



HOW DO OUR STORMWATER TREATMENT FACILITIES STACK UP?

ASSESSING THE PERFORMANCE OF STORMWATER TREATMENT FACILITIES IN SUBURBAN CHRISTCHURCH

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Stormwater 2024

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A VERY WET LAND

- European settlement (from ~1856)
- Land drainage enabled development
- Wetlands replaced with suburbs and streets
- Pressure on drainage network
- Public and legislative pressure (late 1980s)
- Shift to greener infrastructure

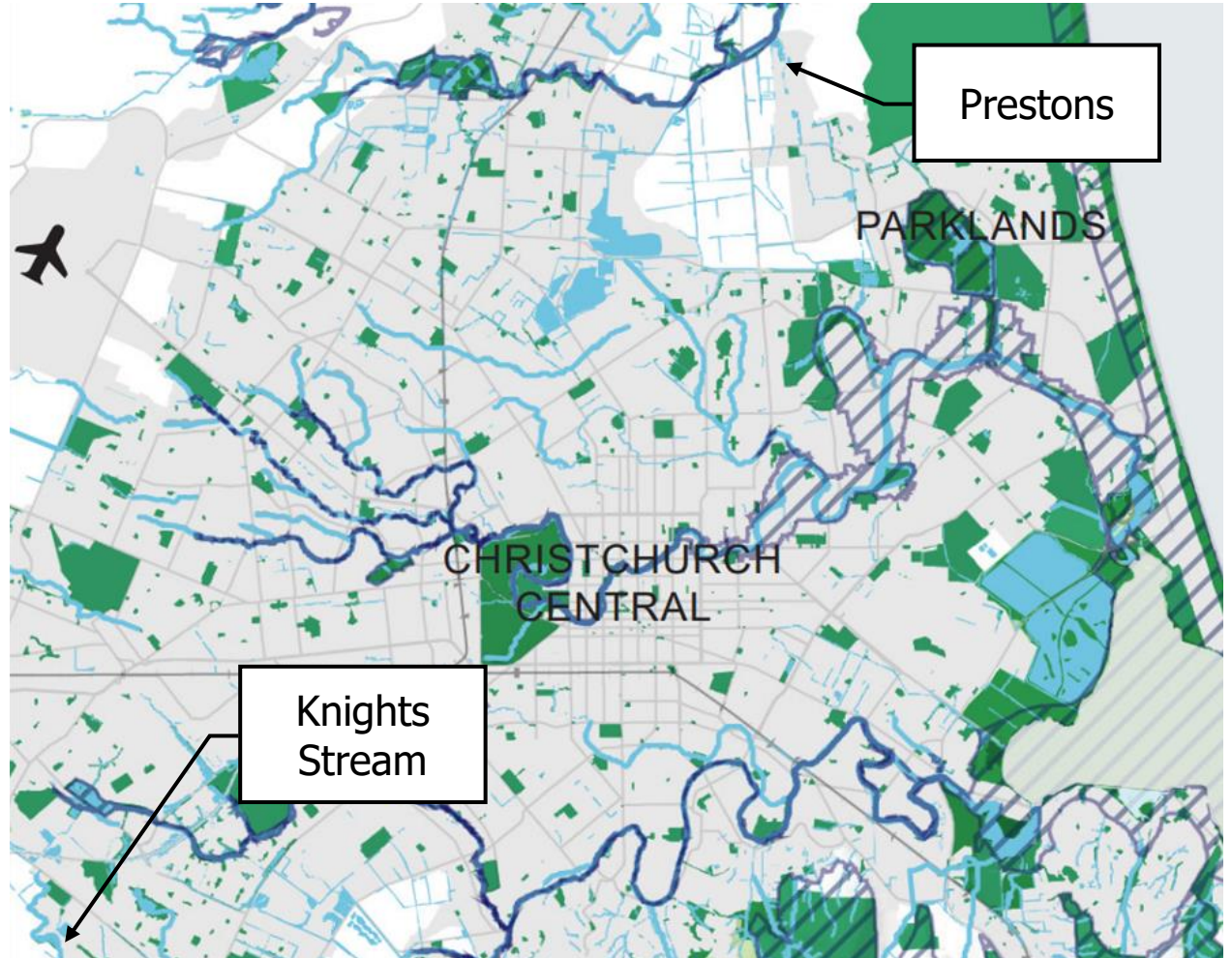


Image source: [Greater Christchurch Partnership](https://www.greaterchristchurch.org.nz/)
[Greater-Christchurch-Spatial-Plan-2024-Web.pdf](https://www.greaterchristchurch.org.nz/greater-christchurch-spatial-plan-2024-web.pdf) ([greaterchristchurch.org.nz](https://www.greaterchristchurch.org.nz/))

STORMWATER FACILITY TREATMENT EFFICIENCIES

Treatment System	International Stormwater BMP Median Removal Efficiencies				CCC WWDG Table 6-6 Removal Efficiencies			
	TSS	Phosphorus	Nitrogen	Metals	Solids	Phosphorus	Nitrogen	Metals
Dry Detention Basin	70%	10-30%	0-30%	10-60%	40-80%	40-60%	20-40%	20-60%
Extended Wet Detention Basin	80%	50%	20-60%	30-70%	60-80%	40-80%	40-60%	40-80%
Wetlands	60%	10-30%	0-40%	20-60%	60-80%	40-80%	20-60%	40-80%

COMPREHENDING THE CONSENT

- CSNDC – Comprehensive Stormwater Network Discharge Consent
- 7 Stormwater Management Plan Areas
- Sets out water quality monitoring programmes and goals
- Requires monitoring of stormwater treatment facilities

