University of Canterbury

Performance Assessment of Storminator™ Barrel: A Dissolved Metal Treatment System

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with Lexi Clarkson, Madison Millar, Tom Cochrane and Aisling O'Sullivan

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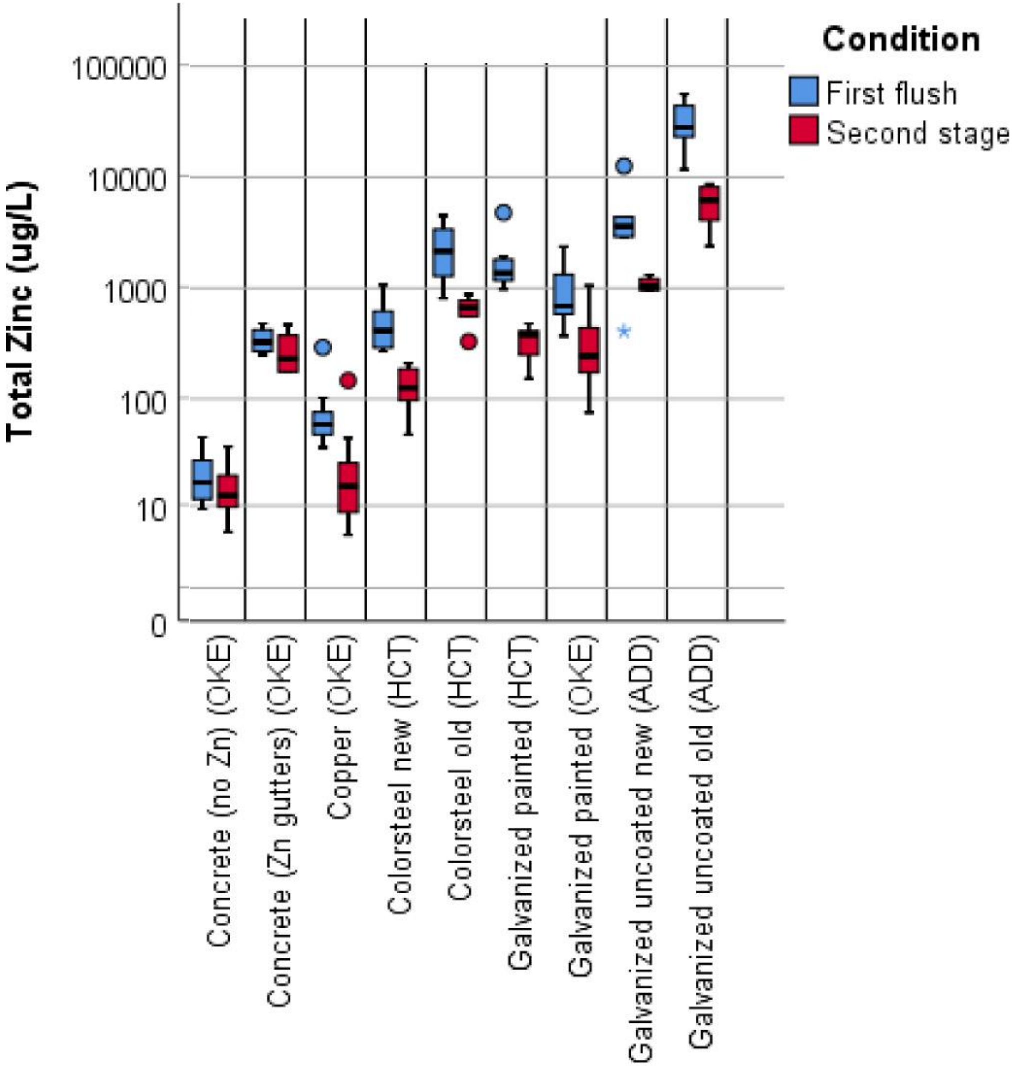
Dissolved Metals in Roof Runoff



Dissolved Metals in Roof Runoff

Introduction
Methodology
Results
Conclusions

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Storminator™ Barrel Performance

Introduction Methodology Results Conclusions

Storminator™ Barrel design criteria

- Effective at dissolved metal removal
- Adequate hydraulics to take full downpipe flow with minimal bypass
- Use of waste materials
- Retrofittable on existing downpipes
- Small footprint, lightweight, low maintenance

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Research Questions

- What is the **performance variation** in the Storminator Barrel across multiple storm events?
- How do the **rainfall and influent quality characteristics** affect the performance of the Storminator Barrel?
- How can we model barrel performance using a **combination of hydraulic and metals removal performance data**?

