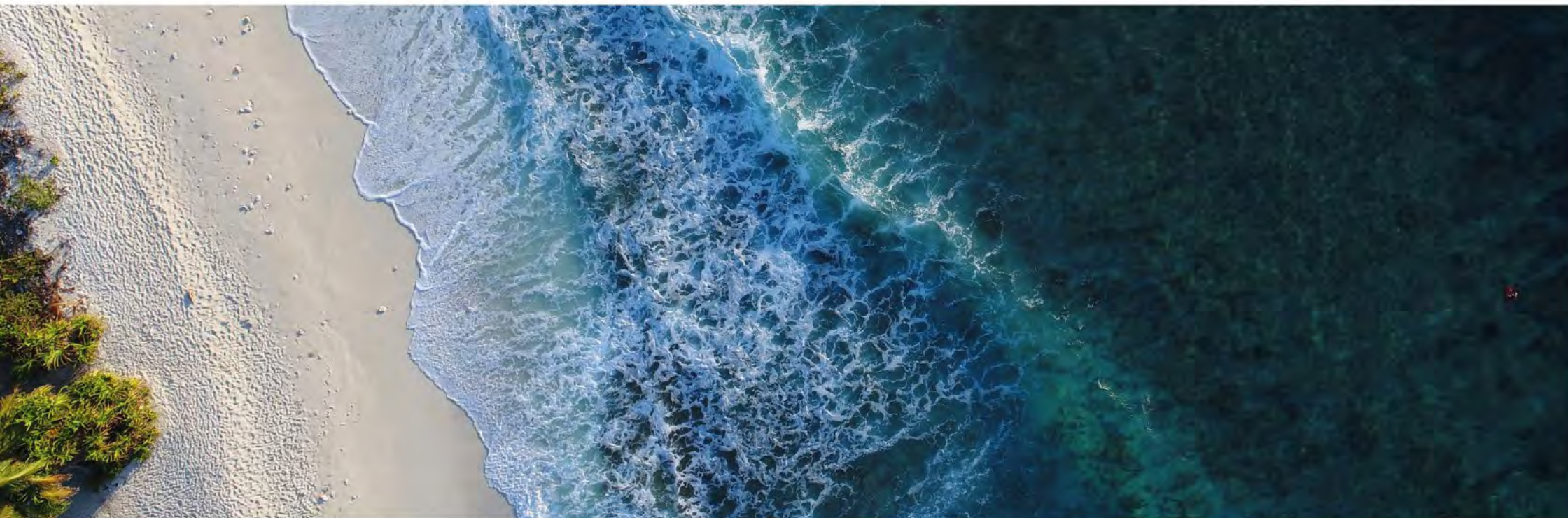


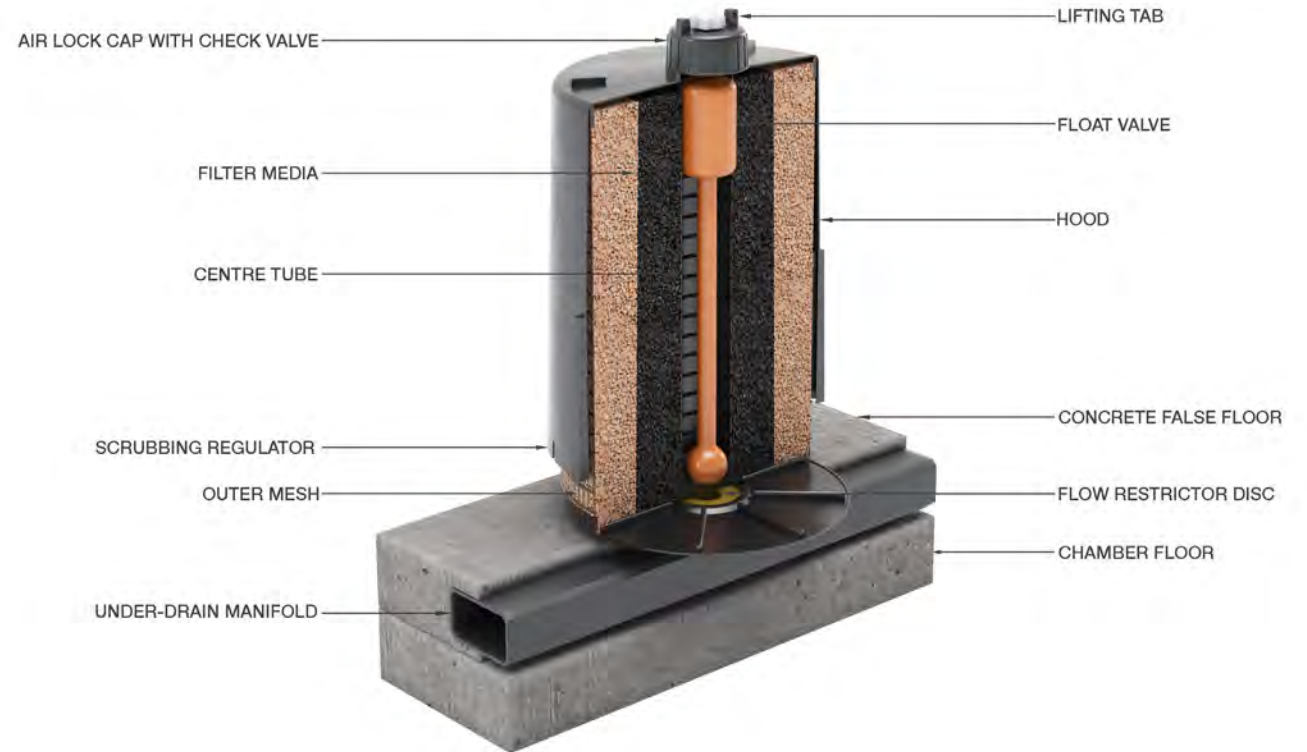


# Stormwater Fundamentals Series - Development Assessment

Ocean Protect webinar by Brad Dalrymple  
24 September 2025



# StormFilter NPSorb technology now available



# 2024 Stormwater Fundamentals Series

- ✓ 1. The Rational Method - Wednesday 7<sup>th</sup> February 2024
- ✓ 2. Inlet Design - Wednesday 21<sup>st</sup> February 2024
- ✓ 3. Pipe Design - Wednesday 27<sup>th</sup> March 2024
- ✓ 4. Impacts of traditional urban stormwater management - Wednesday 1<sup>st</sup> May 2024
- ✓ 5. Water Sensitive Urban Design - Wednesday 22<sup>nd</sup> May 2024
- ✓ 6. Gross Pollutant Traps - Wednesday 12<sup>th</sup> June 2024
- ✓ 7. Bioretention - Wednesday 3<sup>rd</sup> July 2024
- ✓ 8. Proprietary stormwater treatment assets - Wednesday 31<sup>st</sup> July 2024
- ✓ 9. Stormwater pollution in the 'real world' - Wednesday 28<sup>th</sup> August 2024
10. Development assessment (for DA reviewers) - Wednesday 25<sup>th</sup> September 2024
11. WSUD Asset Maintenance - Wednesday 23<sup>rd</sup> October 2024
12. WSUD Asset Compliance - Wednesday 13<sup>th</sup> November 2024

🕒 All info at [www.oceanprotect.com.au/webinars](http://www.oceanprotect.com.au/webinars)

🕒 Subscribe at [www.oceanprotect.com.au/newsletter](http://www.oceanprotect.com.au/newsletter)

Upcoming event

# - TASMANIAN - STORMWATER SYMPOSIUM

**HOTEL GRAND CHANCELLOR HOBART**  
**20th NOVEMBER 2024 | 8:30AM - 5PM**



Derwent  
Estuary  
Program

OCEAN  
PROJECT

# 2025 Stormwater Fundamentals Series

1. Introduction to MUSIC software for stormwater modelling - Wednesday 5<sup>th</sup> February
2. Stormwater channel design - Wednesday 26<sup>th</sup> February
3. GIS for stormwater engineering - Wednesday 12<sup>th</sup> March
4. Rainfall - Wednesday 9<sup>th</sup> April
5. Design of primary stormwater treatment assets - Wednesday 14<sup>th</sup> May
6. Design of secondary stormwater treatment assets - Wednesday 4<sup>th</sup> June
7. High flow bioretention - Wednesday 23<sup>rd</sup> July
8. Integrated Water Management for Buildings - Wednesday 20<sup>th</sup> August
9. Radial flow cartridge system technologies - Wednesday 10<sup>th</sup> September
10. Dewatering done right - Wednesday 1<sup>st</sup> October
11. Law & Order for WSUD Asset Maintenance - Wednesday 12<sup>th</sup> November
12. PFAS - Wednesday 3<sup>rd</sup> December