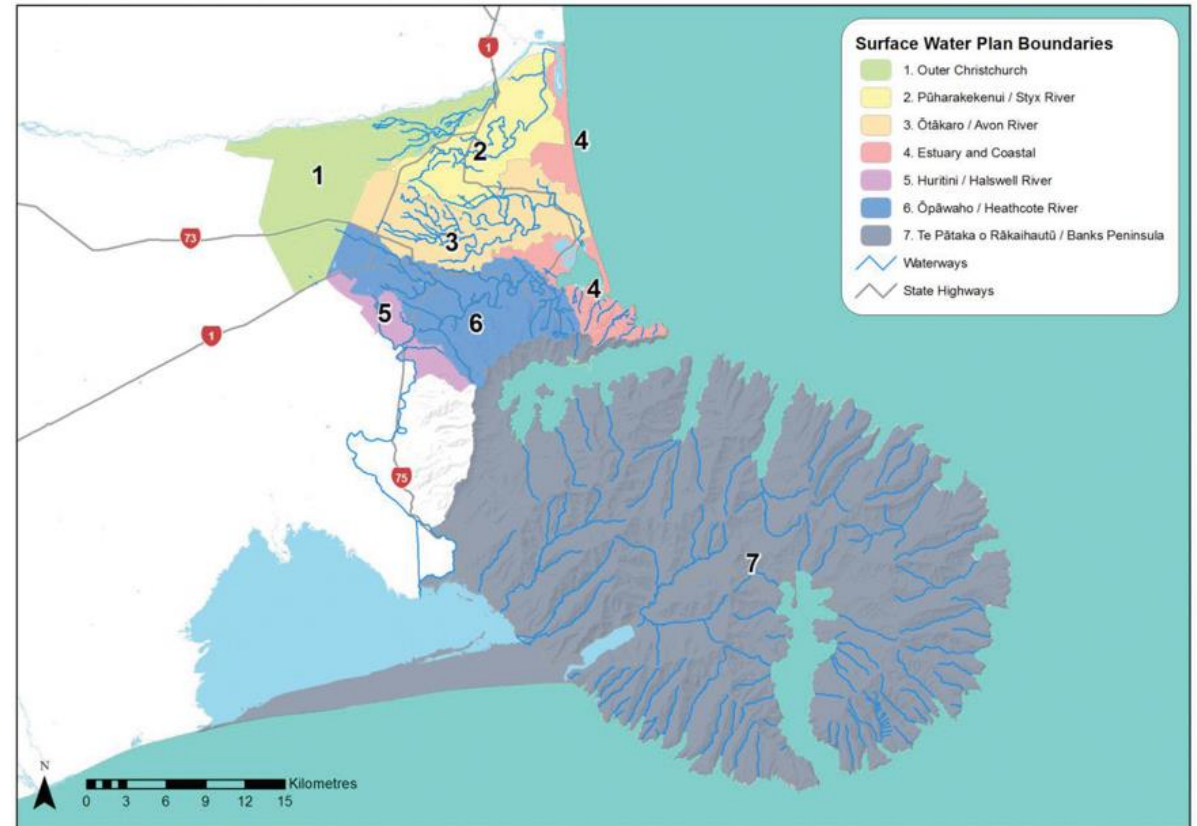


Image source: [Christchurch City Council – Comprehensive Stormwater Network Discharge | Environment Canterbury \(ecan.govt.nz\)](#)



Knights Stream: Swale

SAMPLING METHODOLOGY

- Equipment:
 - Six ISCO 6712 automatic samplers, with ISCO 730 Bubbler Flow Modules to measure the water depth; and
 - One Liquiport 2000 automatic sampler, PS98i pressure transducer to measure water depth
- Collected 72 samples, per sampler, per event
 - Proxy for EMC within 20% error, as recommended by NIWA
- Time-weighted composite samples x3



Image Source: ISCO [ISCO Auto Sampler 6712](#)