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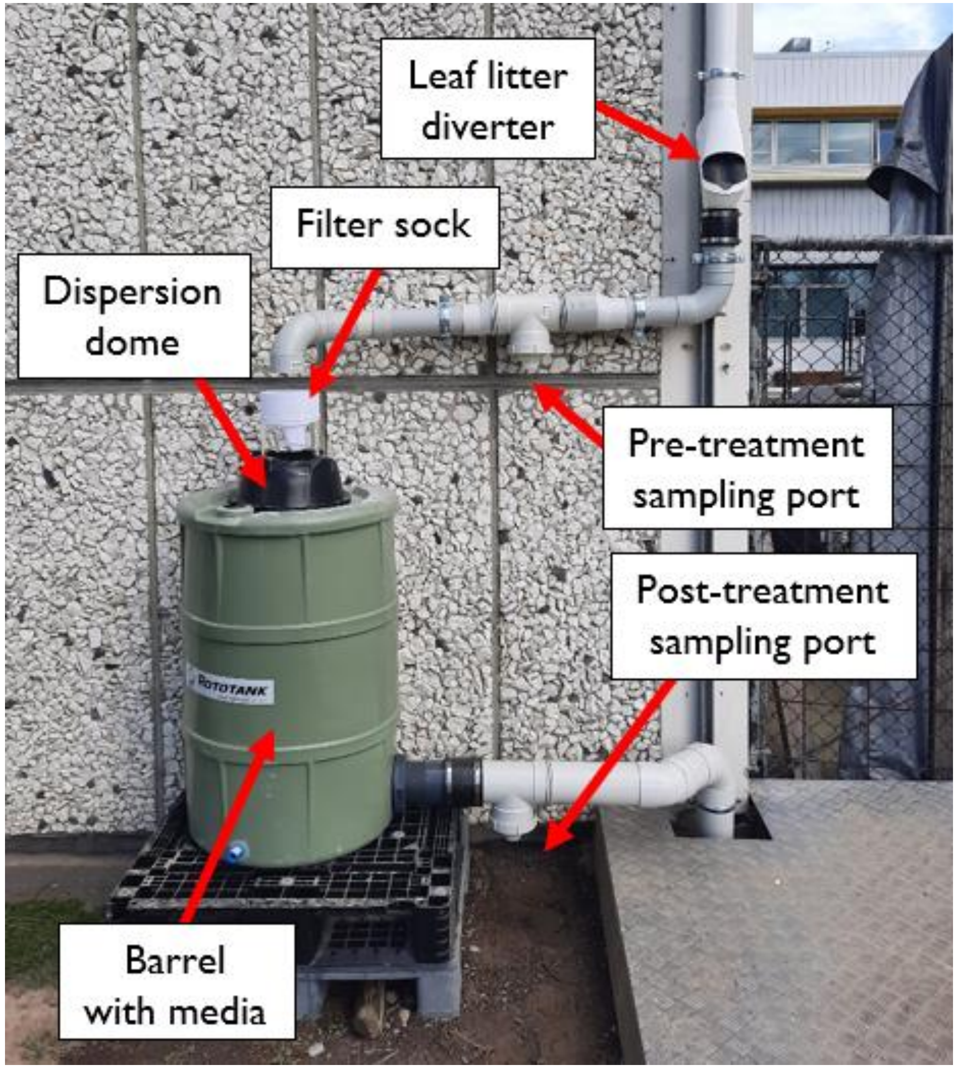
Methodology

Field experiments to characterise and compare:

- **Untreated vs treated water quality; dissolved metals focus**
- Different roof materials
- Different media blends
- Several rain events of different dynamics
- Flow capacity of system



