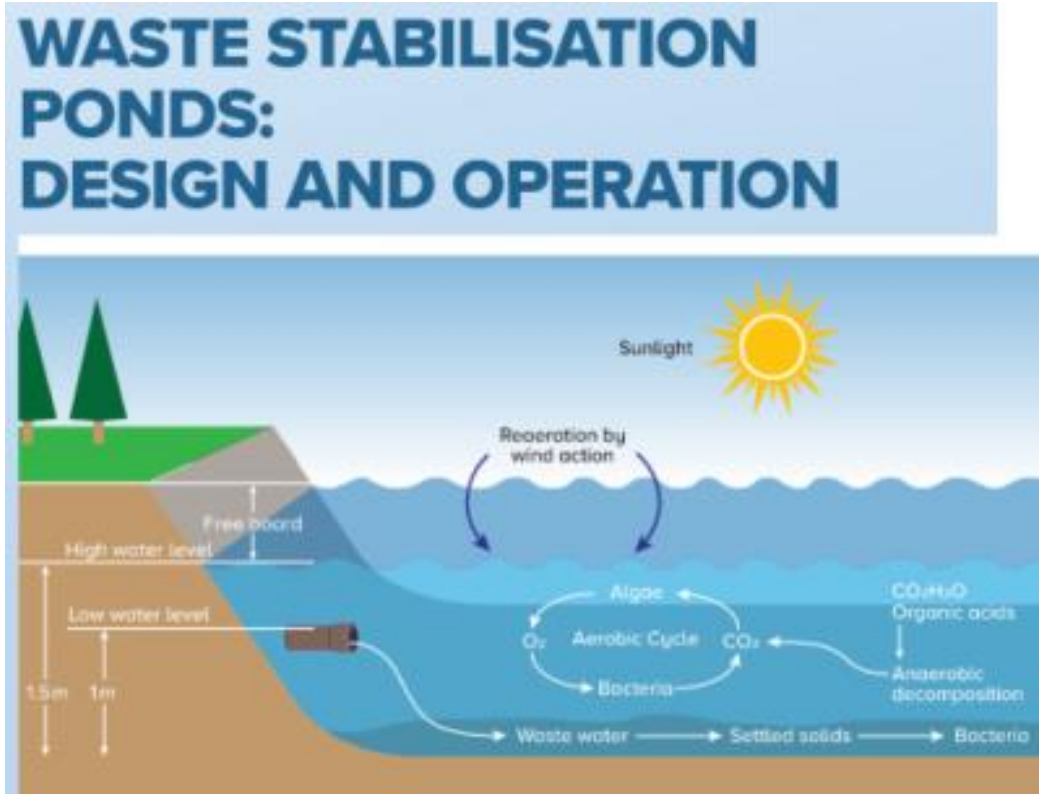
- Is there a ‘One Size Fits All’ answer?

The Challenges

- Pristine receiving environment
- Buildout
- Growth
- Higher Levels of Service
- Reverse sensitivity