SAMPLING METHODOLOGY



Found some rubbish on site, upcycling it to use as a sinker for my level sensor

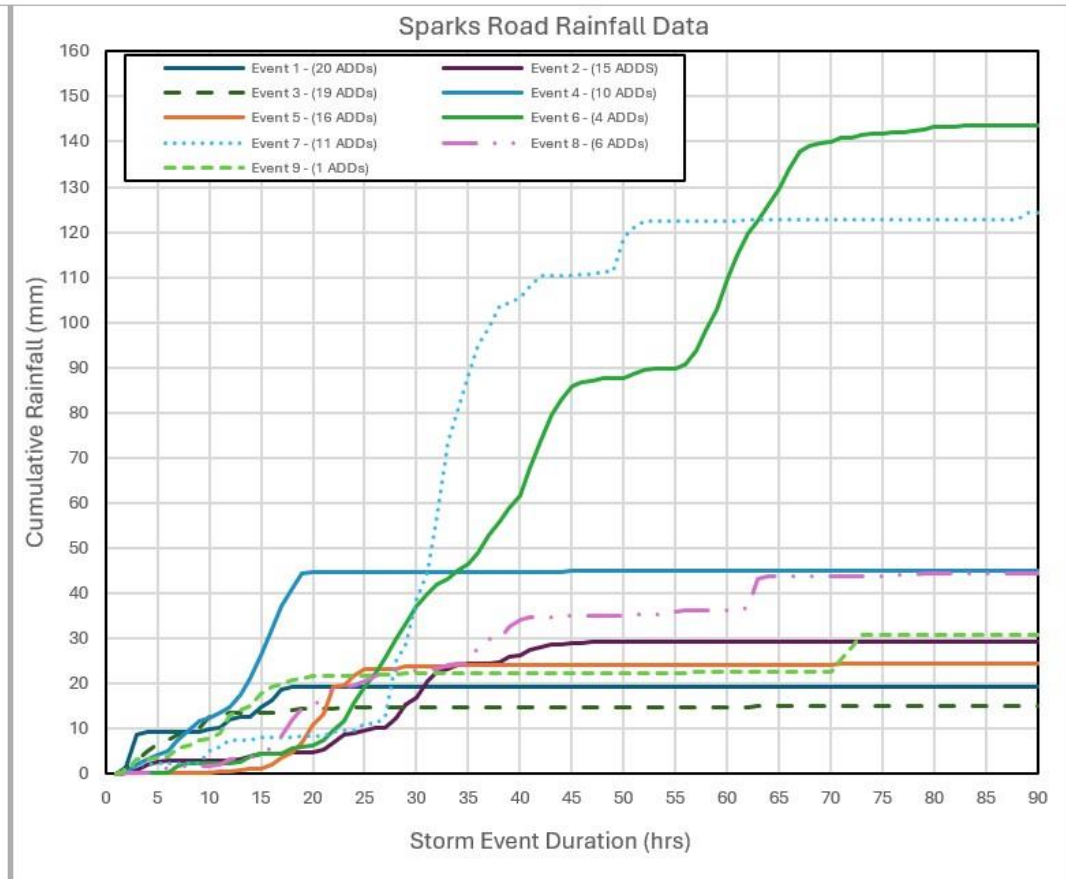
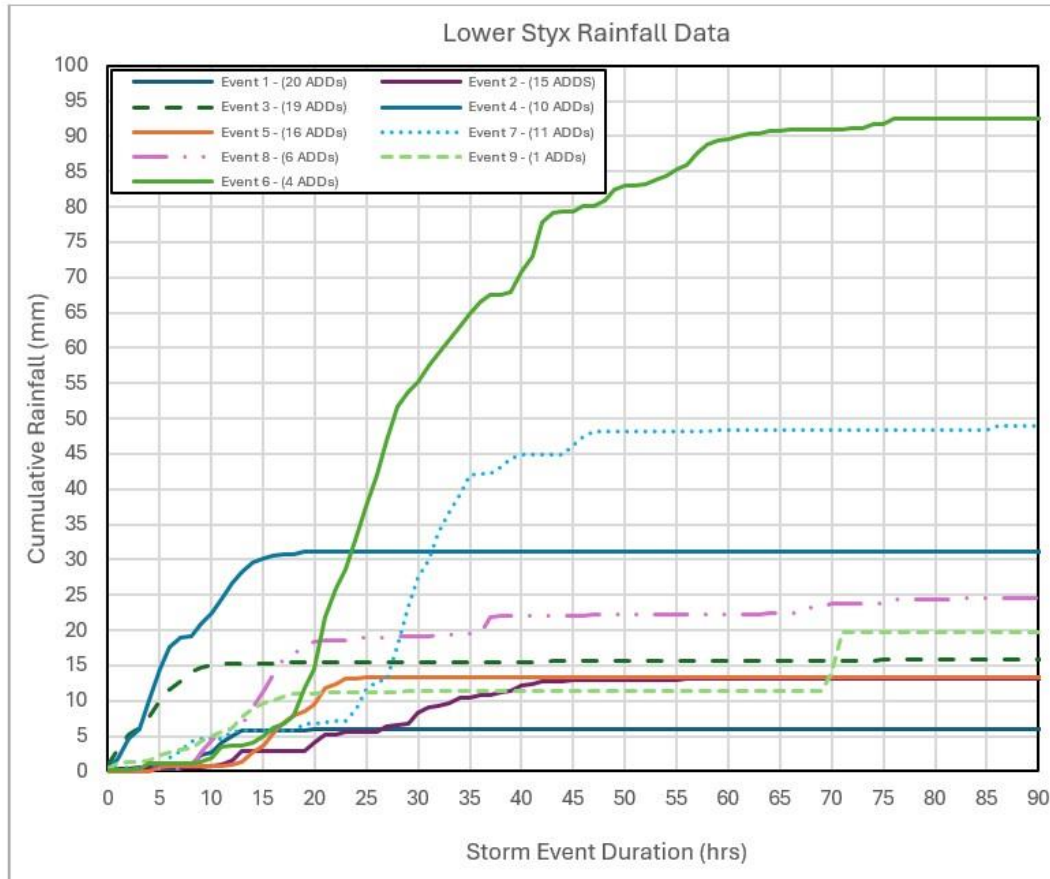


WATER QUALITY ANALYSIS

Analytes:

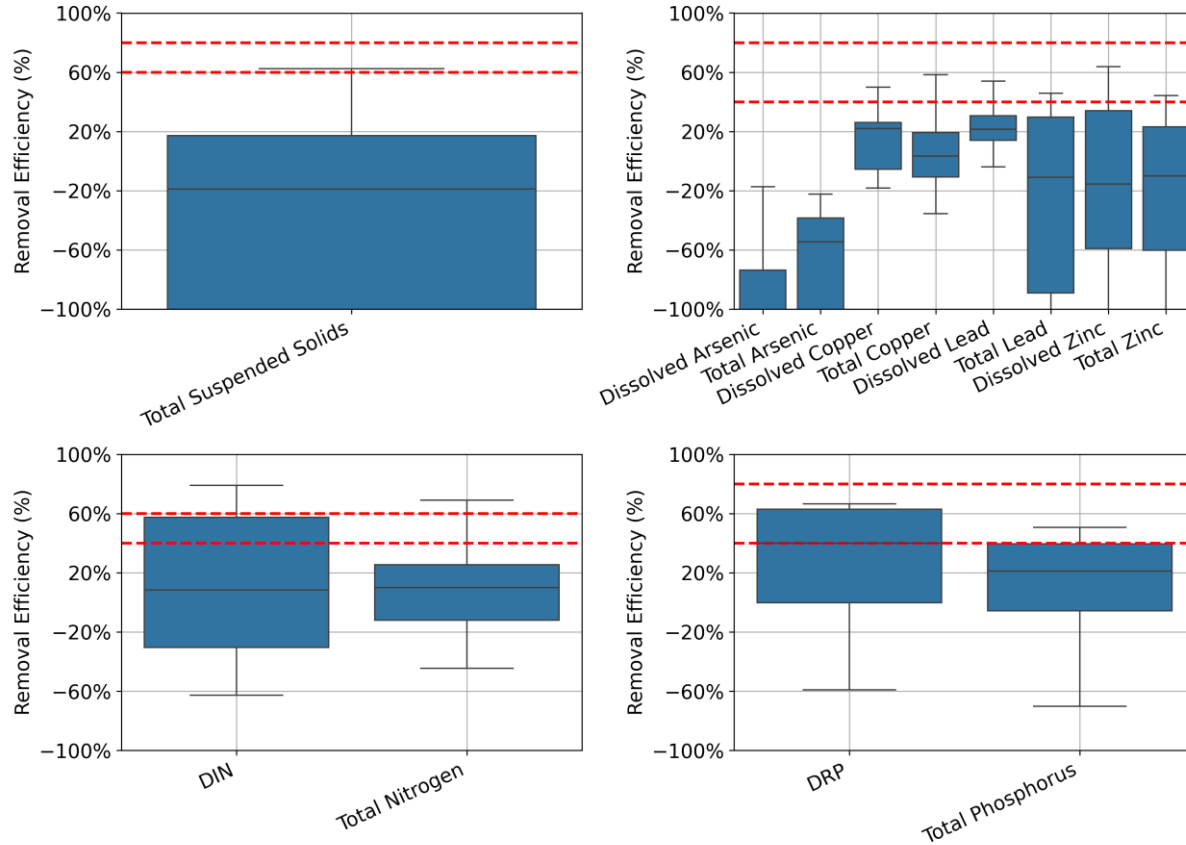
- Dissolved and Total Copper, Lead, and Zinc (Metals)
- Dissolved and Total Arsenic (Metalloid)
- Total Phosphorus (TP) and Dissolved Reactive Phosphorus (DRP)
- Compared to receiving water standards – ECAN LWRP, ANZG
- Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN)
- Total Suspended Solids (TSS)