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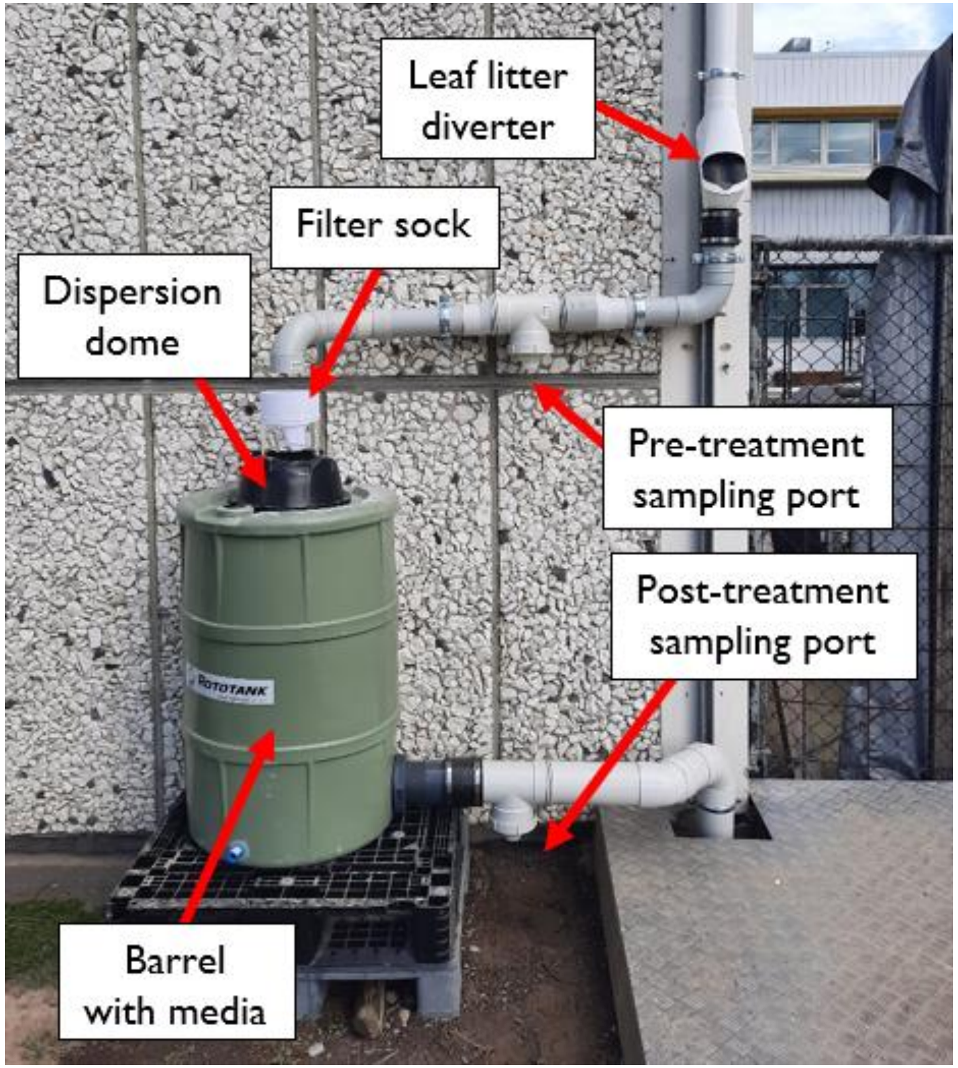

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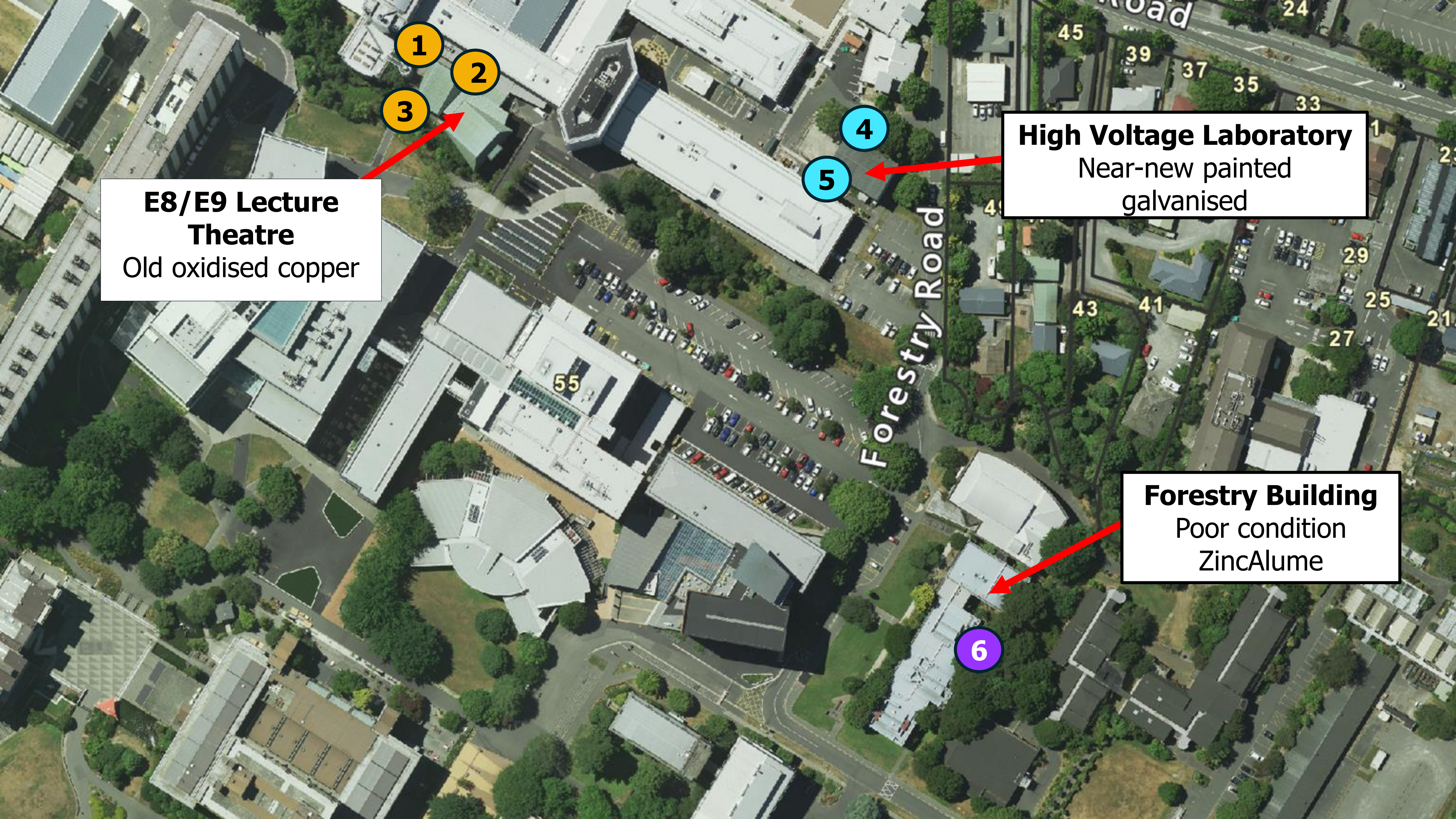
E8/E9 Lecture Theatre
Old oxidised copper
High Voltage Laboratory
Near-new painted galvanised
Forestry Building
Poor condition ZincAlume
1
2
3
4
5
6
Forestry Road