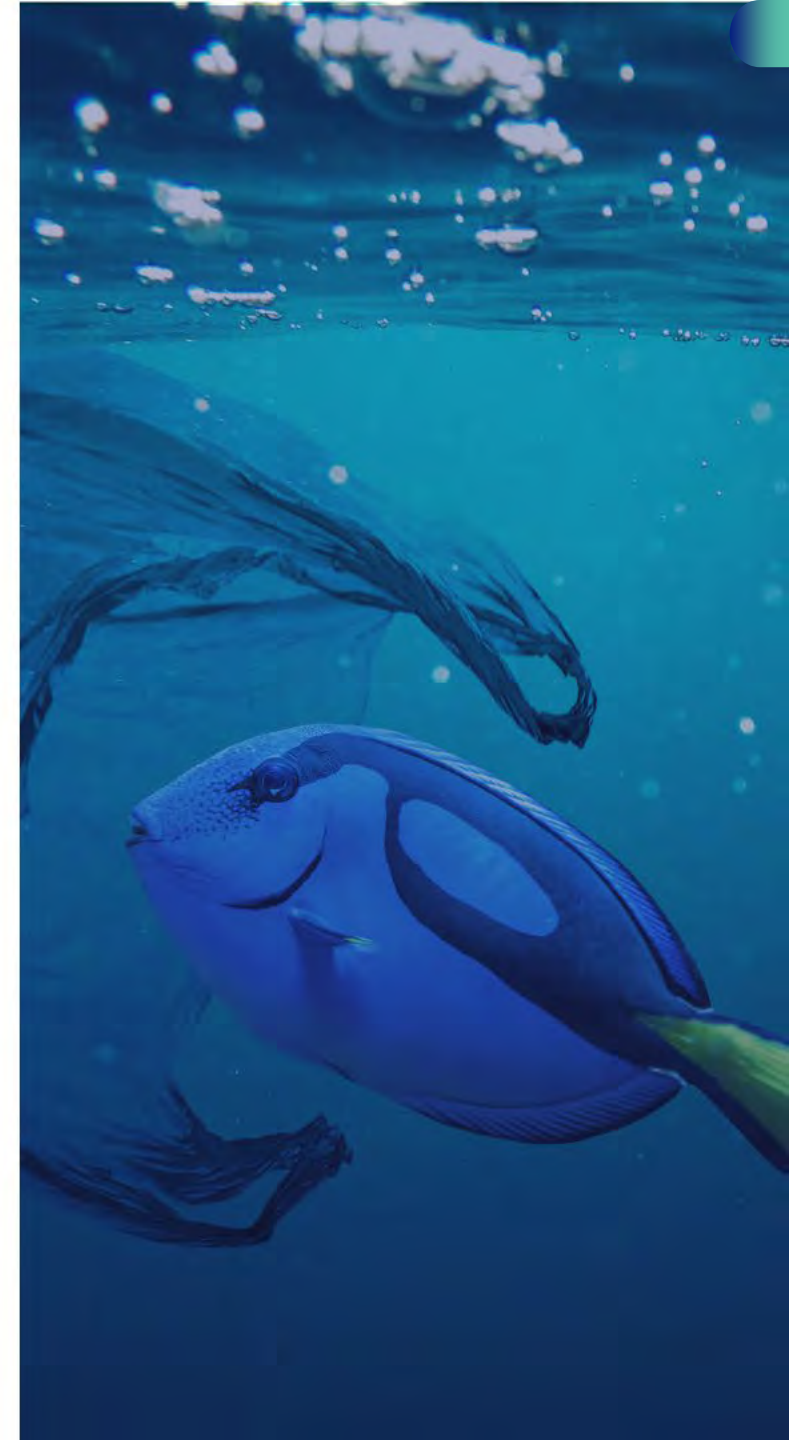
- 🕒 All info at [www.oceanprotect.com.au/webinars](http://www.oceanprotect.com.au/webinars)
- 🕒 Subscribe at [www.oceanprotect.com.au/newsletter](http://www.oceanprotect.com.au/newsletter)

# Conflict of interest declaration



# Reminders

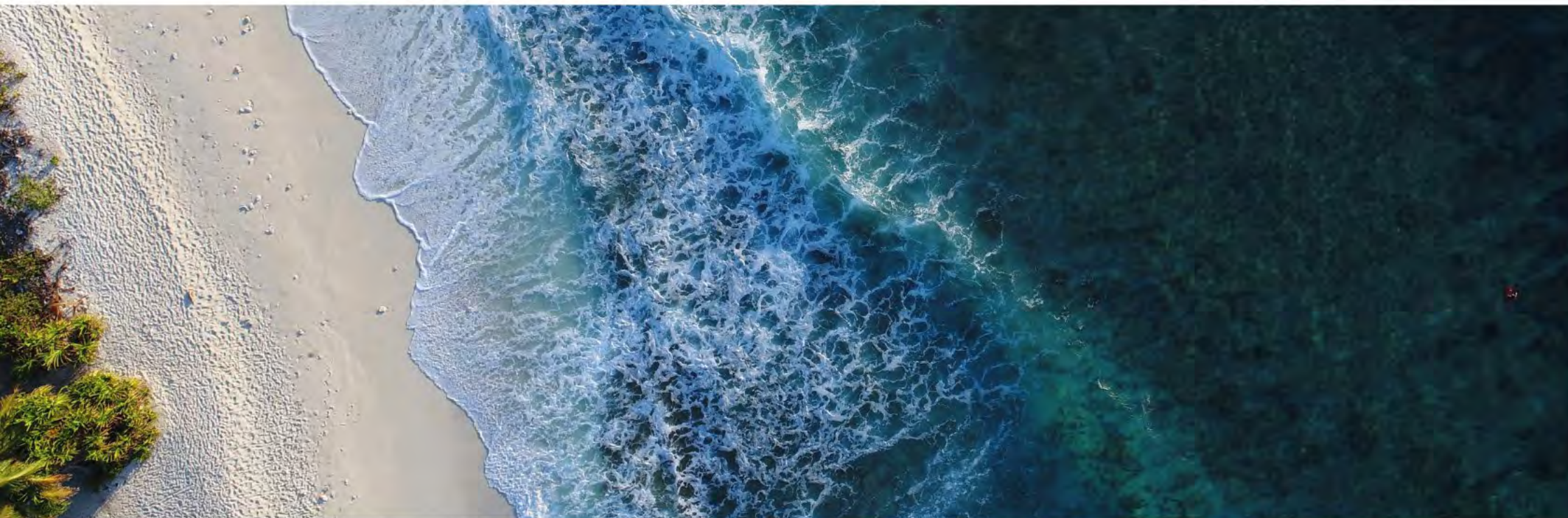
- ④ Please put any questions in the 'Q&A' panel
- ④ The slides & recording will be made available at [www.oceanprotect.com.au/webinars](http://www.oceanprotect.com.au/webinars)
- ④ Please email any CPD form requests to [enquiries@oceanprotect.com.au](mailto:enquiries@oceanprotect.com.au)