STORM EVENTS



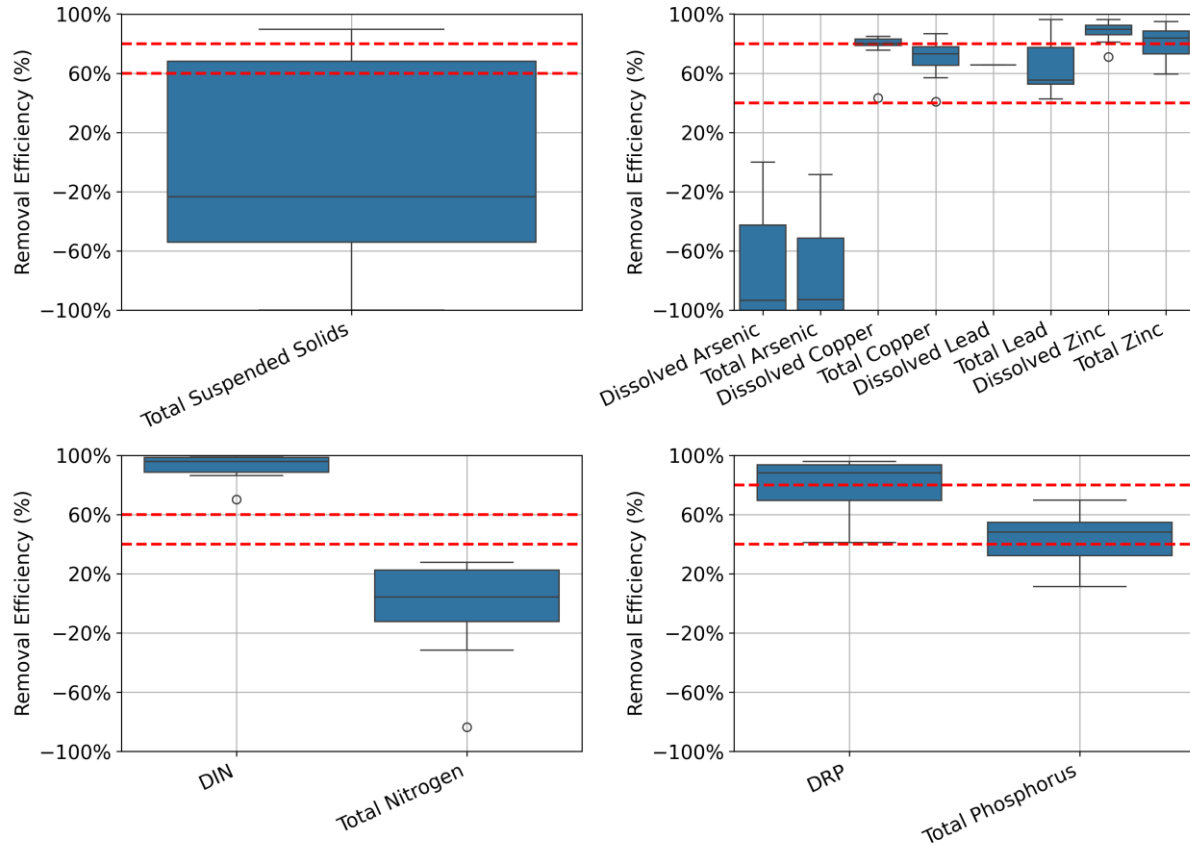
KNIGHTS STREAM FIRST FLUSH BASIN REMOVAL EFFICIENCIES

Knights Stream First Flush Basin Removal Efficiency