Methodology

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- **Several rain events of different dynamics**
- Flow capacity of system

Parameters	
Rain events sampled	17 events (April 2023 to February 2024)
Antecedent dry days	0.1 - 17 days
Average event intensity	0.2 – 6.4 mm/hr
Peak 5-min intensity	Up to 50 mm/hr
Sample types	Untreated and treated First flush and second stage
Water quality analytes	Dissolved copper Dissolved zinc Turbidity Alkalinity, pH

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Methodology

Developing a model for estimating hydraulic throughput and metal removal performance.

- First stage – 100% treatment rate.
- Second Stage – A decline in treatment rate with some overflow.
- Third stage – The total flow of water in exceeds the maximum flow rate (overflow).

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Methodology

Quantifying

- Hydraulic storage capacity.
- Peak treatment rate (170 l/min).
- Maximum flow rate (261 l/min).

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Methodology

Apply model:

- For a 5 minute time period over a full year (2021) for Auckland, Wellington and Christchurch.
- Used Python to estimate Storminator performance for a given roof size.

Storage Volume.

$$\frac{dV}{dt} = Q_{inflow} - Q_{treated} - Q_{overflow}$$

Treated flow.

$$Q_{treated} = \min(Q_{\max treatment}, Q_{potential\ treted})$$

Overflow.

