

DAIRY WASTEWATER REMEDIATION, CONSENT COMPLIANCE AND RESOURCE SAVING OF A 1.25 HECTARE CONSTRUCTED WETLAND

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Martin Mulholland, CAFRE

Research Project Partners



- Greenmount Campus, CAFRE – construction of wetland
- Agri-Food & Biosciences Institute (AFBI) – research study
- Queen’s University, Belfast (QUB) – research studies
- NI Environment Agency (NIEA) – discharge consent

Farmyard Dirty Water

Pollutant	Cumby et al	Healy & O'Flynn	Minogue et al	Forbes et al
BOD (mg/l)	6,593	998	2246	1,646
NH ₄ ⁺ N (mg/l)	457	48	212	6.9
TP (mg/l)	135	-	80	60

Dirty Water Sources

Pollutant	BOD ₅
Dairy parlour washings	449
Grass silage clamp runoff	1,371
Livestock yard runoff	573

(New campus dairy unit & covered silage clamps 2013)



Conventional Dirty Water Management

- Collection and storage in slurry tanks
- Land spreading using tractor drawn slurry tankers
- Annual cost of storage and spreading ~ £5,000 - £10,000
- Constructed wetlands - a viable alternative?



Wetland Construction

- 5 pond gravity fed, surface flow wetland
- 1.25 ha surface area
- Compacted clay base
- 40 mg/l BOD & 60 mg/l SS consent
- 70 day retention
- 5 plant species



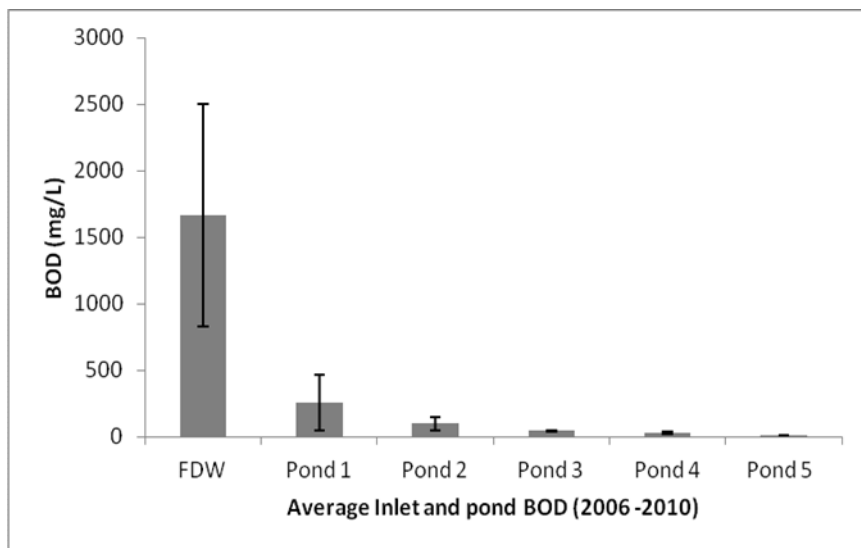
Wetland Monitoring

- 2005 -10 weekly grab samples inlet & outlet of 5 ponds
 - N, P, pH, BOD₅ plus campus weather station
- 2010 – 14 monthly sampling inlet and discharge point
 - N & P (Palintest), pH, BOD₅ plus met office weather station data