# Stormwater Fundamentals Series - Development Assessment

Ocean Protect webinar by Brad Dalrymple  
24 September 2025

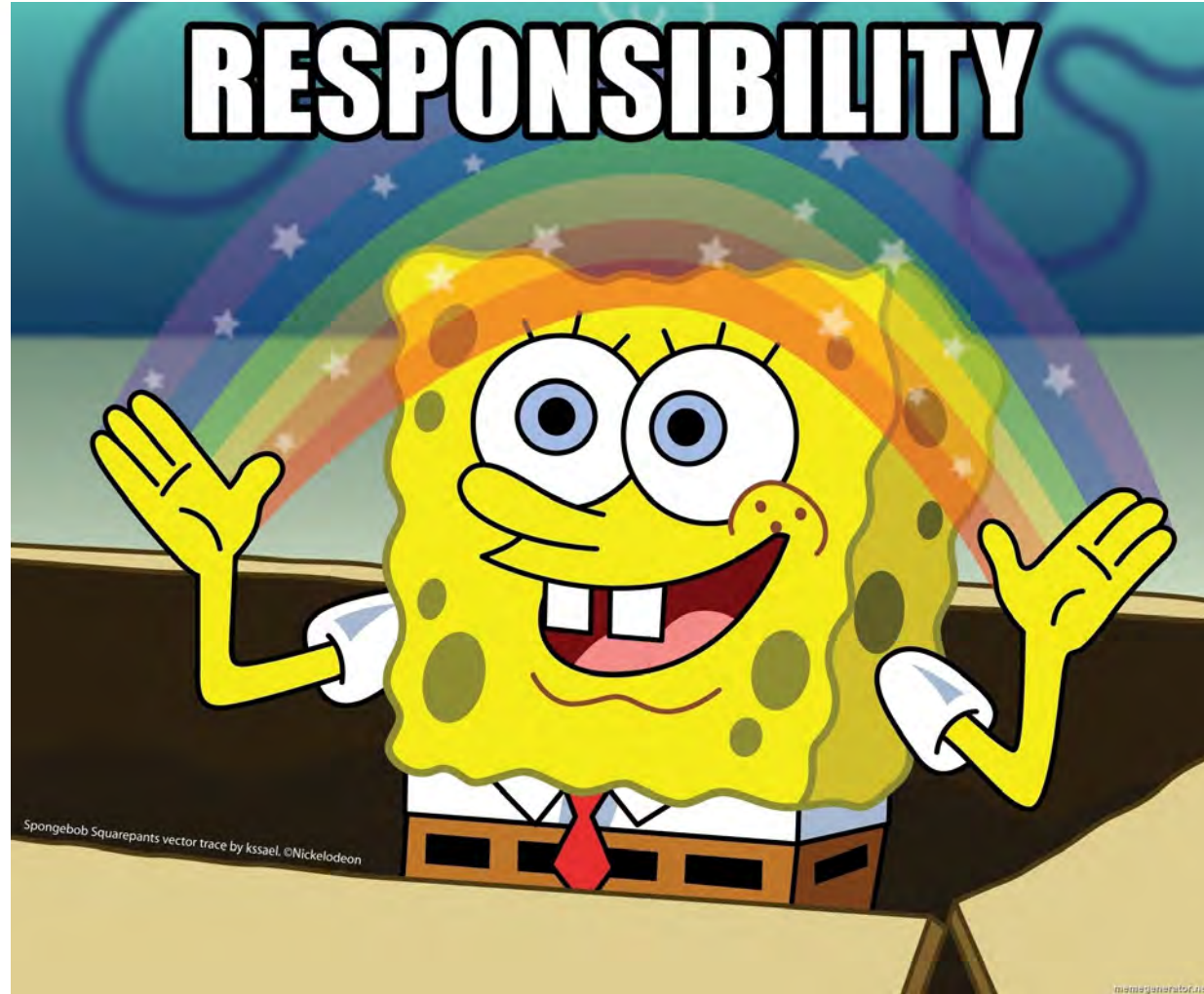








# RESPONSIBILITY



# Key considerations

- ④ Integration
- ④ Water quality
- ④ Hydraulics
- ④ Mass load (longevity & maintenance)



# Integration



# Key considerations

- ④ Maintenance access
- ④ Safety
- ④ Area usage
- ④ Amenity





Wetland @ Redbank, QLD

# Bioretention @ Caloundra, QLD







Bioretention @ Docklands, VIC

Filterra bioretention @  
Silverdale, NSW




A photograph of a bioretention system. In the foreground and middle ground, there are numerous clumps of tall, thin grasses with feathery, light-colored seed heads. To the right, a multi-tiered retaining wall made of large, light-colored stone blocks runs along the edge of the area. Behind the wall, there are more trees and greenery. The sky is a pale, overcast blue. In the bottom center, a small metal pipe with a white cap is visible.

Filterra bioretention @  
Silverdale, NSW

Filterra bioretention @  
Redmond, Washington, USA





Filterra bioretention @  
Redmond, Washington, USA

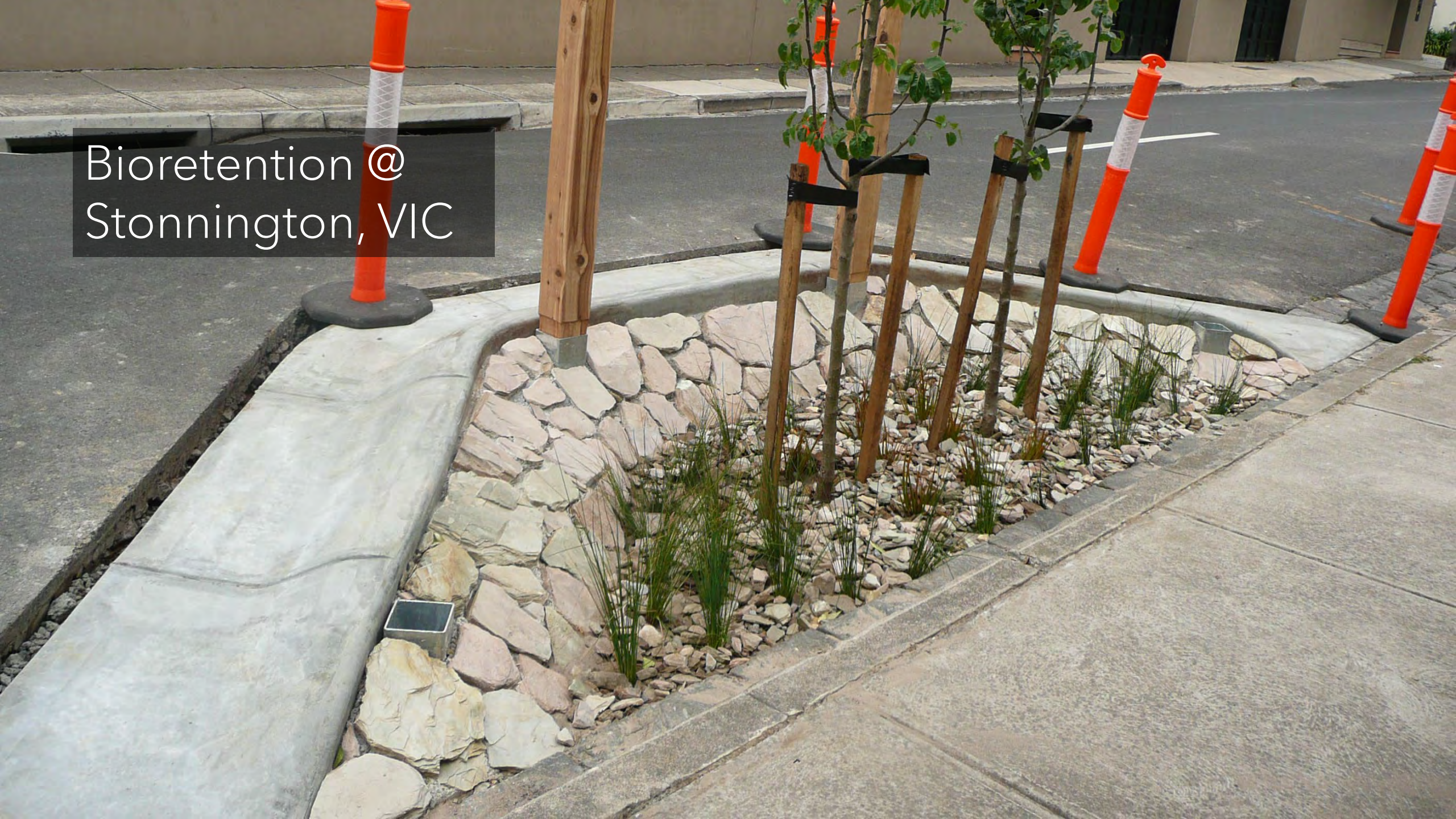
GPT with  
poor access



Sediment  
basin with no  
maintenance  
access



Bioretention @  
Stonnington, VIC







Bioretention @  
Silverdale, NSW



Bioretention @  
Brendale, QLD

Bioretention @  
Kepnock, NSW





Bioretention @  
Thirlmere, NSW



Bioretention @  
Brighton, QLD



Noosa, QLD



Wakerley, QLD

Bioretention



Robina, QLD



Lytton, QLD



Bioretention @  
Toowoomba, QLD







Installation



After





OCEAN  
PROTECT

OCEAN  
PROTECT

OCEAN  
PROTECT

OCEAN  
PROTECT

Stopping

Pollution

Entering

Waterways

We don't inherit the earth from our parents. We borrow it.