$$Q_{max} = (0, V_{current\ storage} - V_{\max storage})$$

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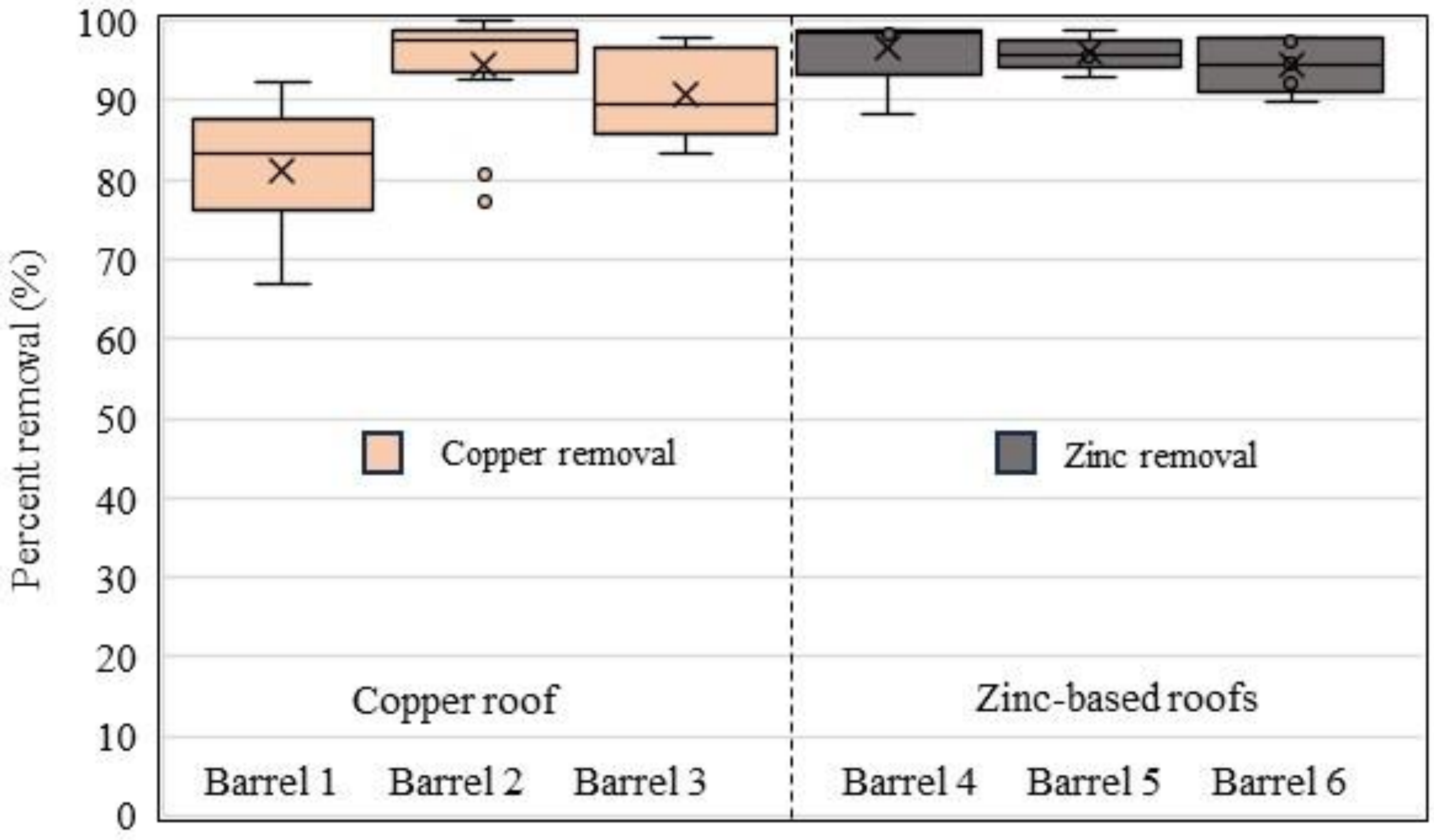
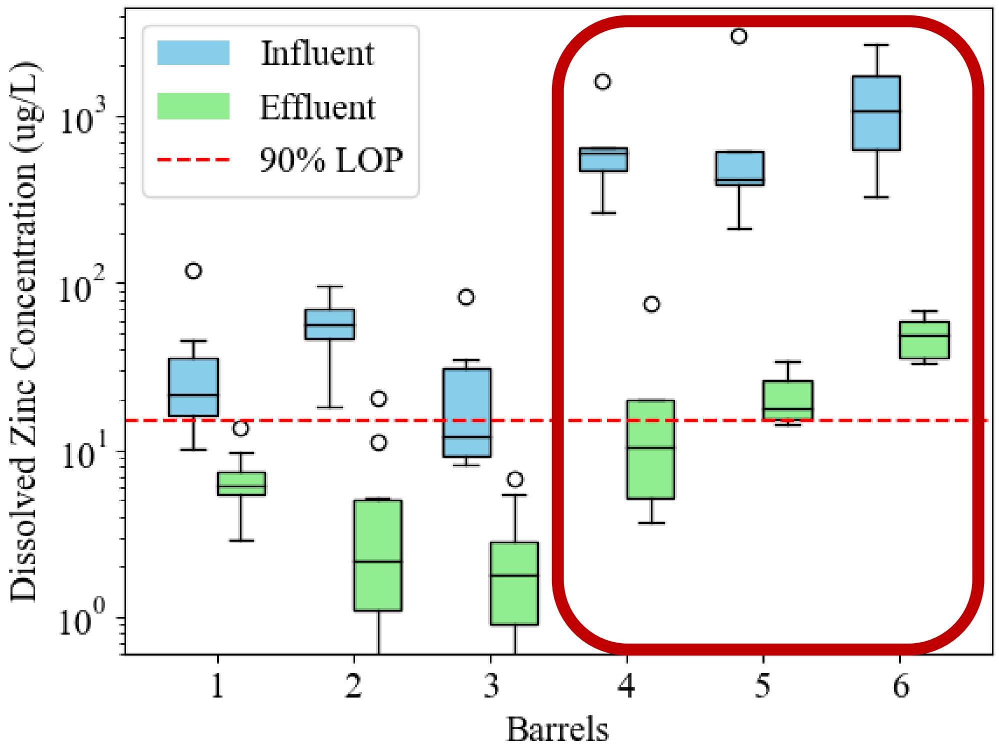
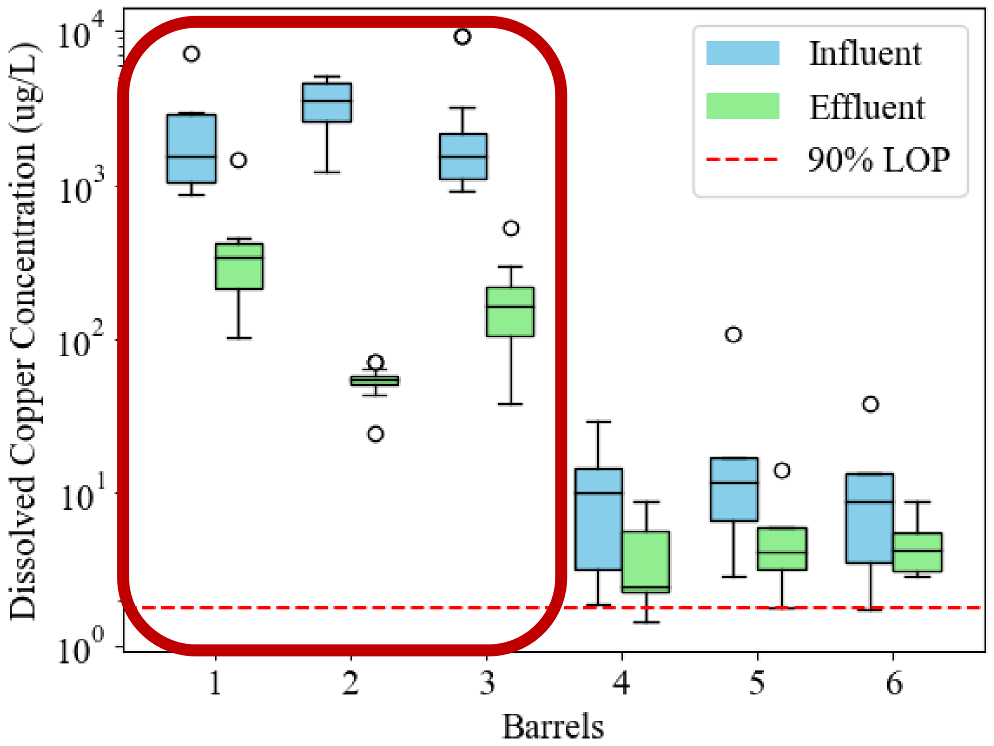
Metals Removal Performance



