

Task 4: Tertiary treatment technologies for water reuse and rainwater harvesting in the Irish dairy industry.

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Presentation Contents

- Task aims
- Background
- Site survey
- Results
- Six month projection

Task 4 - Aims

- The use of tertiary treatment technologies to investigate the potential for;

Water reuse

Rainwater harvesting

WWTP effluent disinfection

within the Irish dairy plant industry.

Water Consumption – Irish Dairy Industry

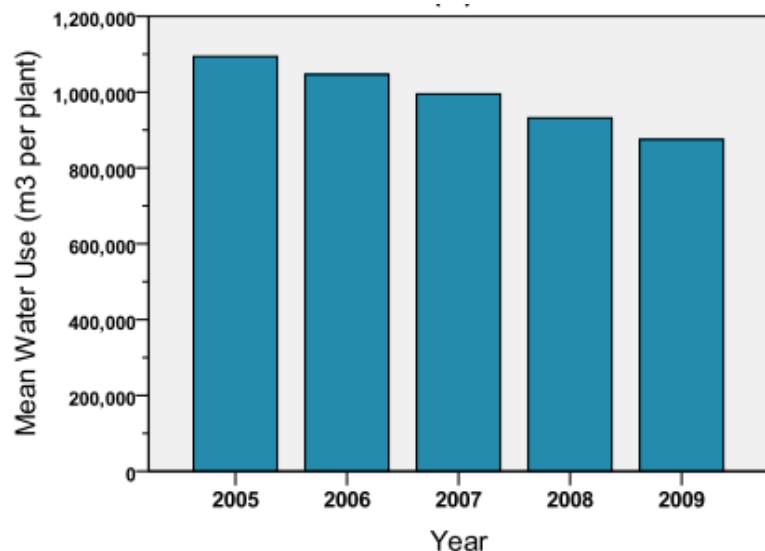


Figure 1. Mean water use in Irish dairy plants (Geraghty, 2011).

- Minimal water stress



IDB Annual Report, 2013.

- Water efficiency

Ireland: $2.5\text{m}^3/\text{m}^3$ of milk processed^a

Australia: $1.75\text{m}^3/\text{m}^3$ of milk processed^b

- CAP abolishment

Industry expansion expected – water use increase.

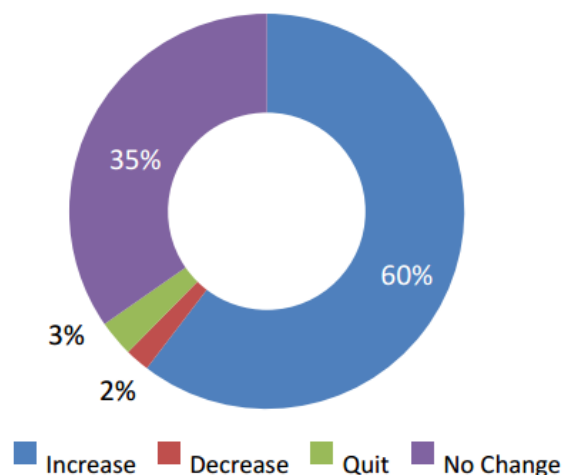


Figure 2. Expected milk production expansion by dairy farmers 2015 – 2017 (Teagasc, 2015).