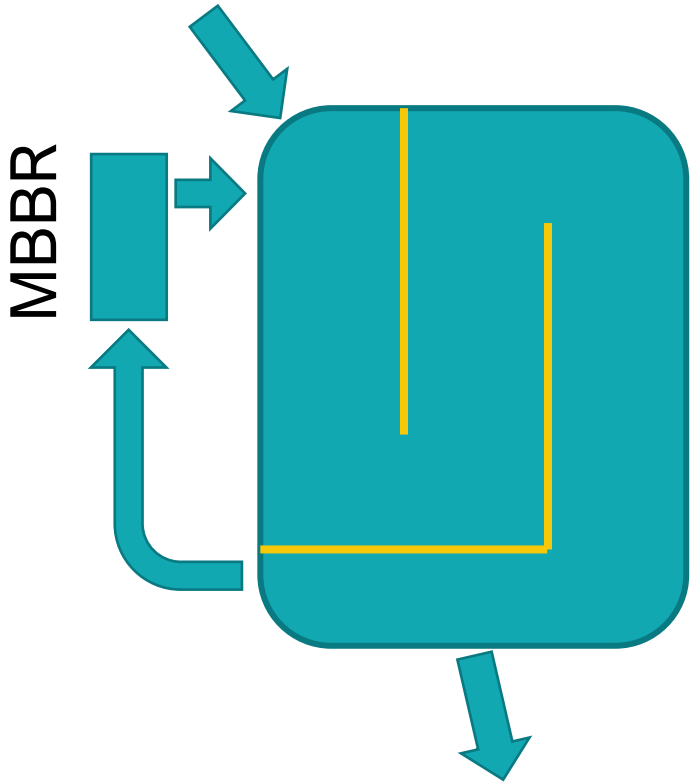
Pond Upgrade Options

- 16 Options assessed in Hugh Ratsey 2016 paper – Upgrading Waste Stailisation Ponds: Reviewing the Options
- Further developed in the 2017 Water NZ guideline
- New Options
  - MBBR (Moving Bed Biofilm Reactor)
    In return stream arrangement
  - MABR (Membrane Aerated Bio-Reactor)



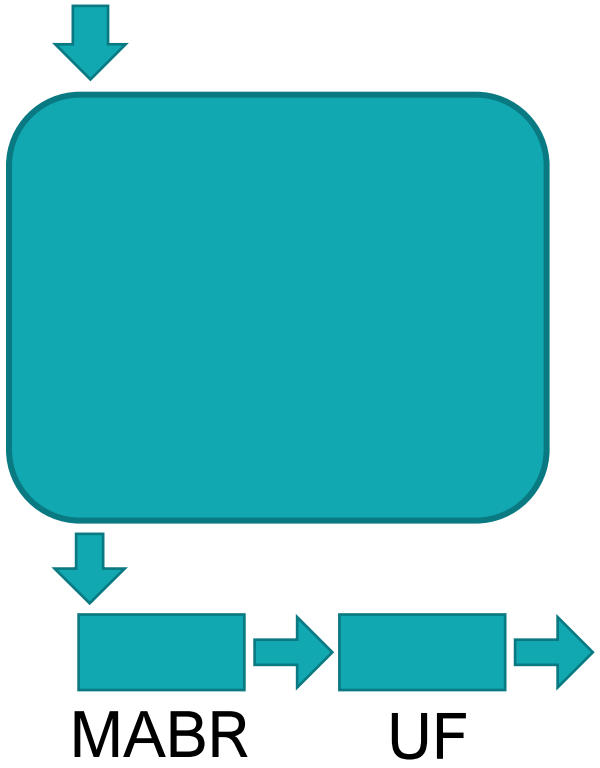
Pond + MBBR

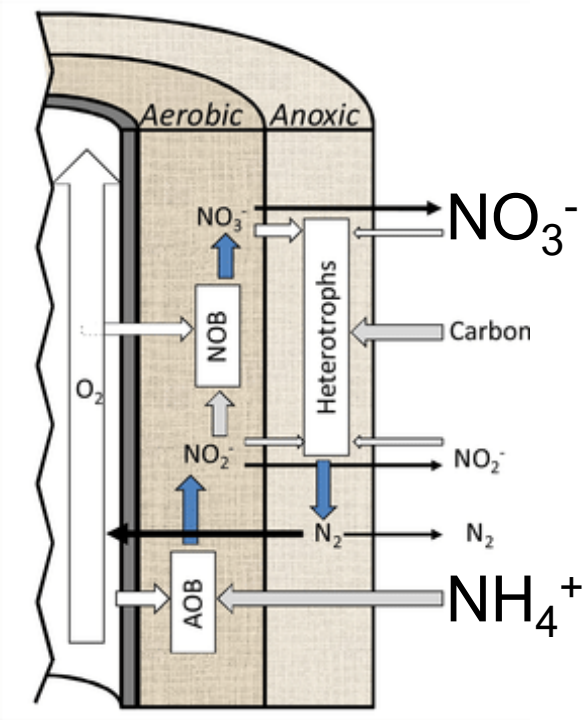
Hāwea WWTP



Pond + MABR

Hellensville WWTP





Common Upgrade Issues – Before we even start

- Influent characterisation
- Unknown inputs
- Large legacy sludge accumulations
- Inappropriate development
- No or insufficient designation
- Population projections
- Future consent conditions