Metals Removal Performance



Zinc
Avg untreated conc: 1,302 ug/L
Avg treated conc: 31 ug/L



Copper
Avg untreated conc: 2,811 ug/L
Avg treated conc: 209 ug/L

Turbidity and Alkalinity Change

Comparison of Barrels 1-3 (Cu) vs Barrels 4-6 (Zn):

- Installed nine months apart
- Alkalinity in newer Barrels reduced to older Barrels concentrations within 5 rain events
- Turbidity in newer Barrels reduced to <20 NTU within 5 events, comparable with influent turbidity
- Turbidity in older Barrels was <1.5 NTU: physical filtering

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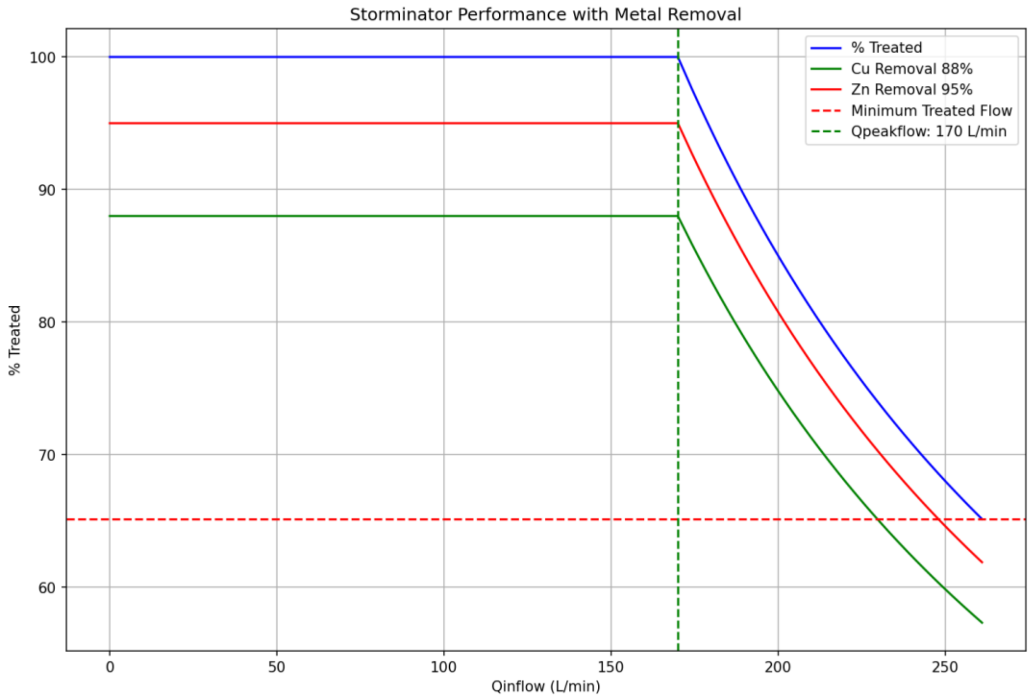
Flow Capacity and Modelling

