Bioretention Dispelling the Myths

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Acknowledge STORM Consulting, Kiama Council & Allison Dunphy

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Lets talk about……

- Kiama Sand Filter – 10 years operation
- Revisit the treatment train – GPTs, filter & reuse
- Site Inspections Nov 2005 and July 2014
- Revisit the GPT strategy
- Review the water quality performance (Dunphy 2007)
- Review Kiama in light of FAWB Specification
- Compare grass v vegetated bioretention systems
- Look at livability, affordability & maintainability

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A Brief History of stw qlty mgmt

- Early 1990s Argue notes - WSUD coined by WA designers
- 1995 Pollutech's (CDS's) first installation in NSW
- 1993 Stormwater Forum – chaired Lawrence Street
- 1996 Blue Mountains Urban Runoff Control Programme
- 1997 EPA's Stormwater Treatment Techniques and DLWC Constructed Wetlands Manual published
- 1998 – Council order to prepare SMPs
- 1998 – Stormwater Trust – 5 stages - stormwater grants
- 1999 – SCA – NorBE
- 2002/3 – first stormwater harvesting projects
- 2003 Rise of decentralised responses - bioretention & filtration
- 2004 – BASIX SEPP – rainwater tanks

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A Brief History of Stormwater in Sydney

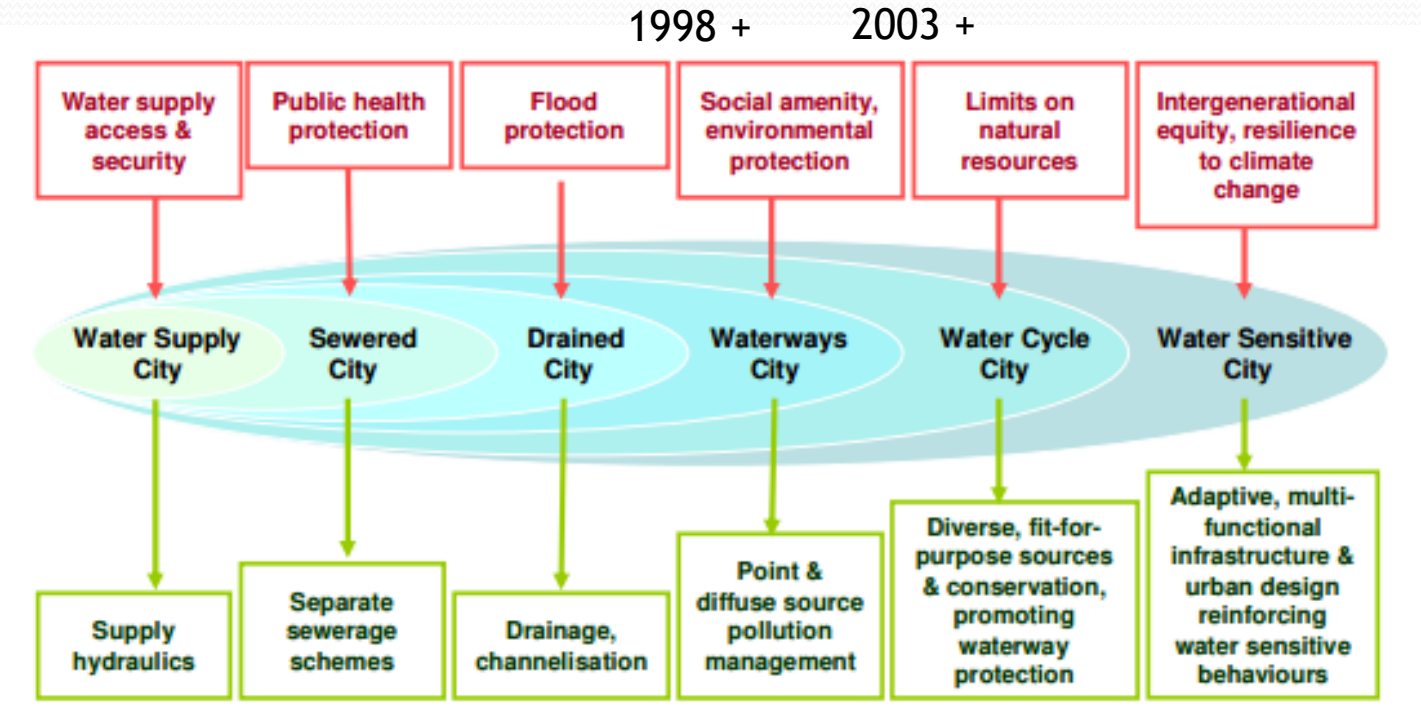

Image courtesy: Brown, Keath and Wong, 2009

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2003 Stage 4 Grant

- Kiama Catchment Caretakers
- Structural & non structural
- Structural components:
  - Gross pollutant trapping strategy → LCA
  - Design & construction of filter
  - Design and Construction of reuse

- “Doomed to failure” but got funding
- Time for humble pie EPA!

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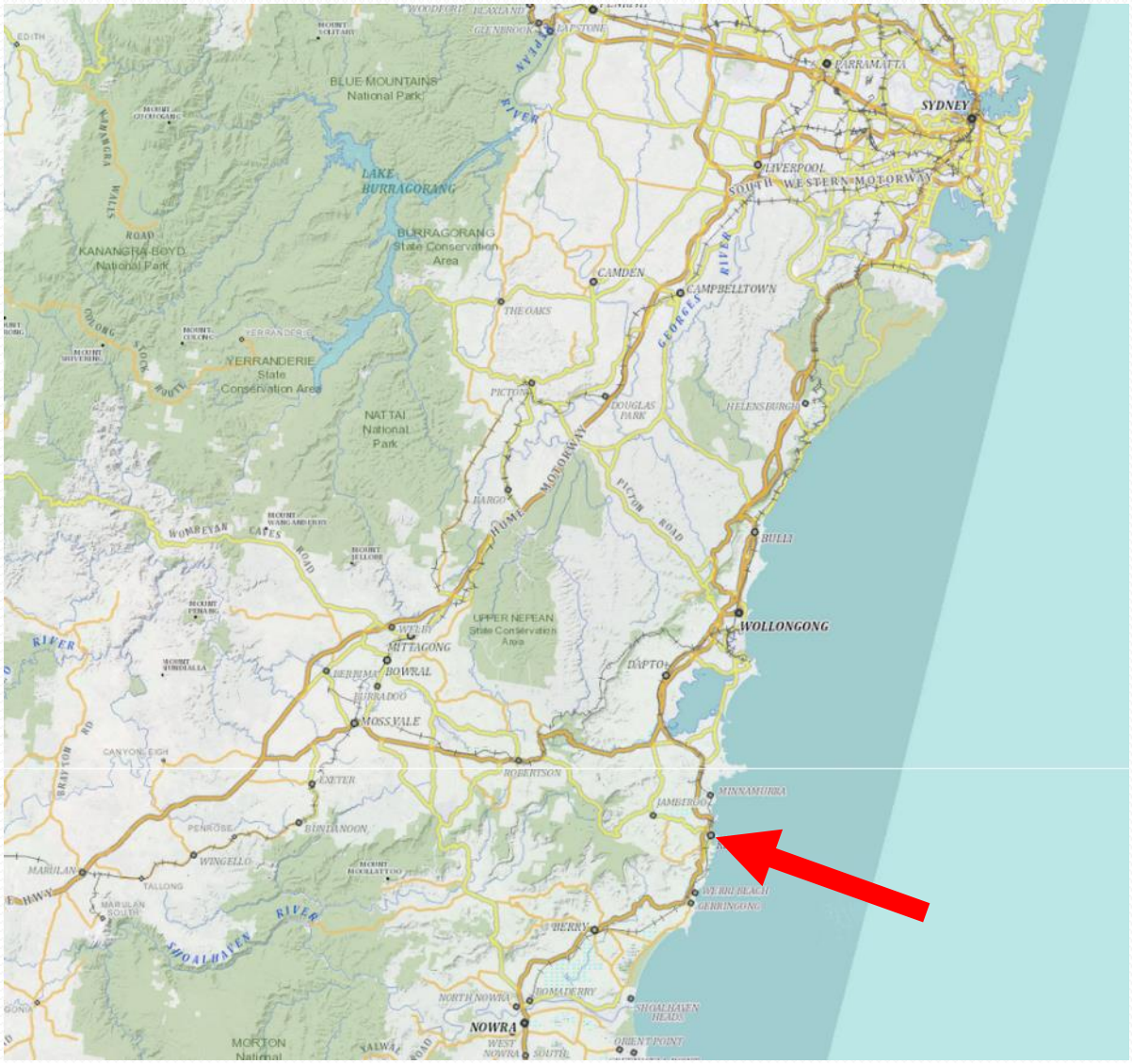