^aGeraghty, 2011

^bBarr & Buuren, 2013

Water reuse

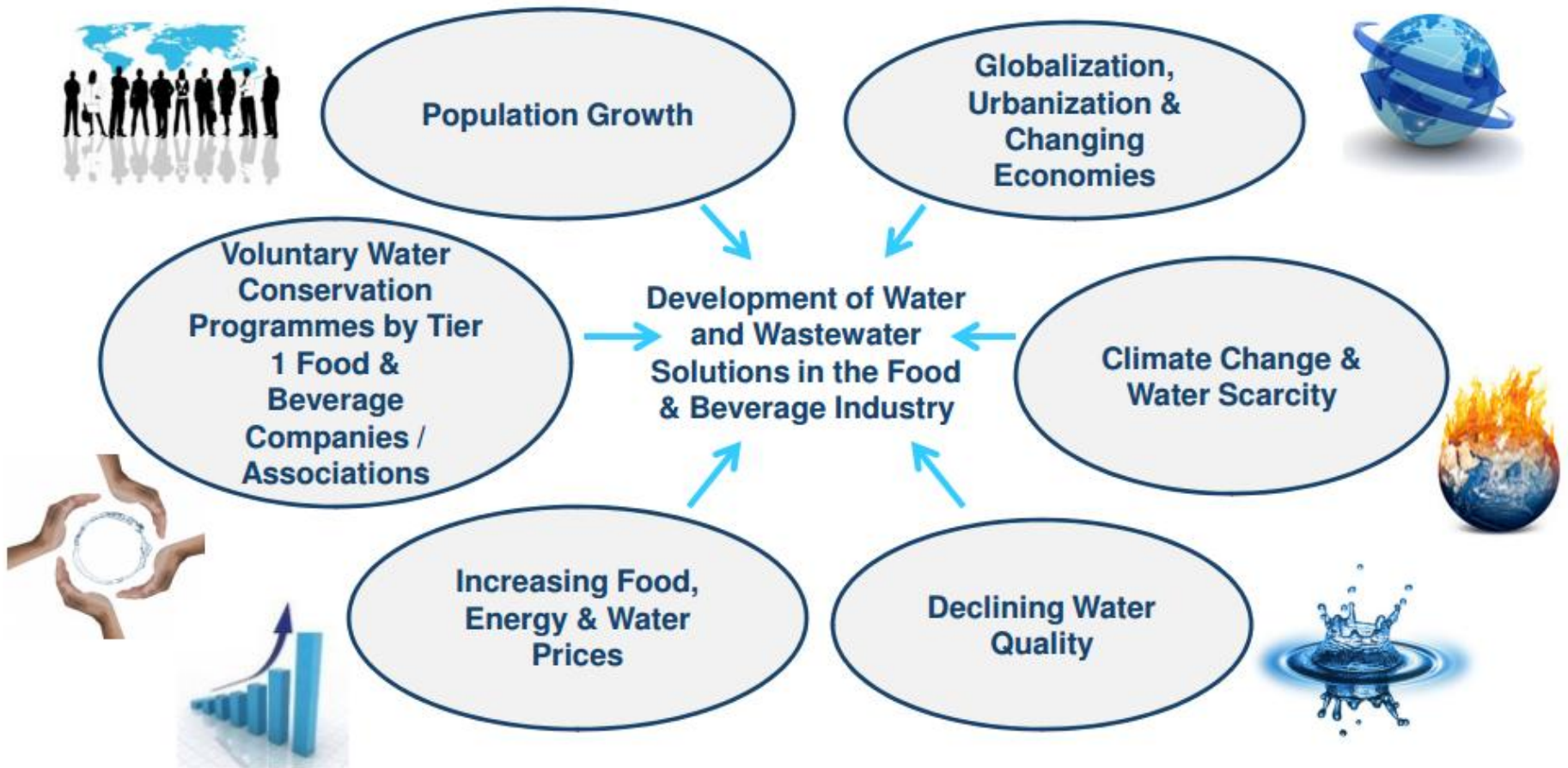


Figure 3. Global trends impacting food & beverage water and wastewater market (Frost & Sullivan, 2012).