DO NOT  
OVERTAKE  
TURNING VEHICLE

JL 05 F

# Key considerations

- ④ Maintenance access
- ④ Safety
- ④ Area usage
- ④ Amenity





# Water Quality

# **Water quality & hydraulics**



## A key assumption

*The asset(s) will function as intended ...*

The asset(s) is in  
'good' condition

Treatment system  
fully utilised

Trust  
everyone

HOPE



# Common problems

- ④ Sediment & litter accumulation
- ④ Assumed treatment processes not fully realised
- ④ 'Optimistic' performance
- ④ Inadequate maintenance





Bioretention smothered in sediment from upstream (developing) catchment

8 Gully pit  
baskets in  
Western Sydney

~2720m<sup>2</sup> urban  
road catchment

5 months  
(2019)

850 bits of plastic, including:

- ⦿ 228 cigarette butts
- ⦿ 88 plastic drink lids
- ⦿ 44 cans
- ⦿ 22 plastic cups
- ⦿ 21 plastic straws

130kg of sediment







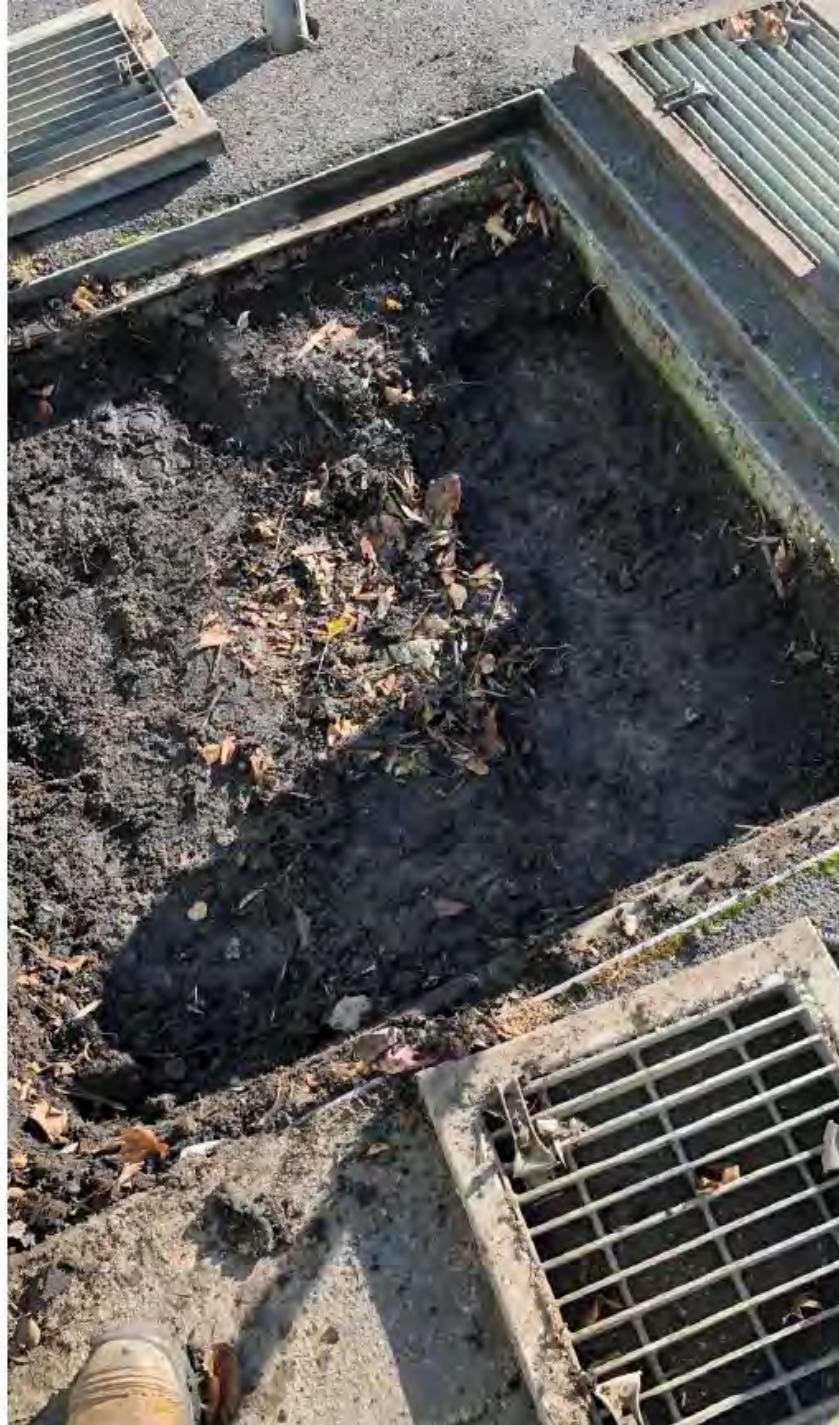




Photos from Daniel Rhodes (Optimal Stormwater, 2024: *Pers.Comm.*)



Source of photos:  
Ralf Pfleiderer (2020: Pers.Comm.)











Flow  
distribution ?

Bioretention @  
Caboolture, QLD



Flow  
distribution ?

Bioretention @  
Mackay, QLD



Flow  
distribution  
& plant  
growth ?



Bioretention @  
Fitzgibbon Chase, QLD

Flow  
distribution ?

Bioretention @  
Fitzgibbon Chase, QLD



# Recommendations

- ④ Design, construction & establishment:
  - Ensure asset(s) will likely function as intended
  - Appropriate maintenance access is essential
  - Review & inspect
  - Prior to development approval, require ongoing condition assessments & long-term maintenance agreements
- ④ Operation:
  - Ensure asset(s) is likely functioning as intended
  - Review & enforce condition assessment & maintenance requirements



An underwater scene with a blue-green color palette. The background is filled with numerous small, clear bubbles rising from the bottom left towards the top right. Light rays and ripples are visible on the water's surface, creating a dynamic and textured environment. The text 'Proprietary SQIDs' is centered in the middle of the frame in a white, bold, sans-serif font.

# Proprietary SQIDs

# Common challenges

- ⌚ Exaggerated performance claims
  - Water quality
  - Hydraulics
  - Maintenance regime
- ⌚ For SQIDs using detention tanks, modelling the 'detention' node with default  $k-C^*$  values



# Example 'optimistic' water quality claim

Claim for SQID X from Company Y website:

TRASH AND LITTER - 100%



OIL WATER SEPARATION - 99.95%



TOTAL PHOSPHORUS (TP) 97%



TOTAL SUSPENDED SOLIDS (TSS) - 95%



TOTAL NITROGEN (TN) 85%



Info for SQID X from Company Y website:

Outflow concentration was 5.01 mg/L. The overall concentration of TP in the outflow was reduced by more than 97%. However, it should be noted that almost all of the phosphorous in water samples at the inlet and outlet of the [REDACTED] was in particulate form, as evidenced by the concentrations of dissolved phosphorous (at or near the adopted detection limits for the water quality laboratory, 0.01 mg/L).