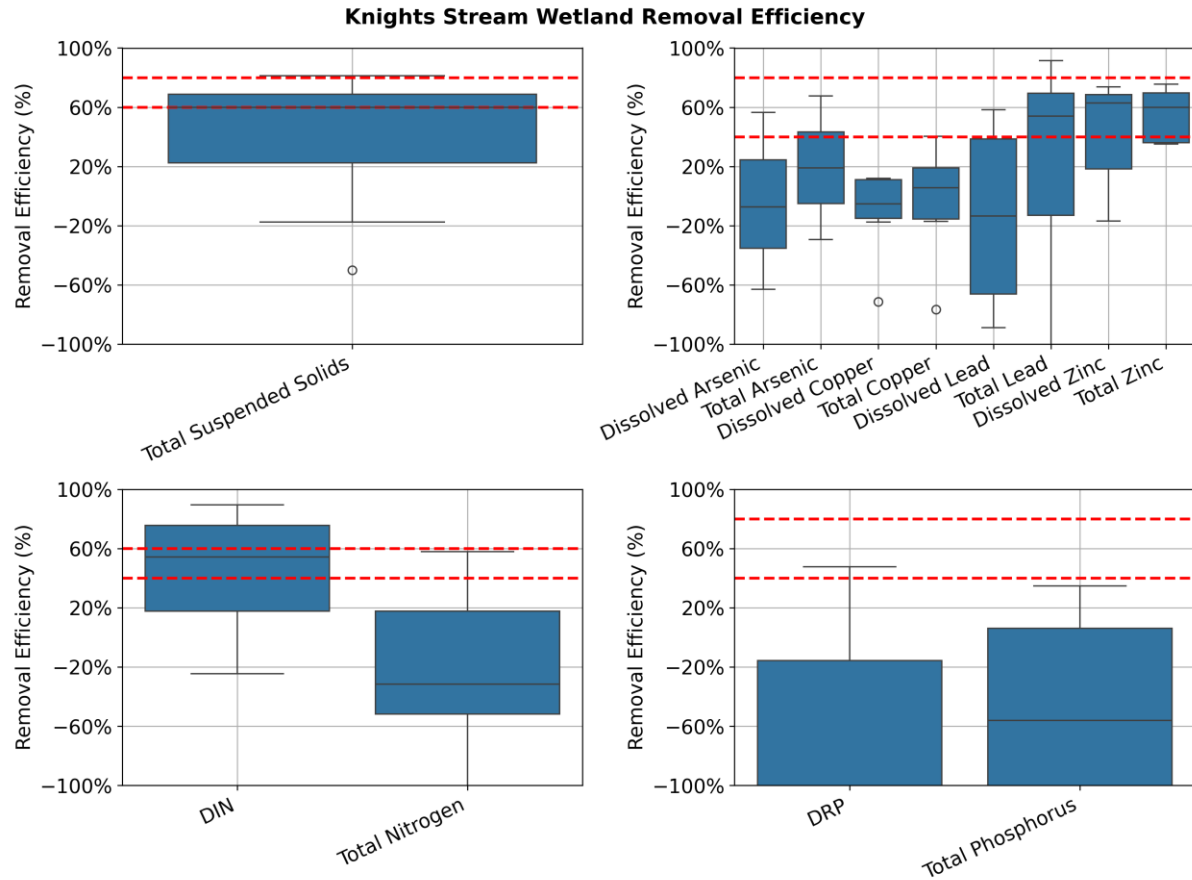


PRESTONS FIRST FLUSH BASIN REMOVAL EFFICIENCIES

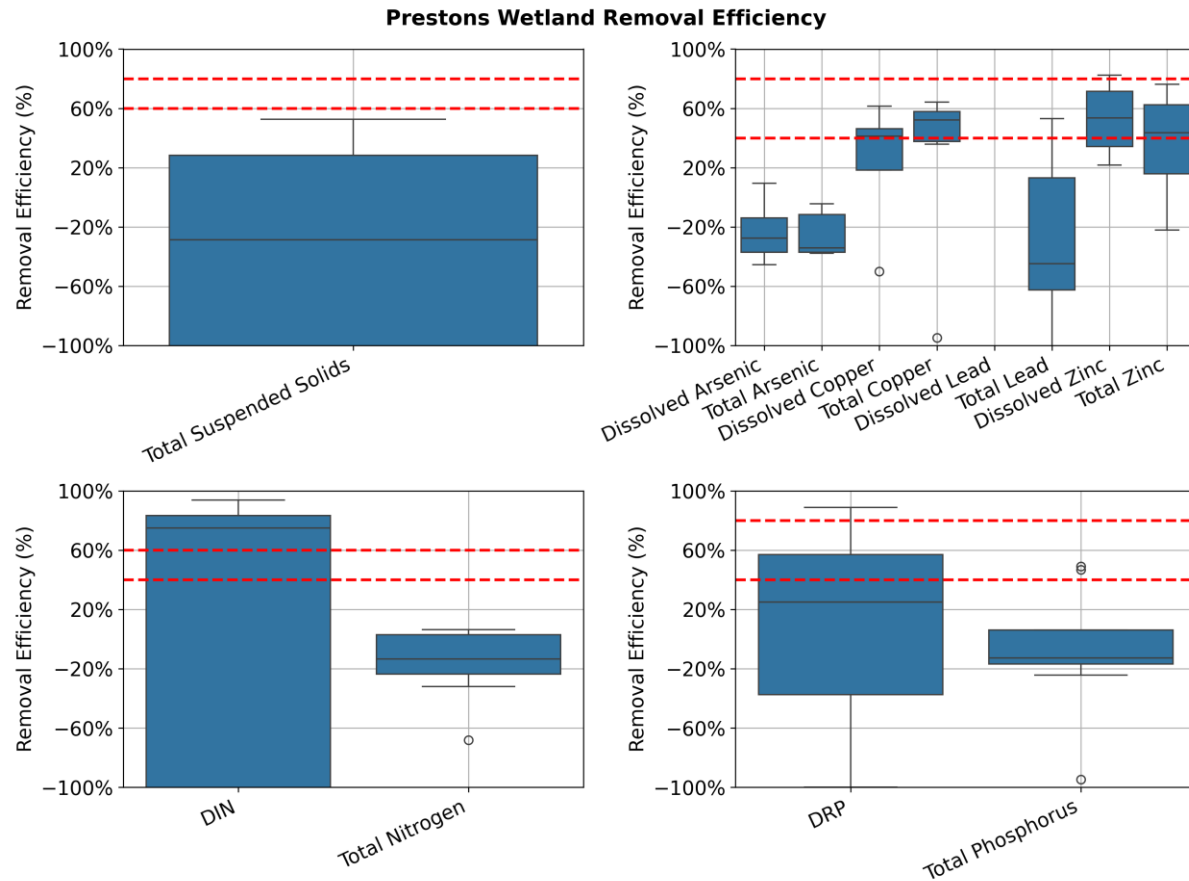
Prestons First Flush Basin Removal Efficiency