Potential for dairy water reuse

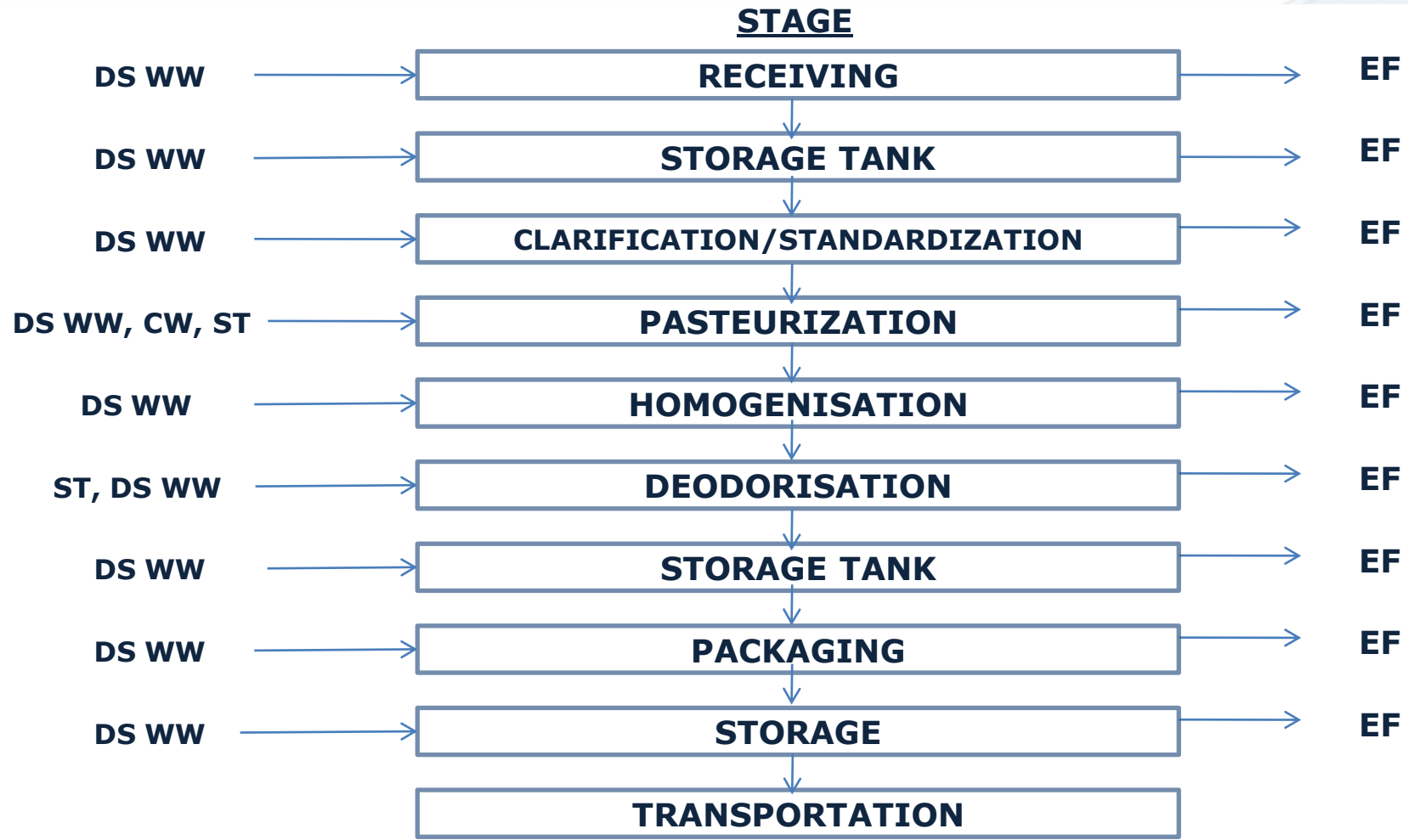