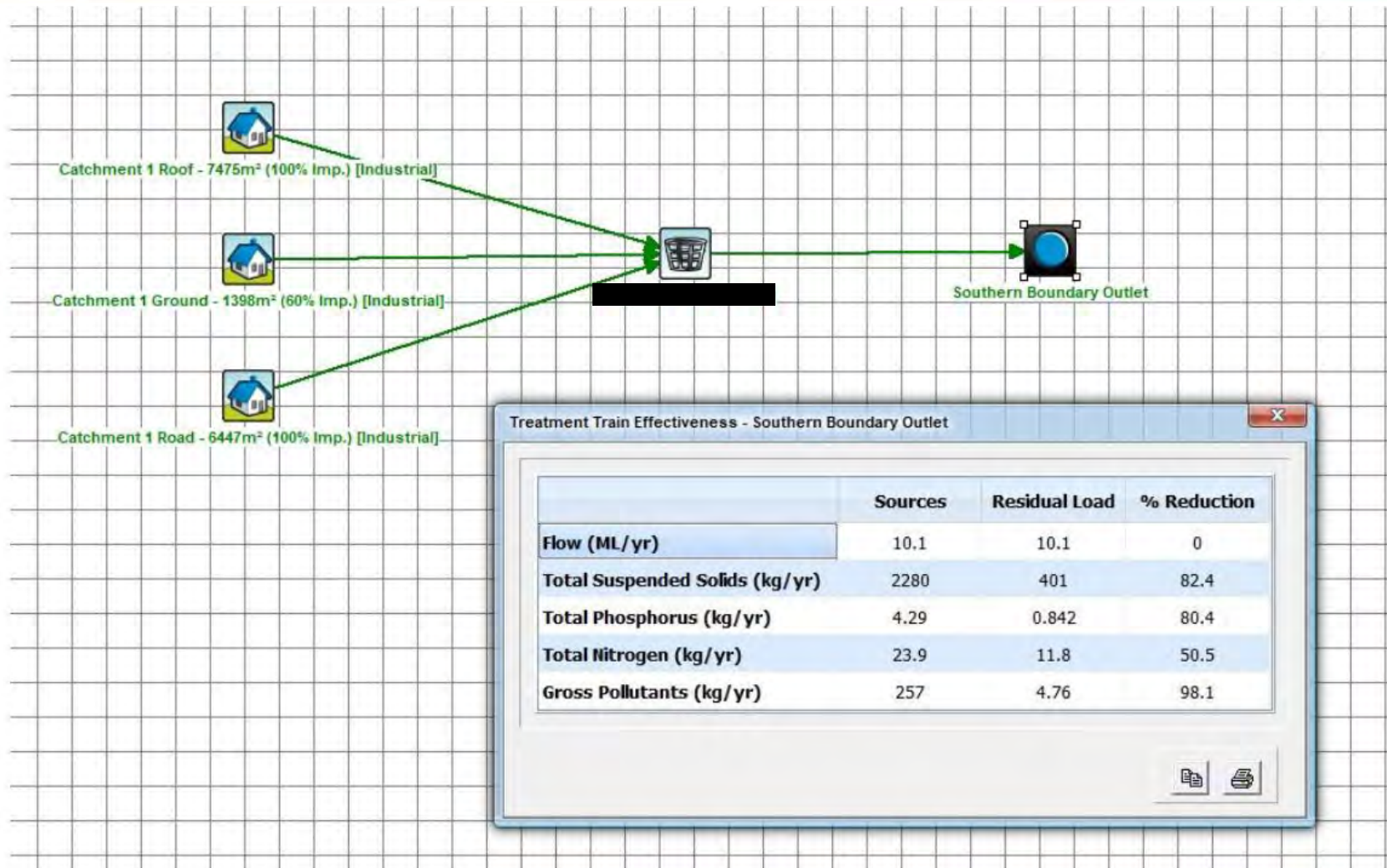
at the outlet, however in the absence of a specific mechanism of removal the means of a dissolved nitrogen (TDN) reduction should be treated with caution. The results also show little influence of the dev

We note that testing in this report was based on a limited water quality sample size – two samples at the inlet an outlet. More confidence in the results would be achieved by increasing the test

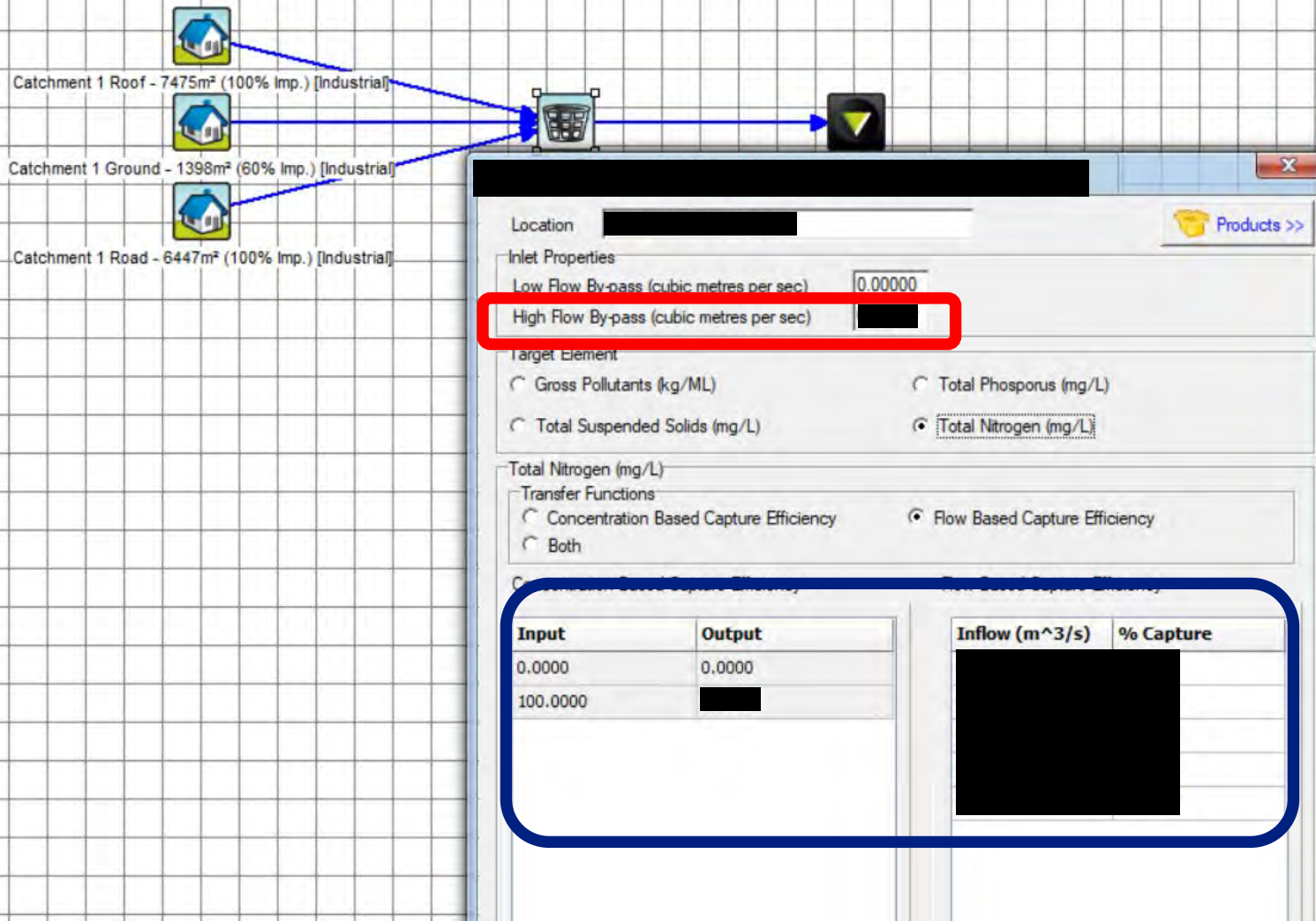
The water quality improvement testing of this project was conducted only once and below the treatment flow rate. It is probable that the performance of the [REDACTED] will be improved at fl

system, 97% of TP and 85% of TN, however all forms of nutrients were dominated by their particulate forms and there was and there was very little TDP or TDN present to compare inlet and outlet concentrations. Comparison with the performance of other devices should be undertaken with caution as

# Example 'optimistic' treatment flow rate & water quality claim



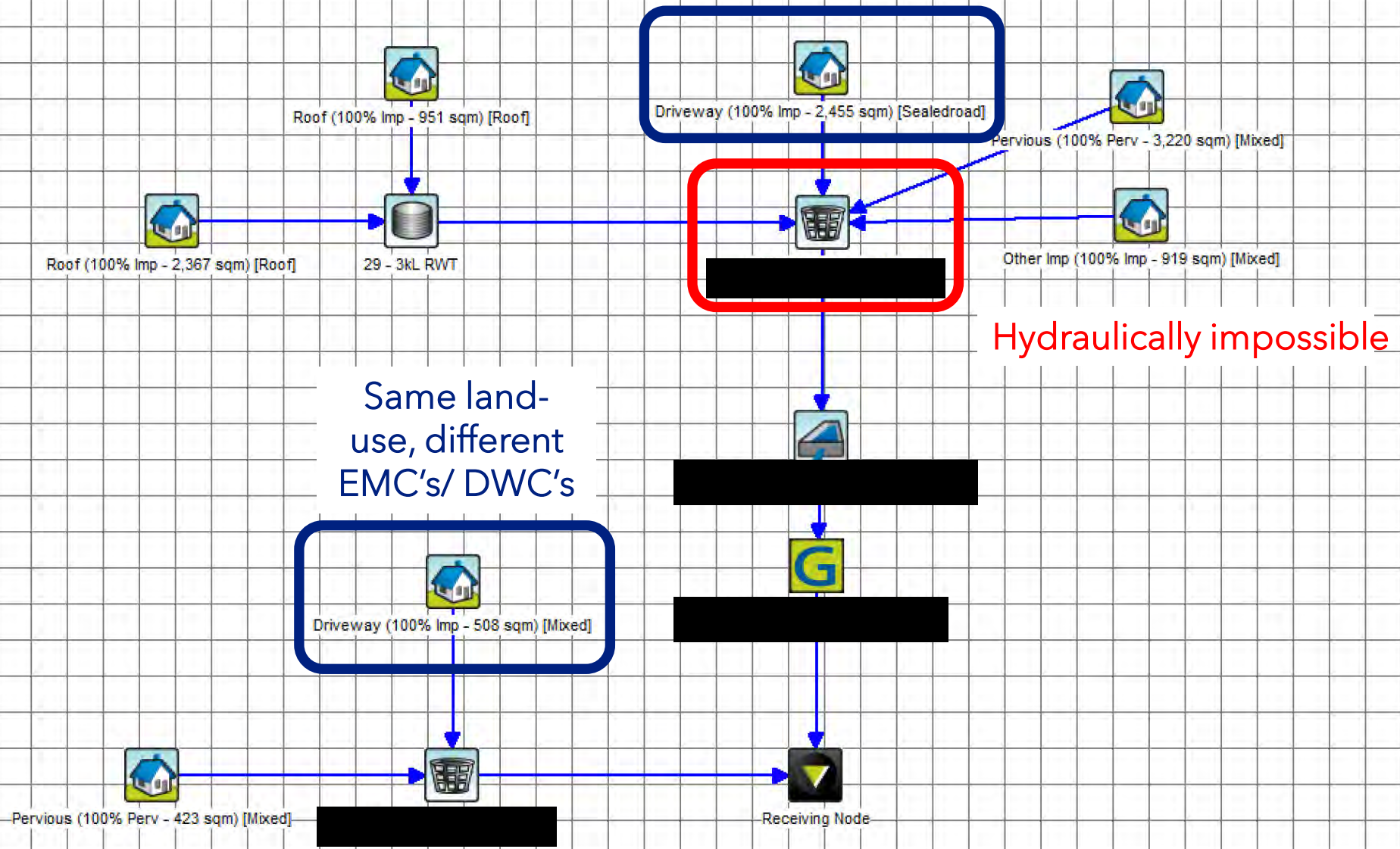
# Example 'optimistic' treatment flow rate & water quality claim