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10 ha catchment
Incl 2 ha of park

Gross Pollutant Mgmt

Versus

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Table 1: Life Cycle Costing for gross pollutant trapping options in Kiama CBD

	Devices	No.	Unit supply & installation cost ($)	Capital Cost ($)	Maintenance events / device / annum	Cost per maintenance event ($)	Annual maintenance cost ($)	10 year replacement cost	Maintenance PV (5% discount rate)	Total Life cost
OPTION 1										
Subcatchment 1	CDS large	1	80000	80000	4	875	3500			
Subcatchment 2	CDS small	1	60000	60000	3	600	1800			
Subcatchment 3 - Terralong St	Enviropod	4	680	2720	3	20	240			
Subcatchment 4	Enviropod	2	680	1360	3	20	120			
Total				**$144,080**			5660	**0**	**$103,329**	**$247,409**
OPTION 2										
Subcatchment 1	CDS large	1	80000	80000	4	875	3500			
Subcatchment 2	Enviropod	26	640	16640	3	25	1950			
Subcatchment 3 - Terralong St	Enviropod	4	640	2560	3	25	300	240		
Subcatchment 4	Enviropod	2	640	1280	3	25	150	120		
Total				**$100,480**			5900	**360**	**$108,987**	**$209,467**
OPTION 3										
Subcatchment 1	Enviropod	79	550	43450	2	25	3950	4740		
Subcatchment 2	Enviropod	26	550	14300	3	25	1950	1560		
Subcatchment 3 - Terralong St	Enviropod	4	550	2200	3	25	300	240		
Subcatchment 4	Enviropod	2	550	1100	3	25	150	120		
Total				**$61,050**			6350	**6660**	**$139,541**	**$200,591**

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10 year GPT Strategy review

- Council happy with outcome
- Early 200 micron bags → 1600 micron bags
- Maintained by hand - lighter easier maintenance
- Early on cigarettes and fireworks burnt some bags
- Both Enviropod and Ecosol RSF100s in place and both perform well
- Maintenance guys winge
- CDS unit better??

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Sand Filter - revisited

- Sand filter or bioretention system?
- Plastic lined
- Coarse river sand
- Non woven geofabric