KNIGHTS STREAM WETLAND REMOVAL EFFICIENCIES



PRESTONS WETLAND REMOVAL EFFICIENCIES



PRESTONS STATISTICAL ANALYSIS

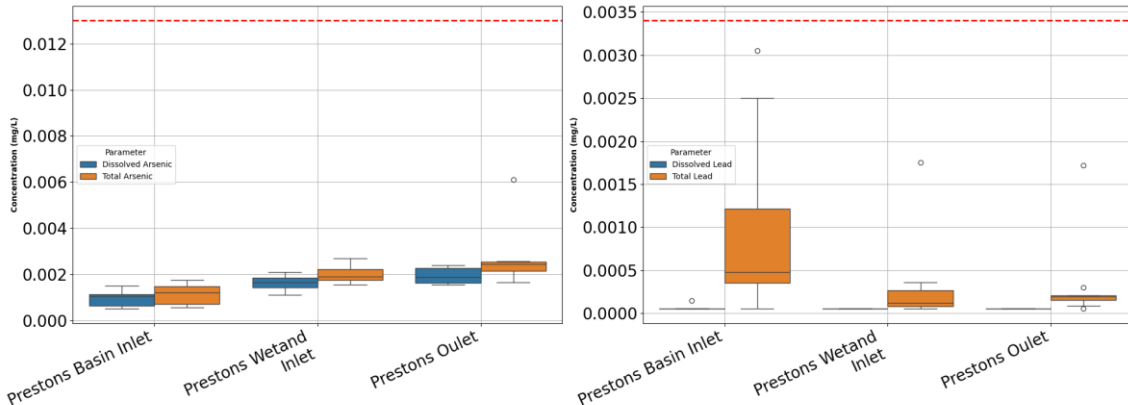
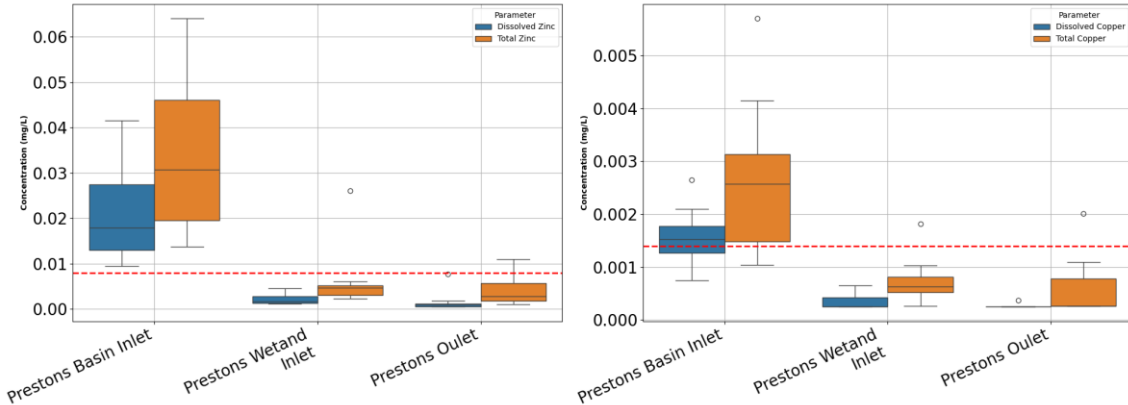
Contaminants	Prestons FFB			Prestons Wetland		
	25th % p-value	p-value	75th % p-value	25th % p-value	p-value	75th % p-value
Total Suspended Solids						
TSS						
Nutrients						
DIN						
DRP						
Metalloids						
Dissolved Arsenic						
Total Arsenic						
Metals						
Dissolved Copper						
Total Copper						
Total Lead						
Dissolved Zinc						
Total Zinc						

	p-value < 0.05
	p-value > 0.95
	p-value < 0.06

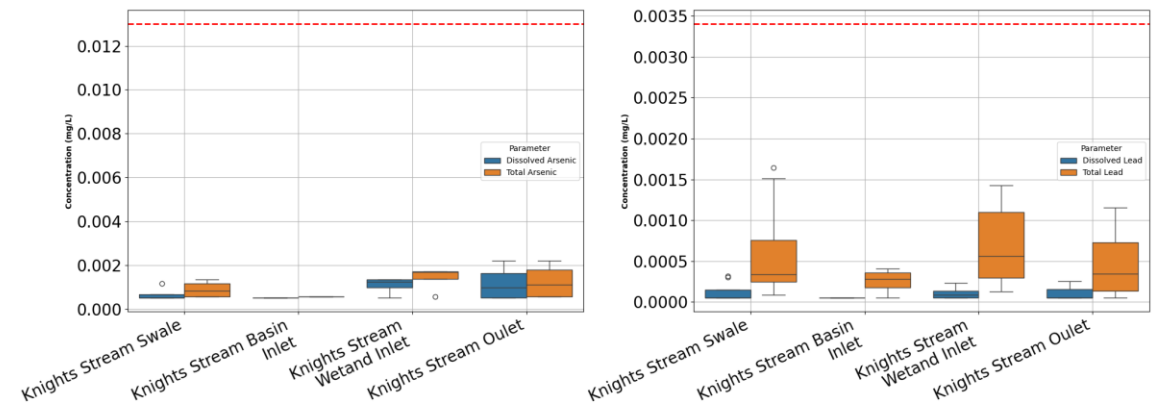
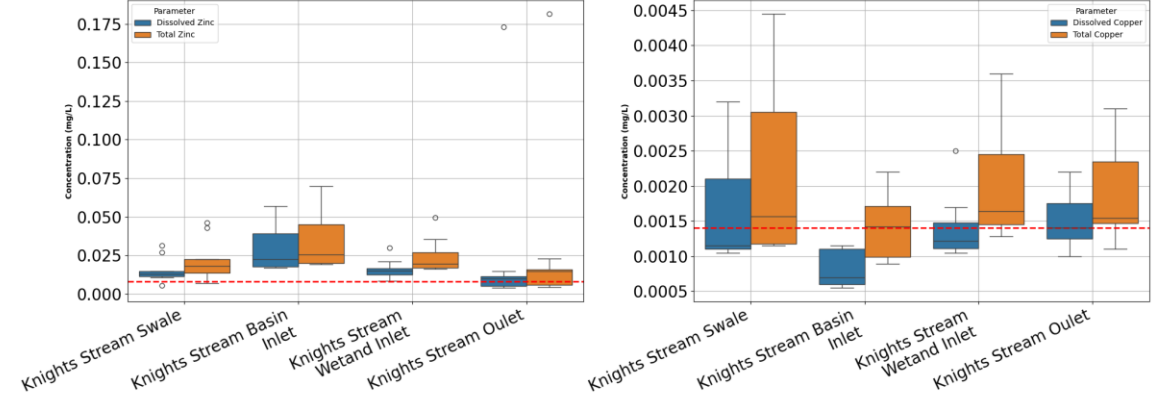
KNIGHTS STREAM STATISTICAL ANALYSIS