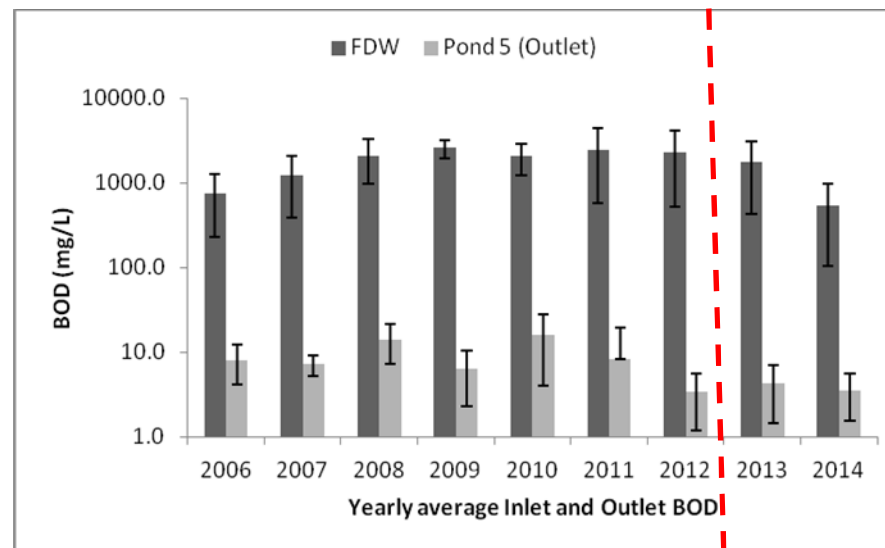
Results - Hydrology

	2005 - 2010	2010 - 2014
Precipitation (mm)	943	854
Temperature (°C)	9.4	n/a
Inflow (m ³ /day)	~50	n/a
Outflow (m ³ /day)	~25	n/a