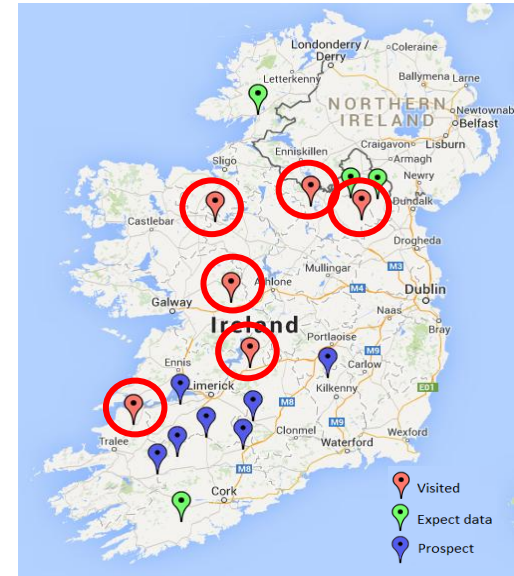
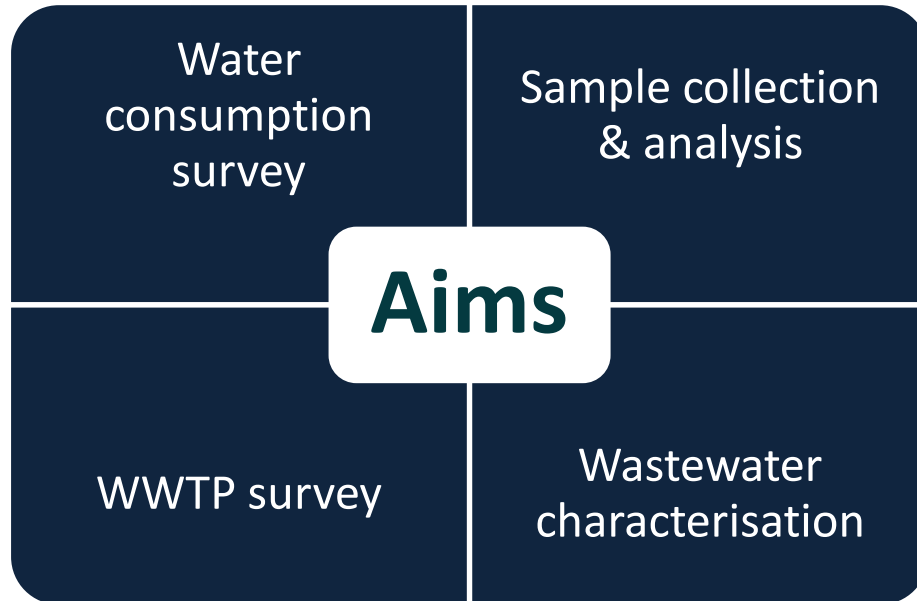