Storminator performance by flow

- Using the model and real-world testing data.



- Average treatment rate Zn 95%, Cu 88% with no bypass (170 L/min)
- Minimum treatment rate Zn 88%, Cu 67% with no bypass
- Minimum treatment rate Zn 62%, Cu 57% at 261 L/min (extreme weather event, with bypass)

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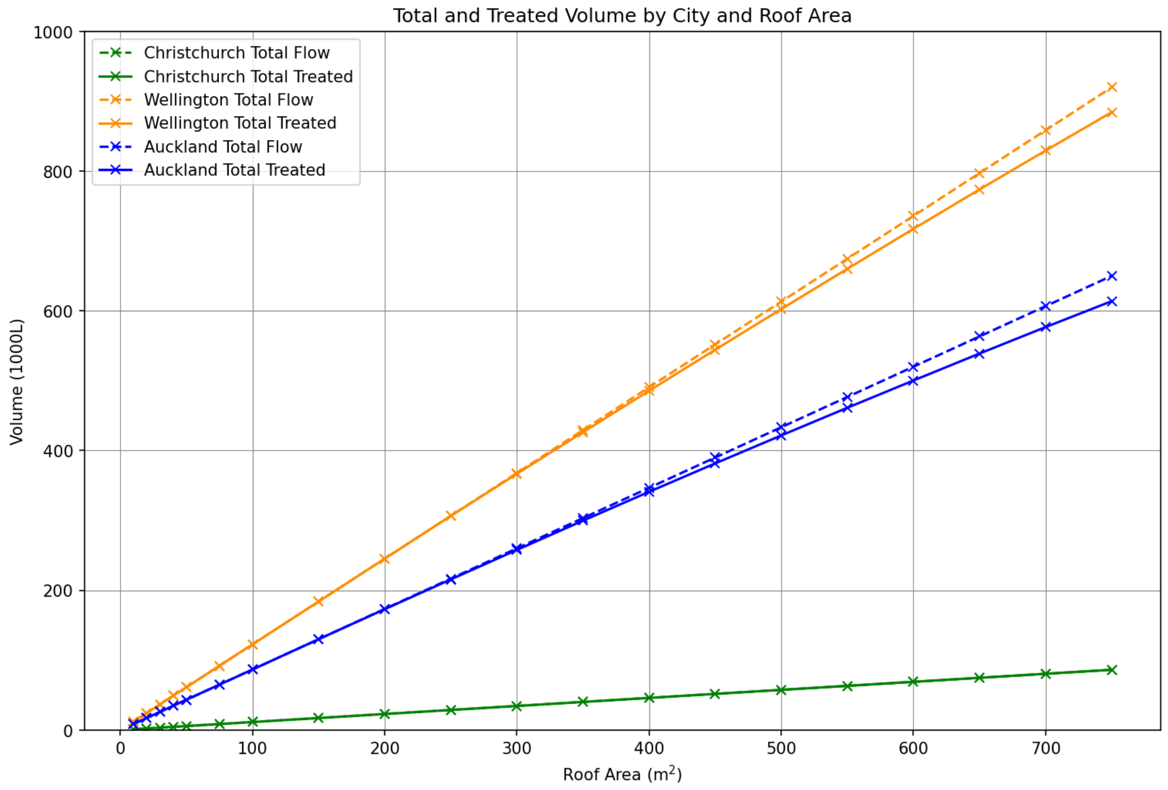
Flow Capacity and Modelling

2021 Modelled total and treated volume

- Models using NIWA data showed the efficacy for different roof sizes in different cities.

- Allowed a maximum suggested roof size for the system based on local climates.