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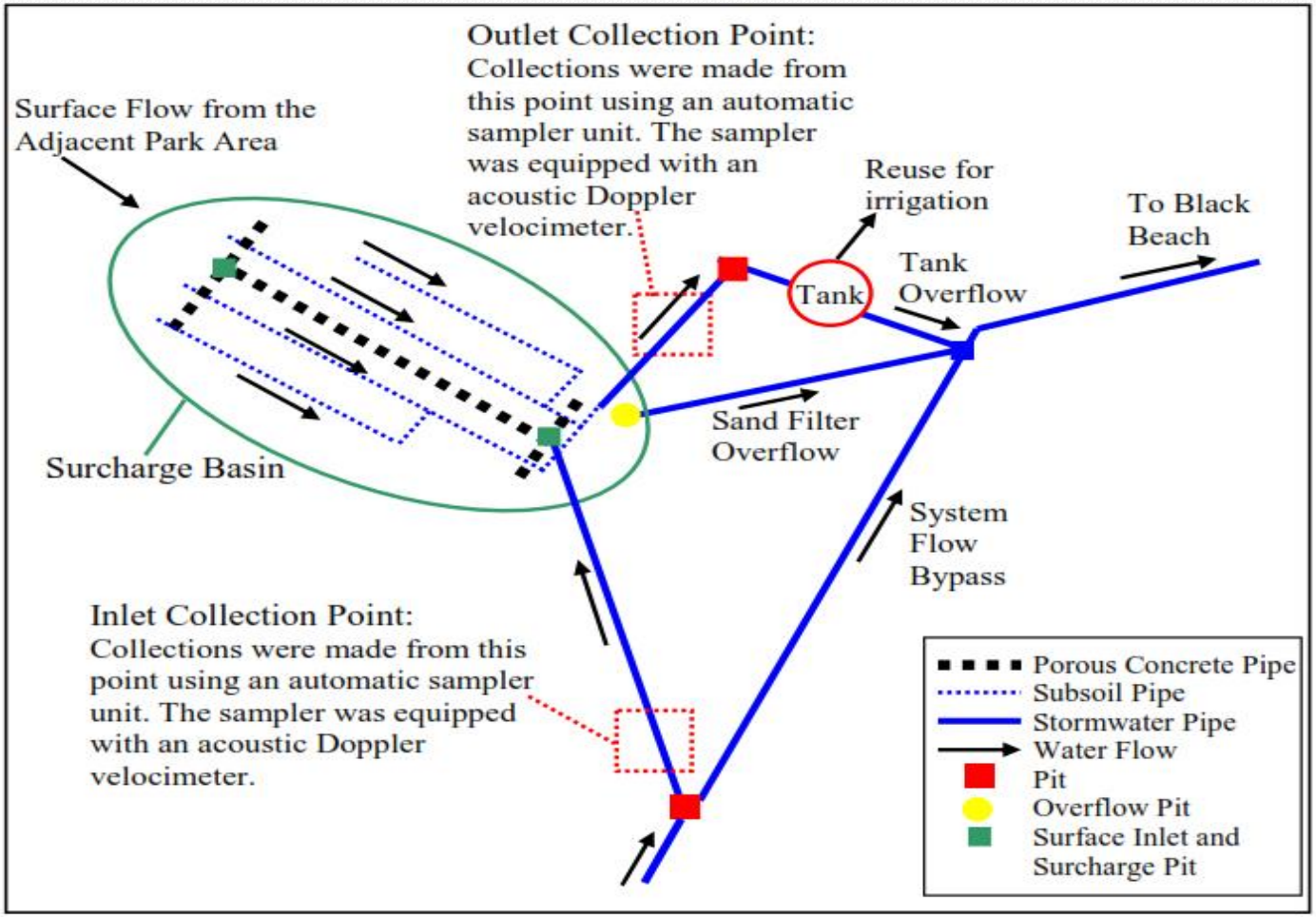
R & D Collaborative Grant