Ensure high flow bypass is relevant to the GPT specified

Pollution removal rates higher than approved by the Council

# Example treatment hydraulics 'optimism'



# How to review performance claims ?



# How to review performance claims ?

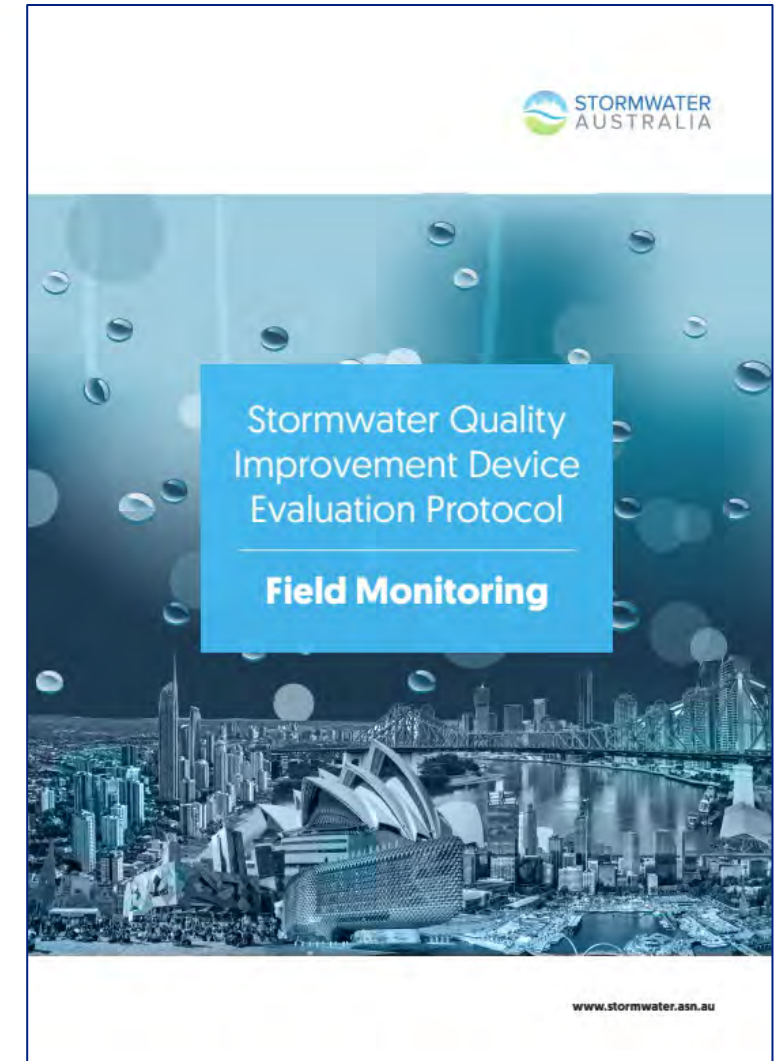


- © Ask for proof
  - With no distribution restrictions
  - Give proof to others for review ?



# Apply SQIDEP verified values ?

- ④ Currently, only applied in South East Queensland & Aerotropolis ?
- ④ Not endorsed by Stormwater Victoria, NSW or Queensland
- ④ Known deficiencies
- ④ 10 x SQIDEP-verified SQIDs
  - Includes 4 x Ocean Protect SQIDs



# Apply Blacktown City Council approved values ?



**WSUD developer handbook**  
MUSIC modelling and design guide 2020

Blacktown Source Nodes	Blacktown Only Nodes	Rocla CDS Units	Humes Products	Ocean Protect Products	SPEL Products				Enviropod 200
BCC Roof Area [Roof]	Blacktown Only Wetland	CDS Nipper 506		OceanGuard 200 micron - white (BCC)	SPEL StormSack BCC 2020			Vortceptor GPT 2020	Enviropod 200 - white insert (BCC)
		CDS 1518							
BCC Road Areas [Sealedroad]	Blacktown Only Swale 2020	CDS 0708	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015	Humegard Blacktown Node May 2015
		CDS 2018							
BCC Other Impervious Areas [Unsealedroad]	Blacktown Only Sedimentation Basin	CDS 0708M	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)	ZPG StormFilter (BCC - October 2015)
		CDS 2028							
BCC Pervious Areas [Revegetatedland]	Blacktown Only Detention Basin	CDS 1009	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19	Humeceptor Blacktown Node 2013-07-19
		CDS 3018							
	Blacktown Only Media Filtration	CDS 1012	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20	Ocean Protect Jellyfish BCC 2015-04-20
		CDS 3024							
	Blacktown Only Green Roof 2020	CDS 1015	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021	Filtera Storage Basin Interim 2021
		CDS 3030							
		CDS 1512	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021	Filterra Biofiltration Treatment Interim 2021
			Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal	Blacktown SPEL Vault Bay - Normal

# Recommendations



or

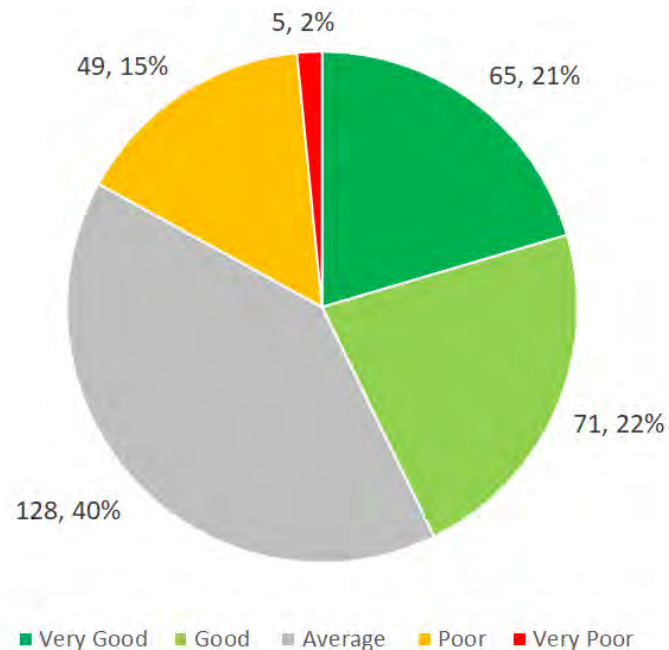


- © Ask for proof
  - With no distribution restrictions
- © Review & consider SQIDEP &/or Blacktown CC approved values