The Comparision

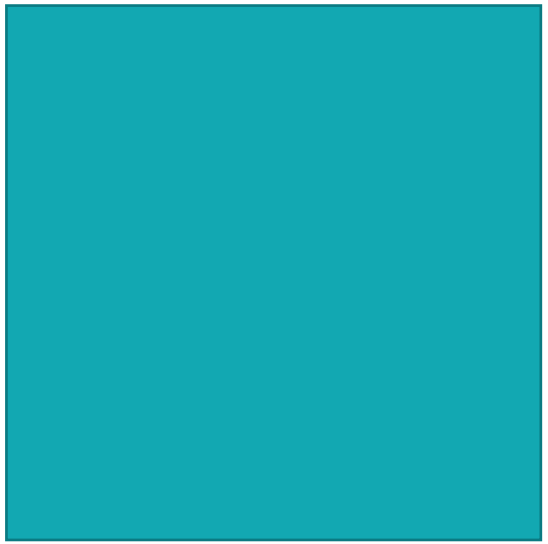
Area

Pond Upgrade

~2 m²/person

Plant Build

~0.3 m²/person



Pond based system | Bio-Mechanical plant

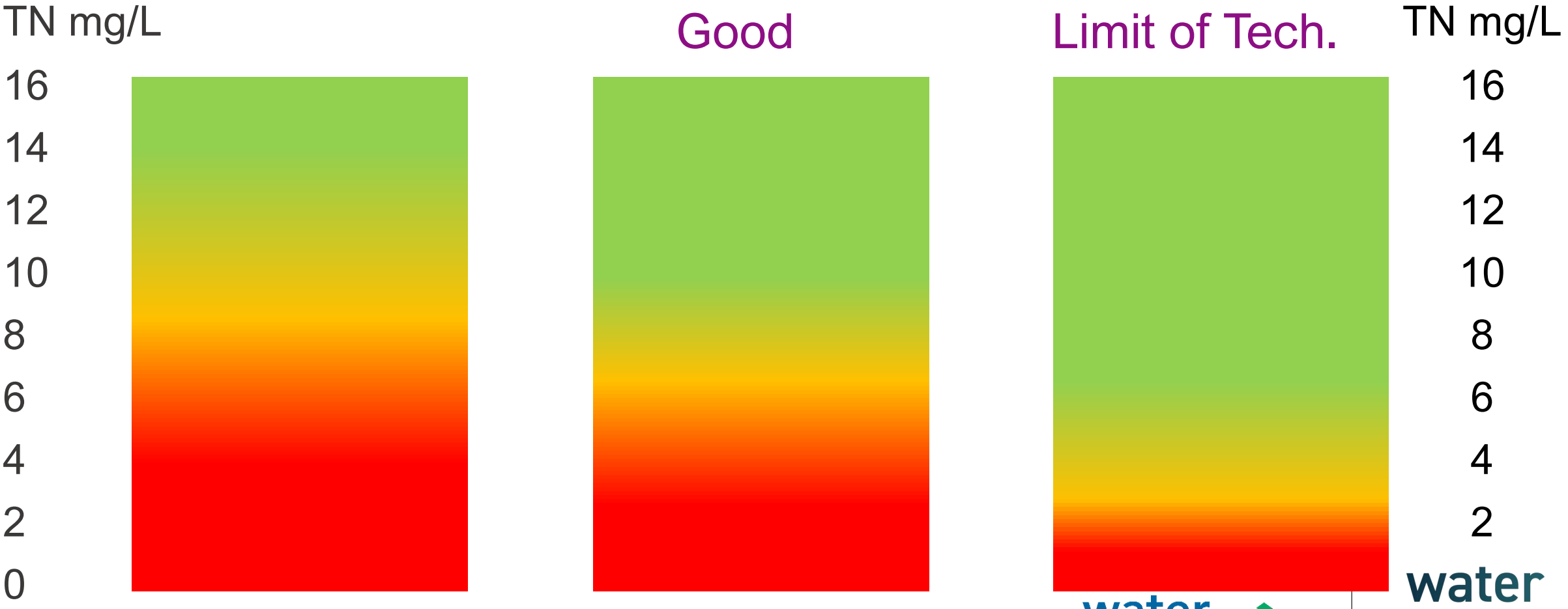
Levels of Service - Nitrogen

Pond Upgrade

Good

Plant Build

Limit of Tech.



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Levels of Service - Pathogens

Pond Upgrade

Filtration &UV	Ponds alone

- Better disinfection in the biological processes
- Algal production is a hinderance to disinfection.
- Typically 1 to 2 $\log_{10}$ less inactivation
- Better helminth control – Long HRT

New Plant Build

Bio-Mechanical plant

- Higher quality FE is easier to disinfect (both reliability and applied dose)

Reliability

Some Issues with Pond Upgrades:

- Temperature
- Sludge not dealt with AND additional sludge load
- High TSS & and very small size of algal particles
- Soluble BOD not first dealt with (before ammonia-N)
- The industry does not fully understand the biokinetics of nitrogen removal in algal based ponds
- Poor process and mechanical engineering
- Poor optimisation of chemical/mechanical systems at commissioning
- High operation and maintenance requirements

Resilience

Hazard	Pond Upgrade	Plant Build
General	**Resilient** to most hazards and quick to reinstate Embankment breach = high volume environmental incident	Design for damage rather than failure. Normally IL3. But repair still takes time.
Flooding	Ponds often low lying (e.g. Waipawa)	Electrical systems vulnerable (e.g Napier)
Power failure	Significant treatment still available with power failure	Standby power must be provided.
Peak Load	**Limited ability** to treat peak seasonal loads.	Can be very **adaptable** to peak loads
Peak Flows	Can treat a **wide variety of flows** with similar performance.	**Buffer storage** is often required Esp. with high I&I or and or MBRs
Toxicity	Reasonably **resilient** to toxic spills Can be the site of **botulism** epidemic to birds	Susceptible to toxic spills

Staff / Operators

- Fewer Operators
- Skills requirements rise
- Process knowledge requirement rises

- >Training / Skill Sets
- >Number
- Maintenance
- Cleaning, Calibration
- Process Support

Do Nothing

Pond Upgrade

New Plant Build

Transitional Operation

- Can continue largely uninterrupted

- Can be disruptive if reclaiming any pond area
- Easy for a greenfield new build