Figure 4. Effluent generation from various stages of milk processing. DS- Detergents and Sanitizing Agents, WW-Wash Water, ST-Steam, CW-Cooling Water (Gautam, 2015)

Preliminary Site Analysis



Rainwater Harvesting

- Not considered a priority on site.
- Other sources of water available.

Water reuse

- Some small scale water reuse at two plants.
- Not practiced universally as yet.

WWTP effluent

- All plants agree standards for microbiological likely to be implemented in the future.

Water Consumption – Survey results

- Water consumption varies between plants; survey results show variations of between 155,000m³ to 2.2million m³ annual water consumption.

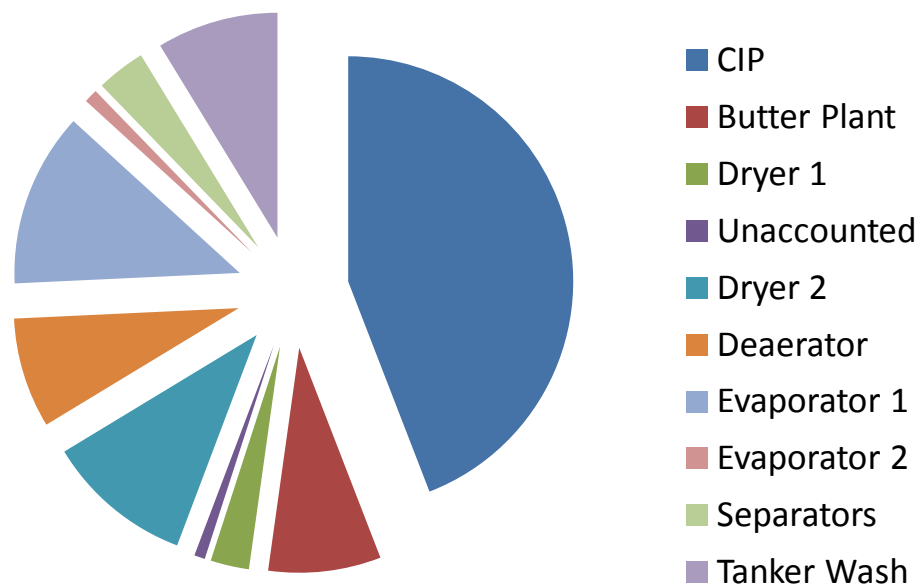
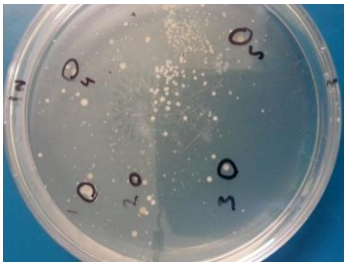


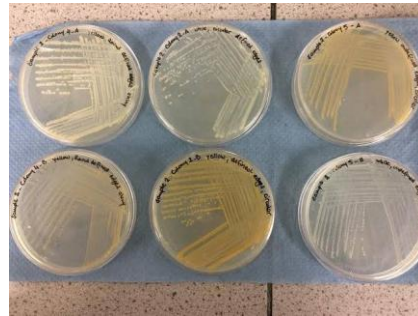
Figure 6. Typical water use breakdown of a butter & milk plant (DairyWater Project Survey, 2015).

Wastewater characterisation

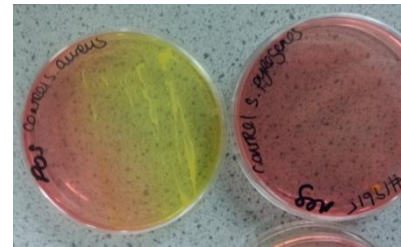
- Various water/wastewater samples collected from two separate dairy plants.
- Microbiological analysis – isolated 70 colonies for further analysis.



Inoculation



Isolation



Selective agar



Enzyme tests

- Water samples from one dairy plant sent to project partners at UCC for molecular analysis.
- Preliminary results show the presence of pathogenic strains *Staphylococcus aureus* and *Bacillus cereus* in WWTP effluent.