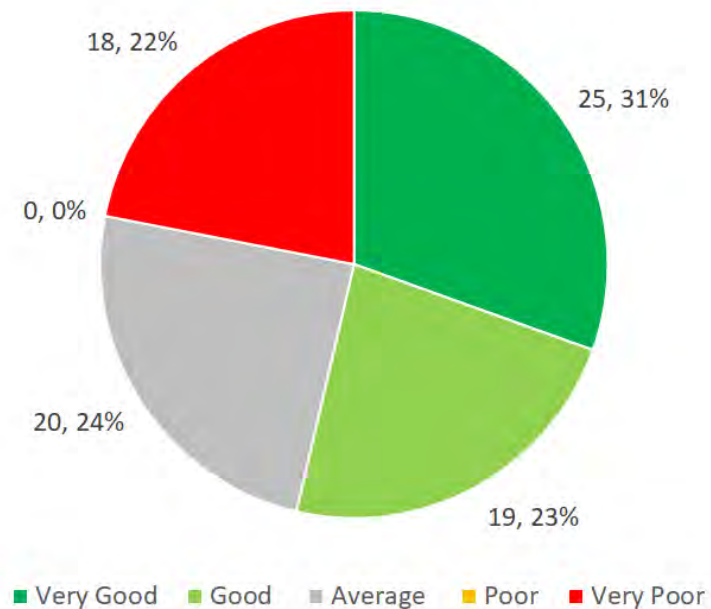


# “Real world” bioretention condition assessments

## Moreton Bay Regional Council



## Un-named SEQ Council



© *“A lack of maintenance activities is predicted to be the key reason for these poor (or very poor) condition ratings.”*

# Thomas et al (2016)



Figure 1: Condition assessment results for Council A (2013)

Council A = 17 bioretention, & 1 wetland

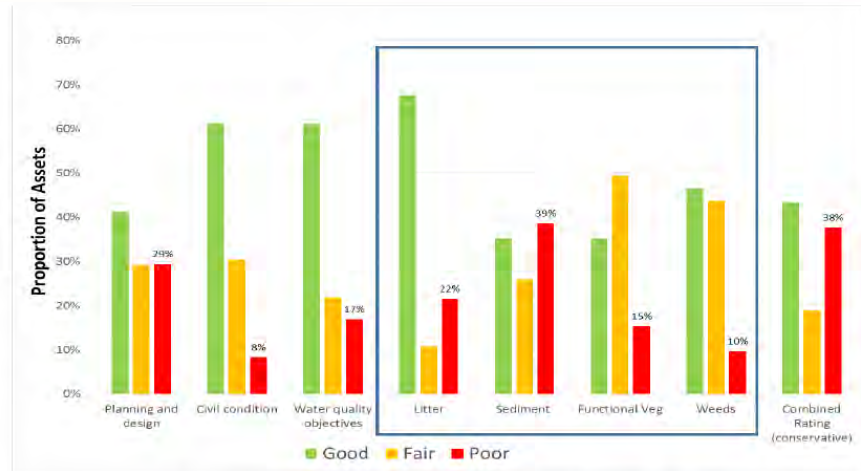


Figure 2: Condition assessment results for Council B (2014)

Council B = 4 sed basin, 16 wetlands, 20 bioretention, 6 swale, 4 retarding basin, 3 ponds

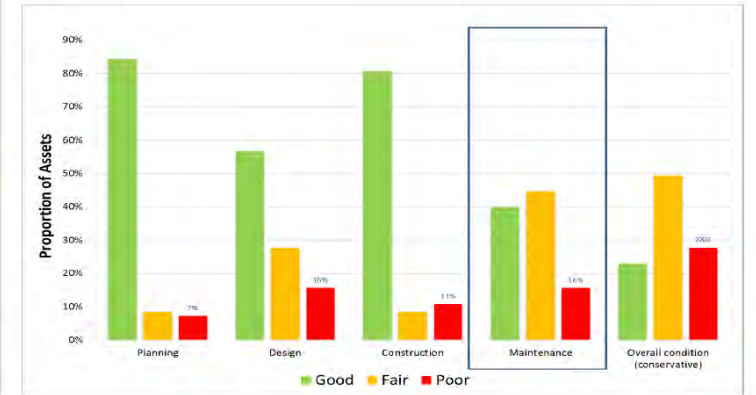


Figure 4: Condition assessment results for Council C (2015)

Council C = 83 SCMs (13 'infiltration', 64 'rain gardens', 5 swale, 1 wetland)

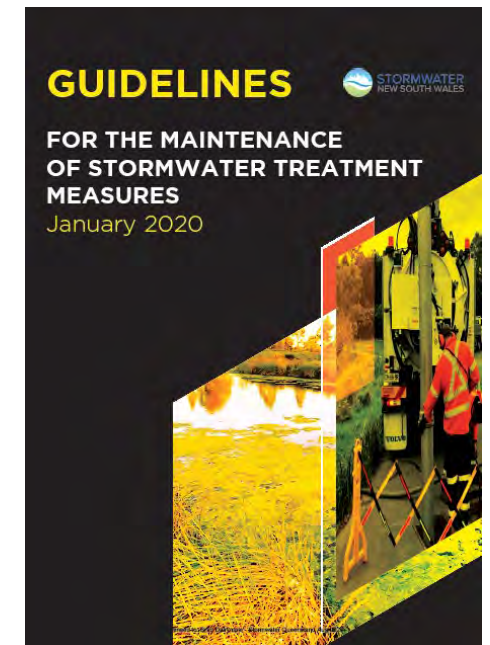
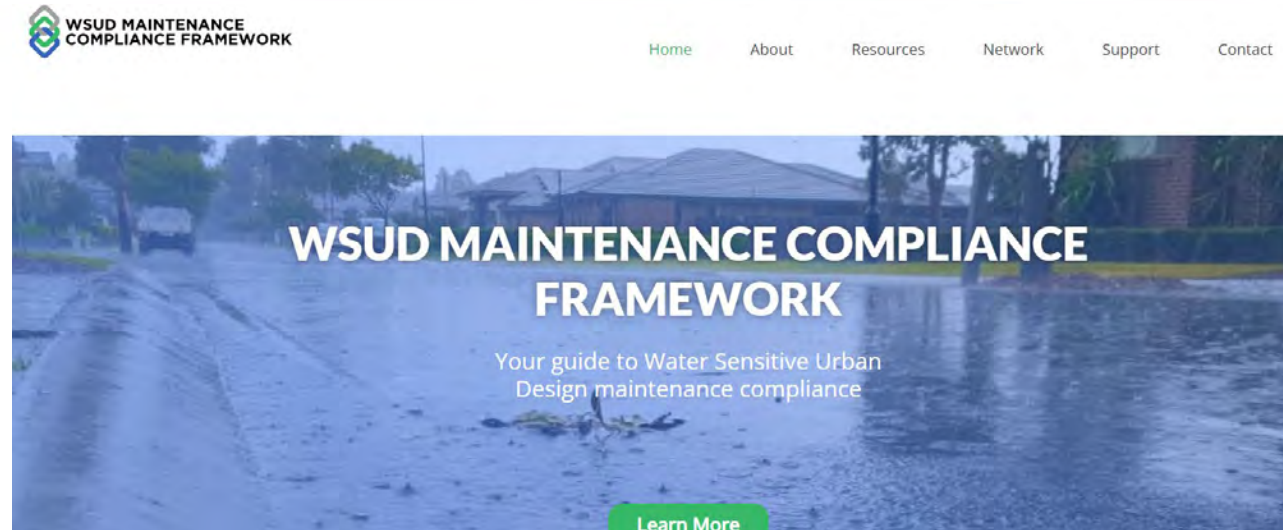
- ⊙ "maintenance practices (or lack-there-of) is the leading reason for the high proportion of assets being in poor condition".
- ⊙ "appropriate levels of maintenance may be the single most important issue currently facing (their) effective long-term performance"."