Contaminants	Knights Stream FFB			Knights Stream Wetland		
	25th % p-value	p-value	75th % p-value	25th % p-value	p-value	75th % p-value
Total Suspended Solids						
TSS						
Nutrients						
DIN						
DRP						
Metalloids						
Dissolved Arsenic						
Total Arsenic						
Metals						
Dissolved Copper						
Total Copper						
Total Lead						
Dissolved Zinc						
Total Zinc						

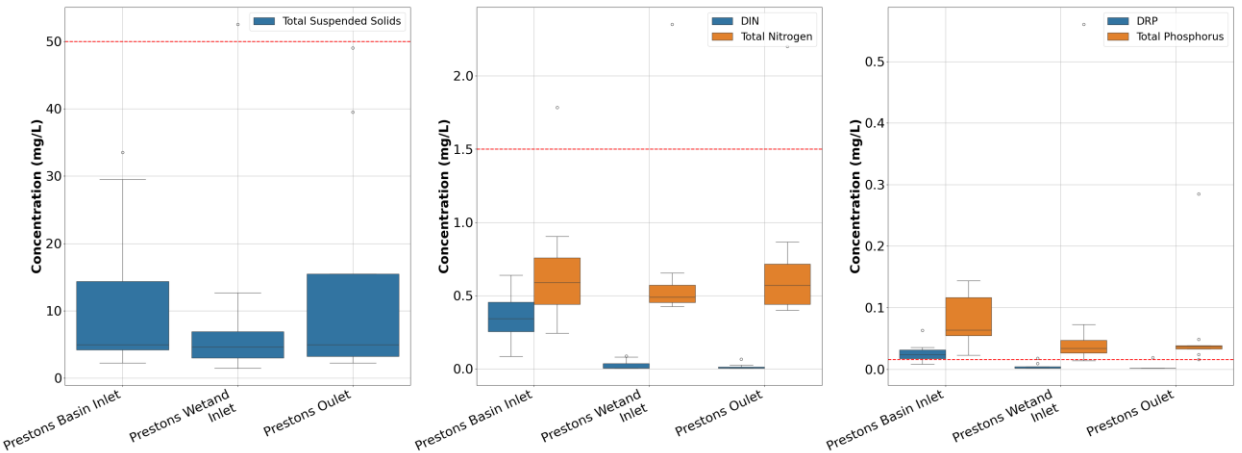
PRESTONS WATER QUALITY



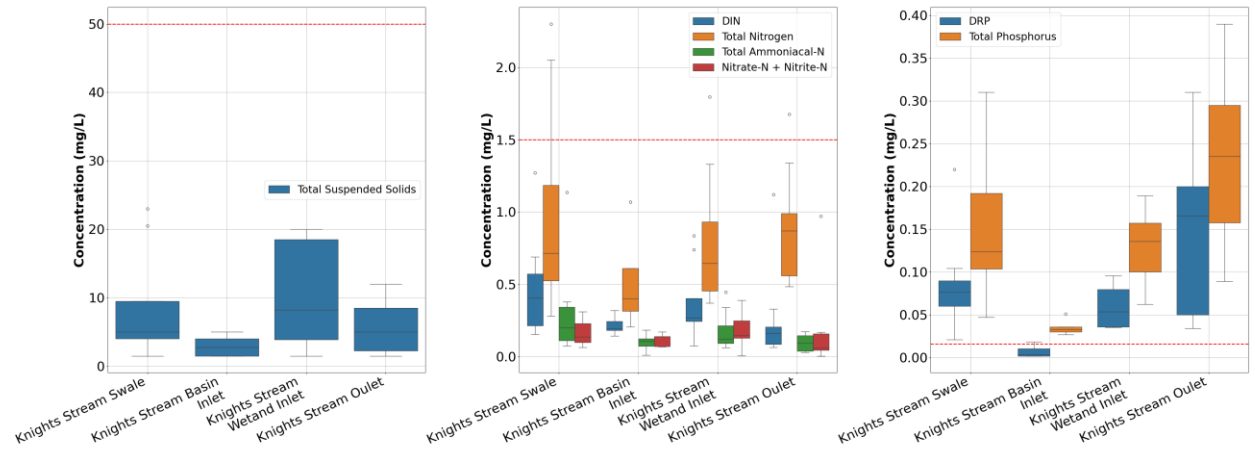
KNIGHTS STREAM WATER QUALITY



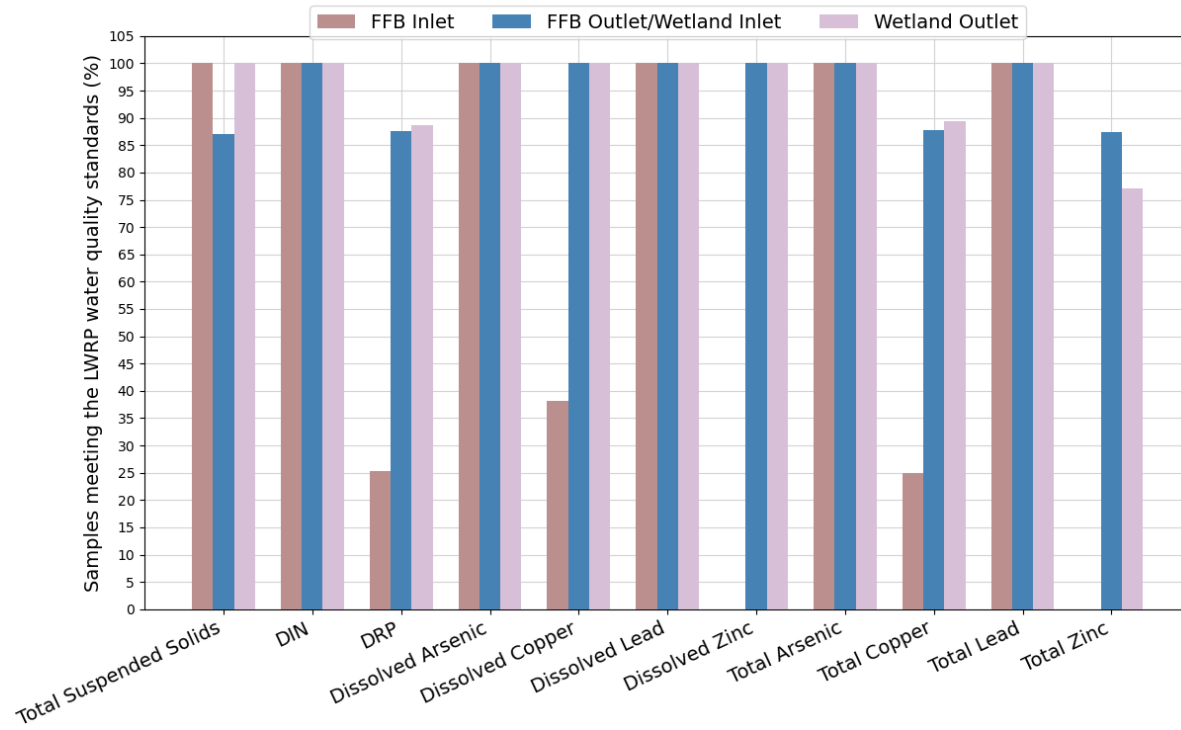
PRESTONS WATER QUALITY



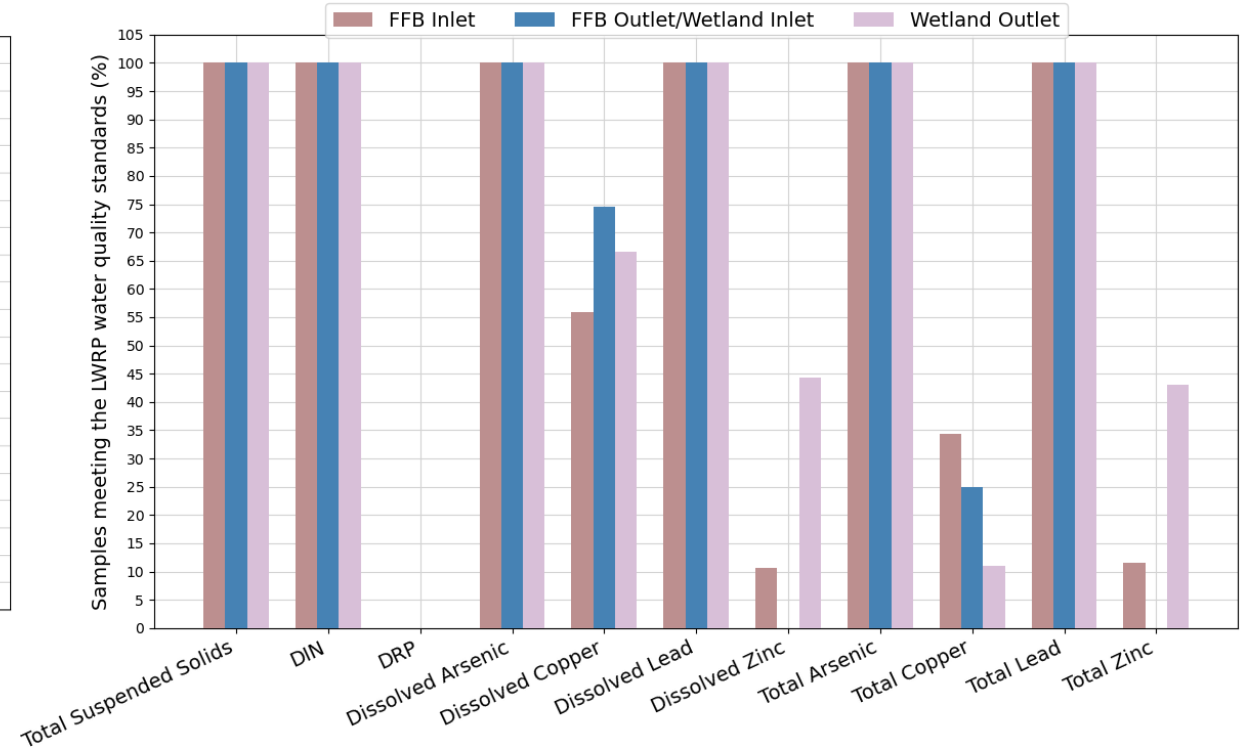
KNIGHTS STREAM WATER QUALITY



PRESTONS COMPLIANCE



KNIGHTS STREAM COMPLIANCE



KEY POINTS

- Water quality outcomes met
- Wet FFB highly effective at metals and nutrients removal
- Water quality standards achieved prior to wetland at Prestons
- Wetlands had variable treatment performance and low influent loading rates
- But stormwater is highly variable:
 - Hydraulic loading rates matter
 - Influent loading rates matter
 - The age of the facility matters



RECOMMENDATIONS

- What next?
 - Flow-weighted composite sampling
 - Catchments with high contaminant loading
 - Other treatment devices
 - Suitability of on-line wetlands for aquatic organisms
- Design considerations:
 - Impact of different land-uses & development age
 - Groundwater quality and interception
 - The other benefits and drawbacks of wetlands
 - Monitoring stormwater facility discharges



ACKNOWLEDGEMENTS

We would like to acknowledge:

- CCC for their reviews, feedback, and funding
- Dr Mark Ellis, Eoghan O'Neill, & Ingrid Cooper from PDP
- NIWA for their review of the methodology and suggestions

Thank you!
Questions? Patai?



Knights Stream Swale was collected at the end of a pretreatment swale.



Knights Stream First Flush Basin Inlet is in a sump at the entrance of the first flush basin



Knights Stream Wetland Inlet is situated at the inlet of the wetland.



Knights Stream Outlet is located in the wetland, at the wetland outlet.



Prestons Inlet is the upstream most sampling point. The sample is collected from a manhole just north of the Prestons first flush basin



Prestons Outlet is located at the end of the wetland, in a sump



Prestons Wetland Inlet is situated in the first cell of the wetland