PUV and LPUV systems

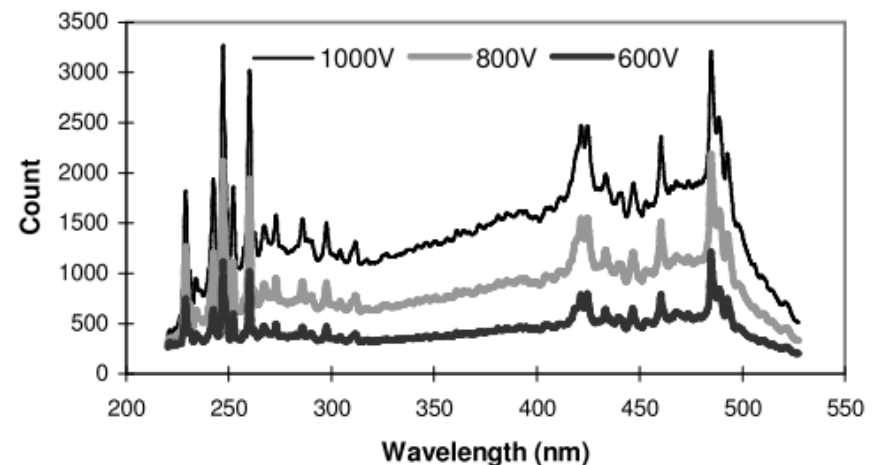
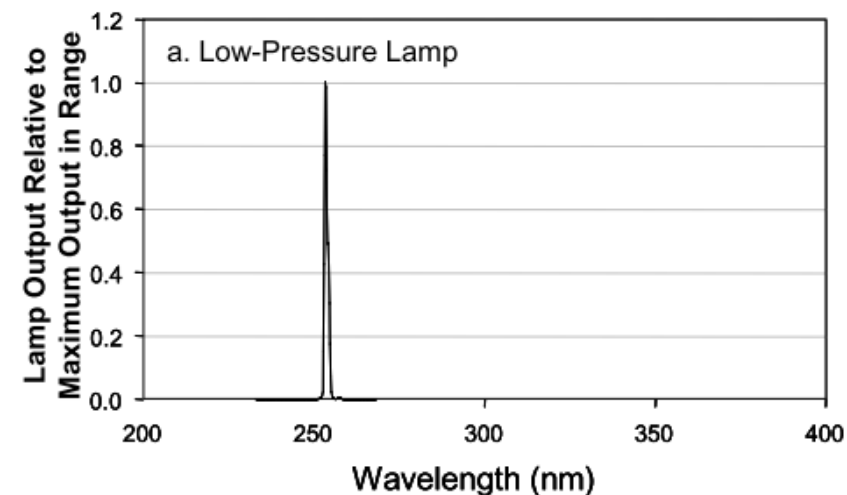
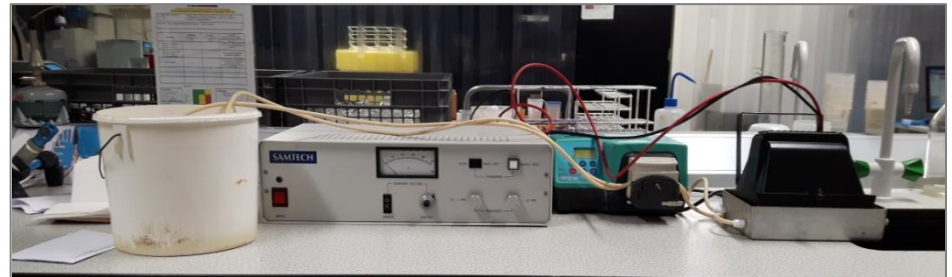
Low Pressure UV

- Monochromatic light at 254 nm
- Continuous wave
- Fixed power output



Pulsed UV

- Polychromatic light emissions in the UV, visible & infrared regions
- Peak outputs at 229nm, 247nm and 260nm
- Adjustable power output i.e. 400 V – 1000V



PUV Results – TSS analysis

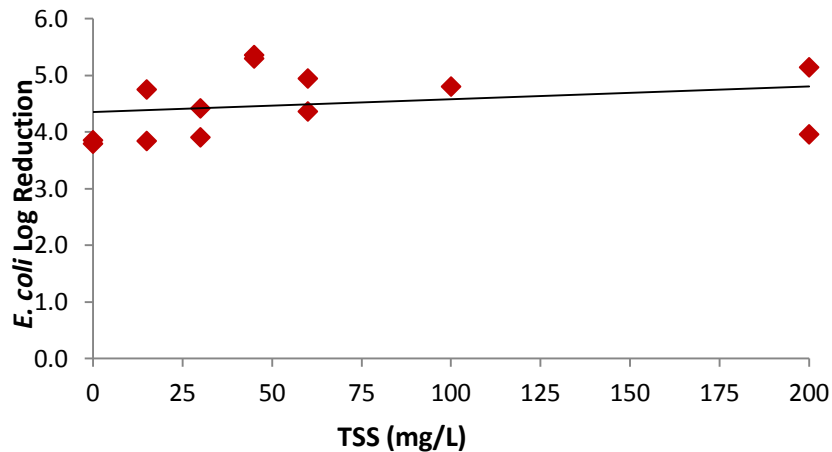


Figure 7. Impact of TSS (**bentonite** <63µm particle size) on *E.coli* inactivation via PUV treatment at UV dose 1.9 J/cm²