# “Must haves”

- ⌚ Regular removal of accumulated material
  - ⌚ Know where assets are
  - ⌚ Know what assets are
  - ⌚ Resources (e.g. staff, equipment/ machinery, \$\$) to maintain/ manage
- ❖ For both publicly and privately owned assets

# Recommendations

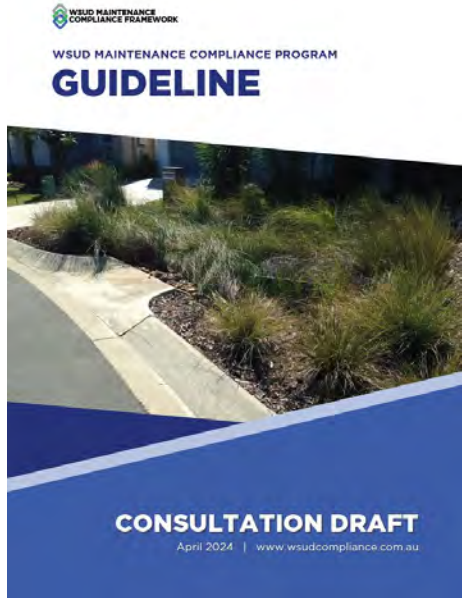
- ③ Ensure asset(s) can be safely, easily & appropriately managed
- ③ Management by suitably qualified personnel
- ③ For private sites:
  - Prior to development approval, require a long-term maintenance agreement
  - Review & enforce maintenance





# WSUD Maintenance Compliance Program Guideline

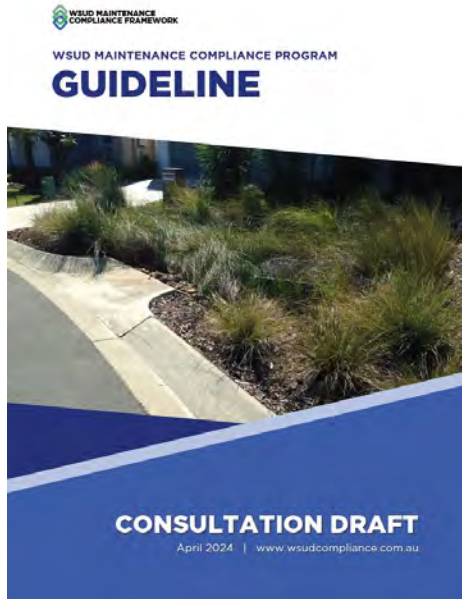
## Appendix A – Development Approval Conditions



Reference	Wording	Further Information	
Condition 1	<p><i>[Insert relevant timing], the Applicant is to prepare and submit to Council for approval a Maintenance Schedule for the WSUD system present at the property in accordance with [Insert relevant source]. When submitting the Maintenance Schedule, the Applicant must also submit to Council appropriate development documentation that identifies the applied (where applicable) types, models, model numbers, sizes, and locations for the assets that form the WSUD system present at the property.</i></p> <p><i>The approved Maintenance Schedule can be modified by agreement with Council.</i></p>	<i>User Additions</i>	Relevant timing will need to be indicated, but for NSW and Queensland, the relevant timing could be prior to the issue of the Subdivision or Occupation Certificate. For Victoria, it could be prior to the issue of the Certification of Plan of Subdivision or Occupancy Permit.
		<i>When</i>	Consider the note above about relevant timing. However, this condition should be prior to the other conditions listed below.
		<i>Assumptions</i>	That the applicant is preparing the Maintenance Schedule, council is reviewing the Maintenance Schedule, and that there is a source that outlines the requirements of a Maintenance Schedule (this could include the Maintenance Schedule template).
		<i>Importance</i>	<ul style="list-style-type: none"> <li>Identifies when and what documents need to be provided.</li> <li>Ensures council has all required information on the WSUD system.</li> <li>Lead to the creation of a vital document for the program.</li> <li>Provides applicants the opportunity to modify the approved Maintenance Schedule if needed.</li> </ul>
		<i>Comments</i>	<p>Alternatives for this condition could include:</p> <ul style="list-style-type: none"> <li>council preparing the whole Maintenance Schedule, and/or</li> <li>applicant and council are involved with parts of the preparation of the Maintenance Schedule.</li> </ul> <p>It is important to remember that councils will need to provide a copy of the provided Maintenance Schedule to future owners of the property as part of the “Welcome Package” recommended in the Framework. This is because it is likely that future owners will not be aware such a document exists.</p>

# WSUD Maintenance Compliance Program Guideline

## Appendix A – Development Approval Conditions

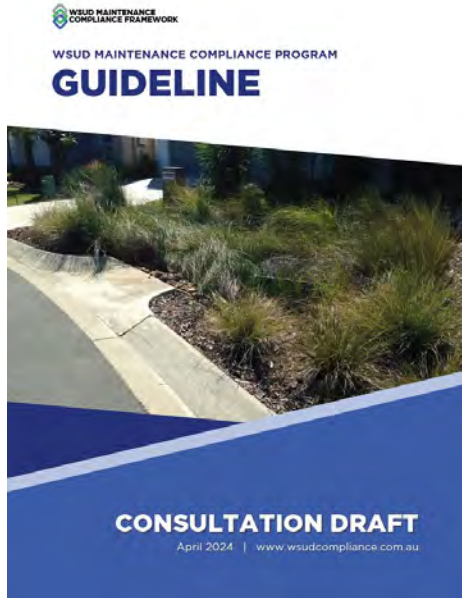


### Appendices

Reference	Wording	Further Information	
Condition 2	<p><i>[Insert relevant timing], the Applicant is to provide to Council written evidence demonstrating that it has engaged a suitably qualified persons to carry out maintenance of the WSUD system in accordance with the Council approved WSUD System Maintenance Schedule.</i></p>	<b>User Additions</b>	Same as Condition 1 for relevant timing.
		<b>When</b>	Conditioned after Condition 1 and before the following conditions.
		<b>Assumptions</b>	There is a definition somewhere for an SQP. Further it assumes that council has approved a Maintenance Schedule.
		<b>Importance</b>	<ul style="list-style-type: none"> <li>Identifies when this needs to occur.</li> <li>Ensures that the WSUD system will be maintained in accordance with the Council approved Maintenance Schedule and by an SQP.</li> <li>Provide flexibility for applicants to choose how they engage with an SQP.</li> </ul>
		<b>Comments</b>	In some cases, councils may choose to have the applicant prepay for a period of engagement. For example, Blacktown City Council typically imposes a 5-year prepaid maintenance contract condition.
Condition 3	<p><i>[Insert relevant timing], the Applicant must submit a [Insert relevant agreement] over the WSUD system present at the property. The [Insert relevant agreement] is to be in accordance with [Insert relevant source]. The [Insert relevant agreement] is to be approved by Council and lodged with [Insert relevant organisation]. The</i></p>	<b>User Additions</b>	<p>Same as Condition 1 for relevant timing.</p> <p>Relevant agreements would be:</p> <ul style="list-style-type: none"> <li>Positive Covenant and Restrictive Covenant for NSW.</li> <li>Section 173 Agreement for Victoria.</li> </ul> <p>Relevant organisations would be:</p> <ul style="list-style-type: none"> <li>NSW Land Registry Services for NSW.</li> <li>Victorian Land Titles Office for Victoria.</li> </ul>

# WSUD Maintenance Compliance Program Guideline

## Appendix A – Development Approval Conditions



Reference	Wording	Further Information		
	<p><i>Applicant must provide to Council documentary evidence of the registration of the [Insert relevant agreement] on title prior to [Insert relevant timing].</i></p>		Relevant sources will vary depending on the organisation. For example, Blacktown City Council has this within Appendix F of their “Engineering Guidelines for Development”.	
		<i>When</i>	Conditioned after Condition 2 and before the following condition.	
		<i>Assumptions</i>	There is a source document that outlines standard wording for the Agreement.	
		<i>Importance</i>	<ul style="list-style-type: none"> <li>Identifies when this needs to occur.</li> <li>Identifies who the documents need to be registered with.</li> <li>Identifies what the agreements need to be in accordance with.</li> <li>Should ensure that council receives registered copies of the agreements.</li> <li>Leads to the registration of a critical instrument for the program.</li> </ul>	
		<i>Comments</i>	<p>If there is no source document, the condition could read “the wording in the instrument must be in accordance with Council’s standard wording”.</p> <p>Please see the note below this table regarding Queensland and this condition.</p>	
Condition 4	<p><i>The WSUD system must be maintained for the life of the development in accordance with Council’s requirements which are outlined in the:</i></p> <ul style="list-style-type: none"> <li><i>the [Insert relevant agreement] registered on title with respect to the WSUD system;</i></li> </ul>	<i>User Additions</i>	Same as Condition 3 for relevant agreements.	
		<i>When</i>	Conditioned after the relevant certificate has been issued for the development (e.g. Occupation Certificate in NSW).	
		<i>Assumptions</i>	That all of council’s requirements are outlined in the stated sources. Further, it assumes council has approved a Maintenance Schedule.	

# Key considerations

- ④ Integration
- ④ Water quality
- ④ Hydraulics
- ④ Mass load (longevity & maintenance)







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1300 354 722

# THANK YOU

Brad Dalrymple  
[bradd@oceanprotect.com.au](mailto:bradd@oceanprotect.com.au)

# Reminders

- ④ Please put any questions in the 'Q&A' panel
- ④ The slides & recording will be made available at [www.oceanprotect.com.au/webinars](http://www.oceanprotect.com.au/webinars)
- ④ Please email any CPD form requests to [enquiries@oceanprotect.com.au](mailto:enquiries@oceanprotect.com.au)