Electricity

Pond Upgrade

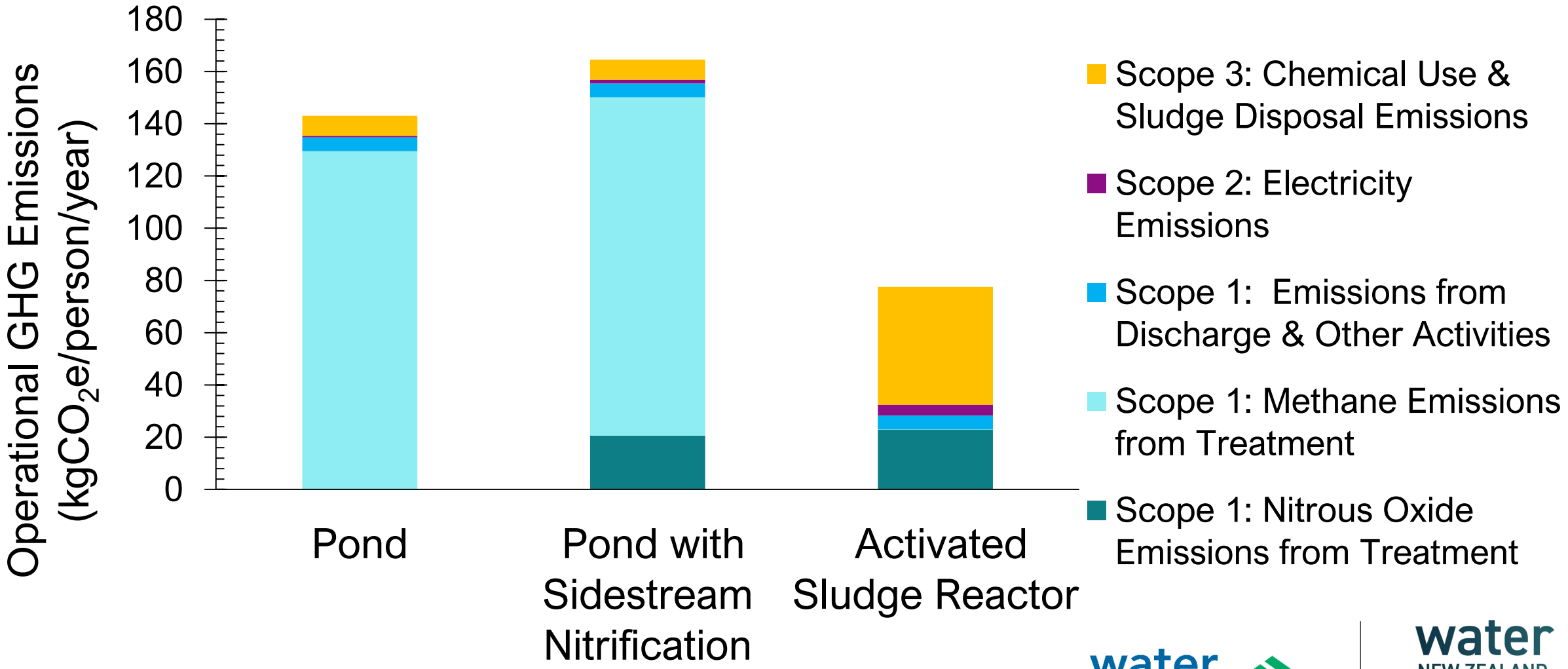
0.1 to 0.2 kWh/m³

Includes allowance for Nitrification

Plant Build

>0.35 kWh/m³

Green House Gas Emissions



Odour

Pond Upgrade

- Large surface area remains for potential odour emission
- Seasonal risk at Spring / Summer turnover
- Can be difficult to maintain sufficient odour buffers
  150 to 300m
- Higher loading = higher odour risk

Plant Build

- Easier to maintain odour buffers
- More 'contained' so high risk processes are easier to configure for odour capture and destruction

Sludge Quantity, Quality, and Management

Parameter	Pond Based	Plant based
Yield	Significantly **Lower**	**Higher** (although can be reduced by using fixed growth system)
Removal	10 - 15 years.	Frequent removal from reactor and site.
Treatment	Digested in pond sludge layer	Typically dewatered Other processes (AD etc.) can be added.
Contamination	Historical screenings and metals contamination %g/kg can be high	Stabilisation required if primary sludge is produced.
Disposal	Can be difficult due to apparent contaminants Often **mono-filled on site**	Commonly **landfilled** Opportunities for **land application** esp. in AU

Potential Cultural Implications

Pond Upgrade | Plant Build

Cost

Pond Upgrade

Typically cheaper BUT:

- How much TN to remove? May still need large or multiple reactors
- Future upgrades. Is this a ‘sunk cost?
- There will be a cost tipping point where it is no longer cost effective to keep adding electro-mechanical ‘bits’

Plant Build

- Concrete, steel & Technology dominate CAPEX
- Power and daily sludge management dominate OPEX

Summary

Evaluation Parameter	Pond Upgrade	New Build Plant
Nitrogen performance	If TN <10 mg/L	
Pathogen performance	Filtration &UV	
Real Estate		
Reliability	Depends on technology chosen	
Resilience		
Operation		
Energy		
Carbon		
Odour		
Sludge		
Culture		
Cost		
Future Proof		