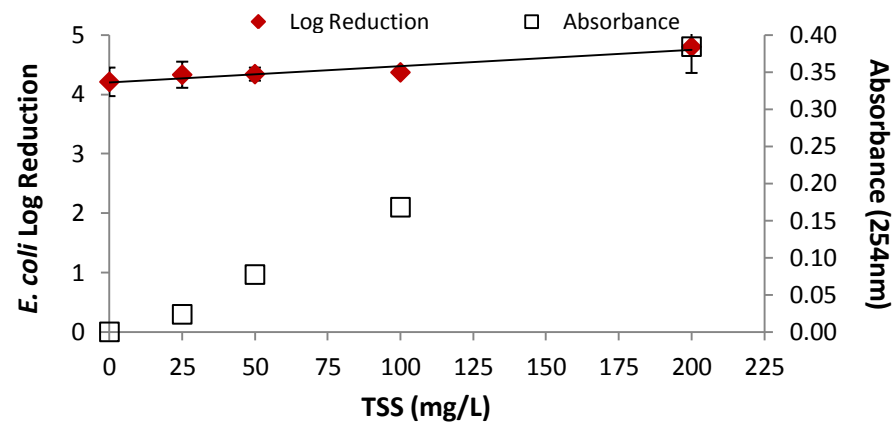


Figure 8. Impact of TSS (**CaCO₃** <10µm particle size) on *E.coli* inactivation via PUV treatment at UV dose 1.9 J/cm²

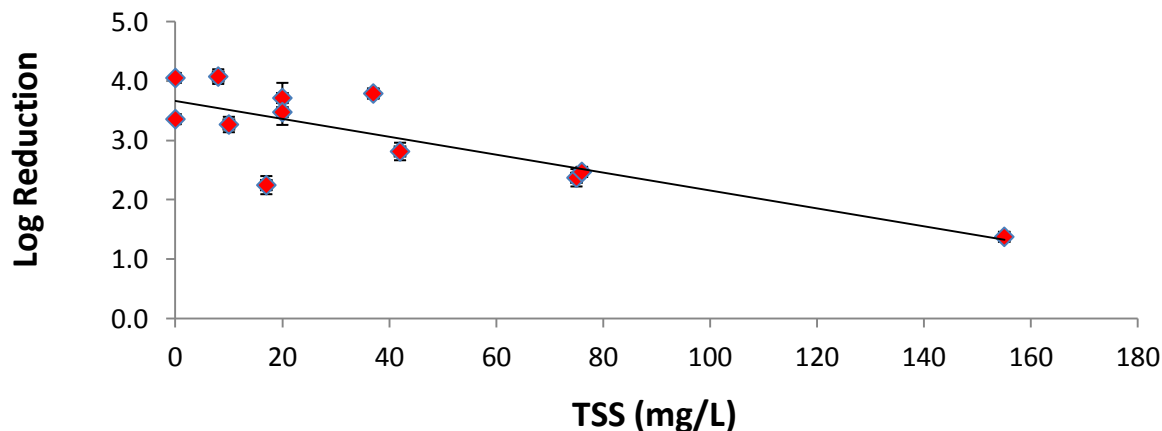


Figure 9. Relationship between suspended solids (**IASBR sludge**) and *E.coli* inactivation via PUV treatment at UV dose 1.9 J/cm²