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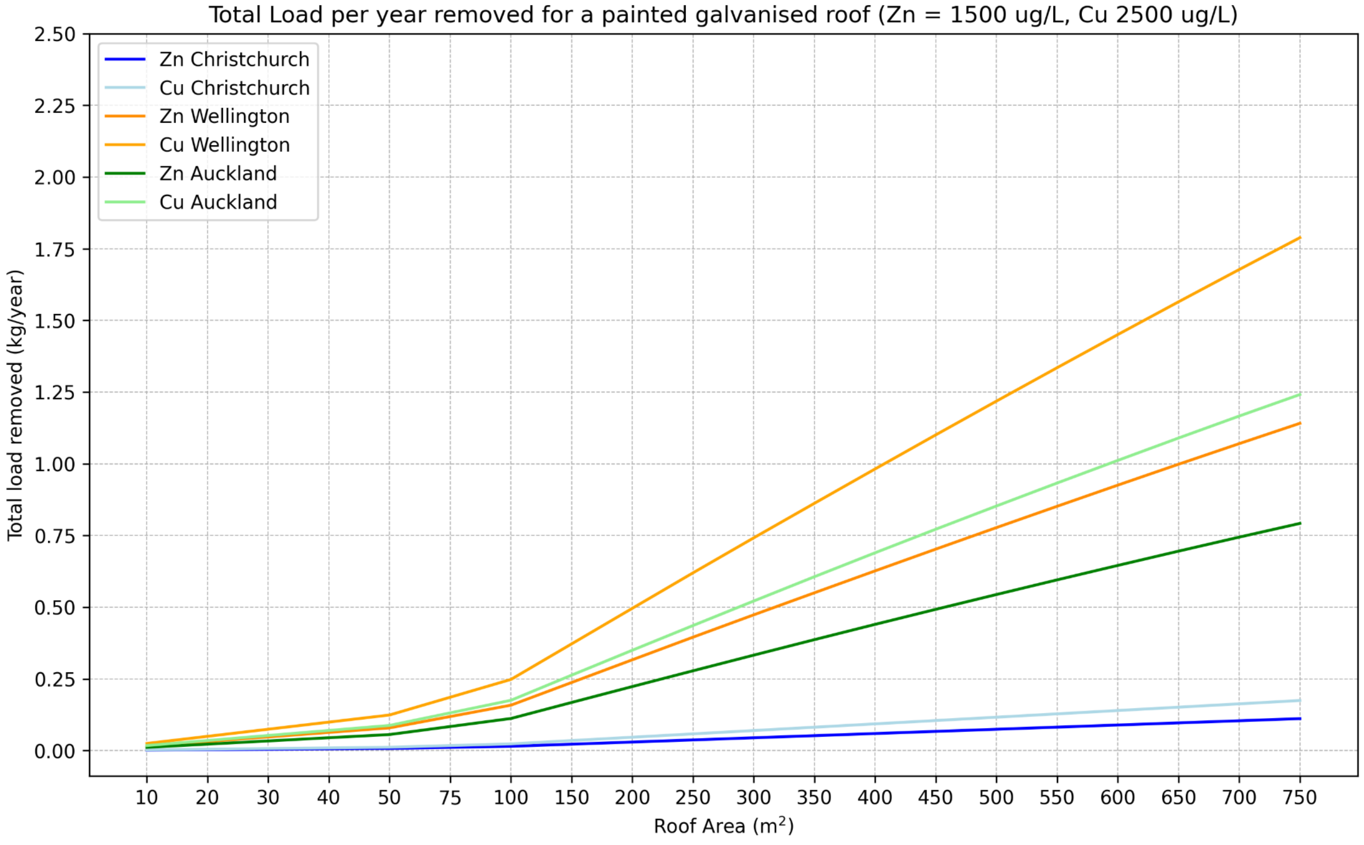
Flow Capacity and Modelling

2021 Modelled total load removed

- Modelled total load removed from Stormwater for different roof sizes in different cities, using 2021 NIWA data.

- Using a representative stormwater: Zn 1,500 ug/L and Cu 2,500 ug/L



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Key Findings

- ✓ The Storminator™ Barrel consistently removes >88% of dissolved zinc from zinc-based roofs, for concentrations up to 3,000 ug/L
- ✓ Consistently removes >67% dissolved copper from copper-based roofs, for concentrations up to 9,000 ug/L
- ✓ The system can handle flows up 170 L/min without any bypass
- ✓ For a 250 m^2 roof in Wellington and Auckland, removal of 300-500 g Zn/year

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Implications and Next Steps

- Uncertainty in influent quantity and quality, and in treatment performance
  - Can be reduced by having a large capacity system
  - Need to aim for minimal bypass

- The treated zinc concentrations average only 2x the instream water quality limit
- Treated copper concentrations can still exceed instream limits by >100x
  - For copper, need policies to avoid copper use
  - For zinc, need source reduction tools, not just end-of pipe options
  - What is needed to enable this?

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Thank you!
Questions? Patai?

Want to know more? Contact us via www.storminator.co.nz

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