Results – BOD₅

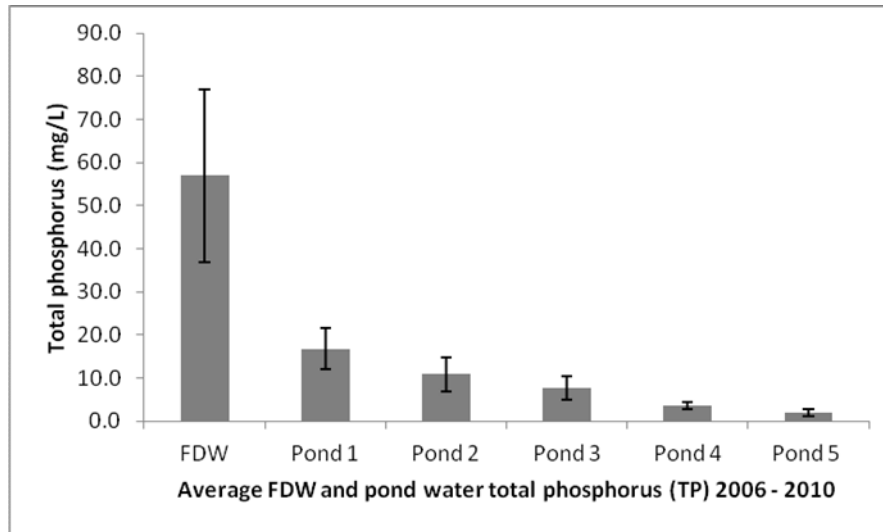


Average BOD concentrations 2006-10

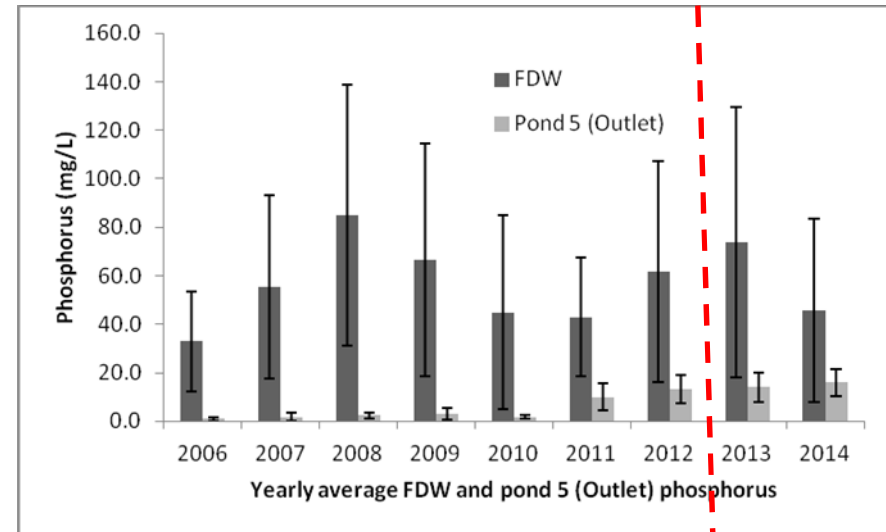


Yearly average inlet and outlet BOD concentrations

Results – Phosphorus

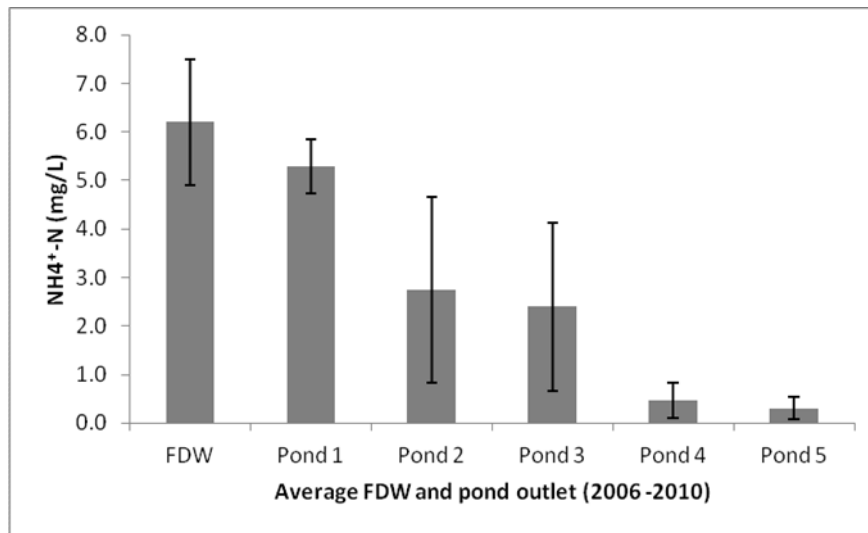


Average total P concentrations 2006-10

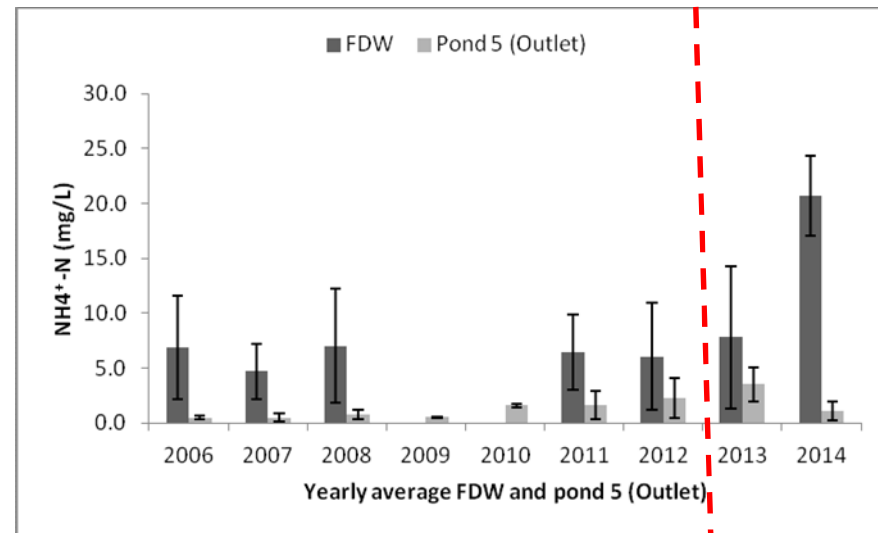


Yearly average inlet and outlet total P concentrations

Results – Nitrogen

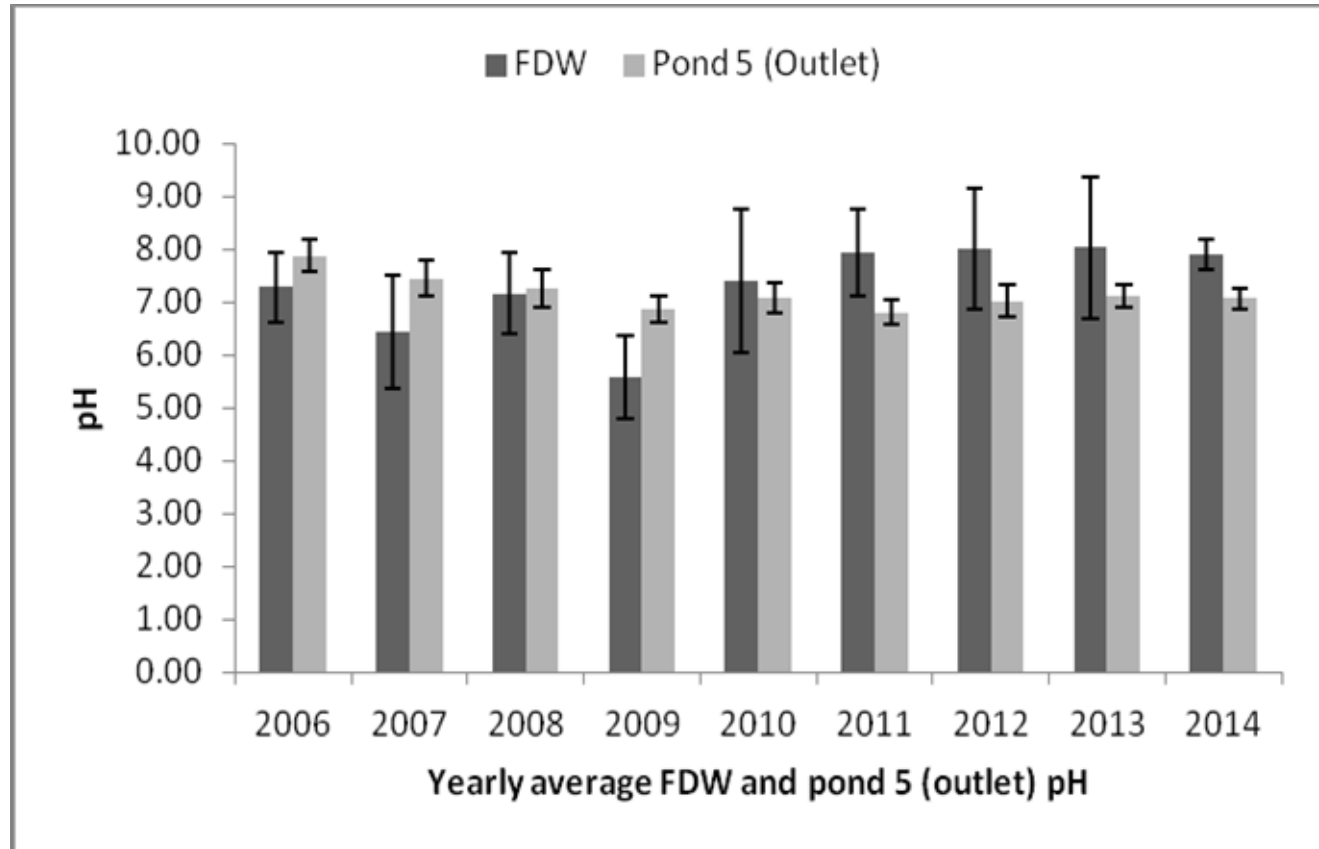


Average total NH_4^+ concentrations 2006-10



Yearly average inlet and outlet total NH_4^+ concentrations

Results - pH



Wetland Cost/Benefit Analysis



Assumptions:

- 3,000 m² dirty yard area
- Average rainfall 4mm per day
- Dairy washings 5m³ per day
- Dirty water storage cost £40 per m³
- Land spreading cost £30 per hour
- Wetland construction cost £30,000

Wetlands Partial Budget

Constructed Wetland		Land Spreading	
Extra costs		Costs saved	
Construction depreciation	£3,000	Tank depreciation	£2,856
Maintenance	£500	Dirty water spreading	£6,807
Land rental	£222		
Total	£3,722	Total	£9,663
		Extra costs	£5,941

Conclusions

1. Pond water chemistry of tested parameters shows the CW has retained a high level of functionality.
2. BOD reduction has remained extremely effective since the first years of operation and has operated consistently at >95% and always below the set discharge limit.
3. Phosphorus retention and nitrogen (as ammonium nitrogen) reductions appear to have declined slightly since 2010 though reductions between inlet and outlet are still effective.
3. Changes in pH of the FDW influent did not affect pond water and discharge water pH concentrations.
4. Cost and resource saving resulting from avoiding land-spreading FDW and construction depreciation were positive and resulted in a 5 to 6 year payback on CW development costs.
5. An agricultural constructed wetland, appropriately designed for the expected hydraulic loading and with defined contaminant parameters, can function efficiently, reliably and sustainably over a term of at least ten years.