LPUV Results

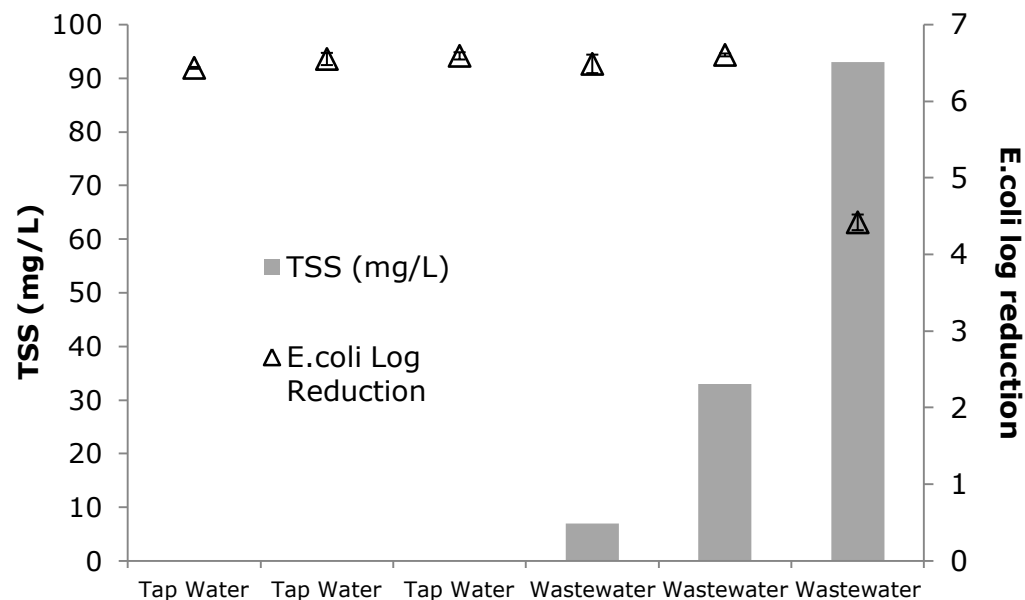


Figure 10. Comparison of E.coli reduction in both tap water and wastewater at UV dose of 11mJ/cm².

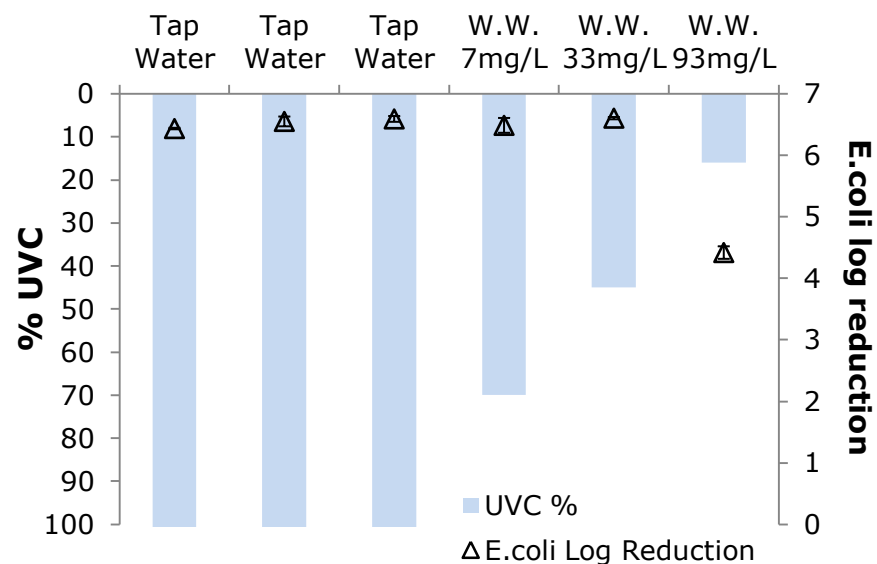


Figure 11. Comparison of E.coli reduction and UVC readings of LPUV.

Six Month Projection

- Continued analysis of the impacts of TSS on PUV/LPUV efficiency.
- Laboratory scale analysis of the impact of carbon on PUV/LPUV efficiency.
- Pathogenic bacteria of interest to dairy plant wastewater will be incorporated for comparison to vegetative *E.coli*.
- Ongoing literature review.

Acknowledgements

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Any questions?



DairyWater