- Composite samples

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Monitoring Results - TSS

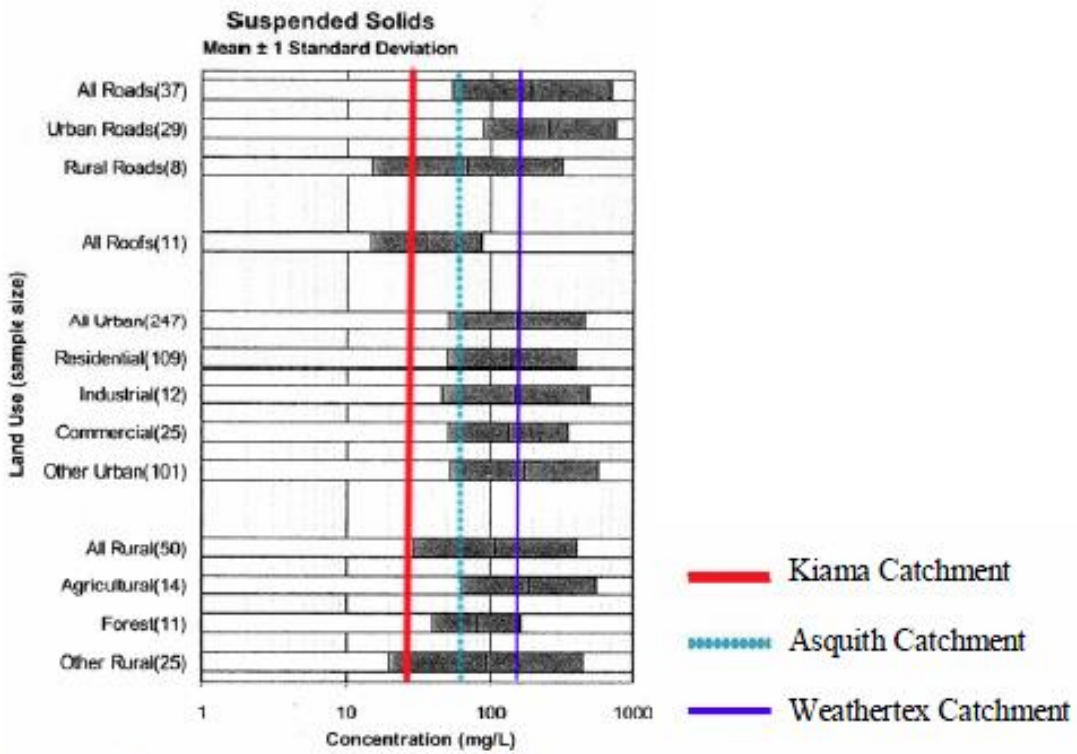

Figure 5-21 – Average Suspended Solids Concentration of Stormwater from the Current Study Catchments Compared With Other Studies (adapted from Duncan, 2005)

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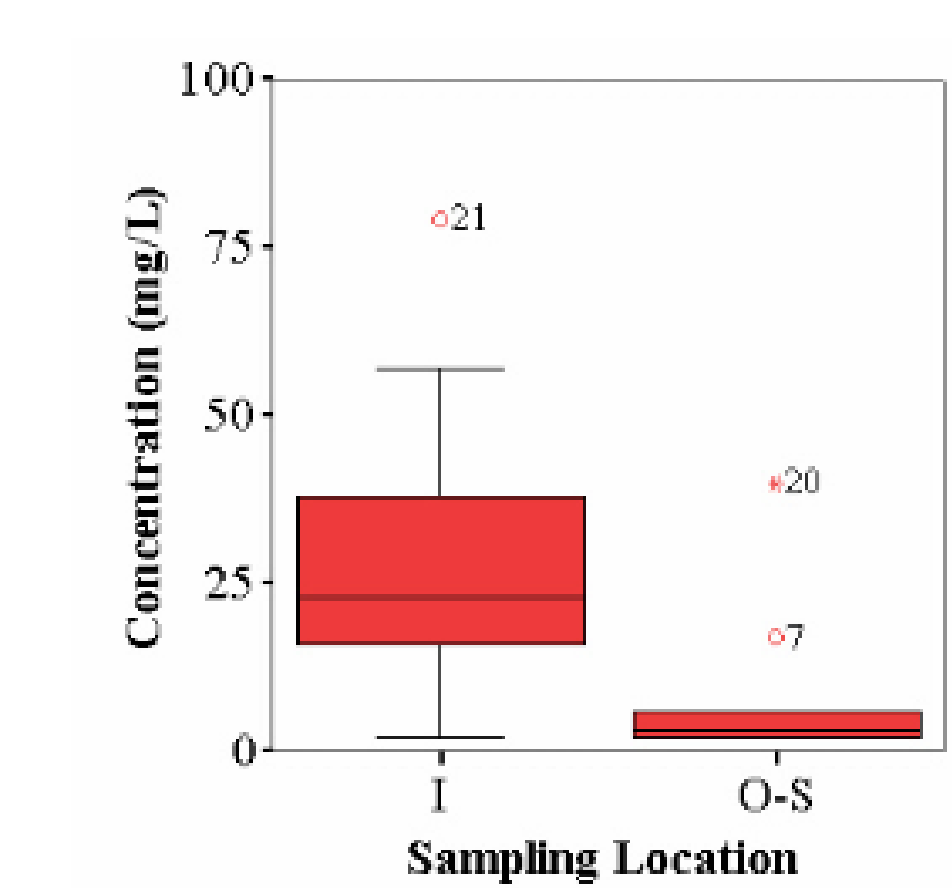
Monitoring Results - TSS



- TSS ↓ 75%
- Starting TSS affected by litter baskets
- Including baskets + filter – total TSS reduction would exceed 85%

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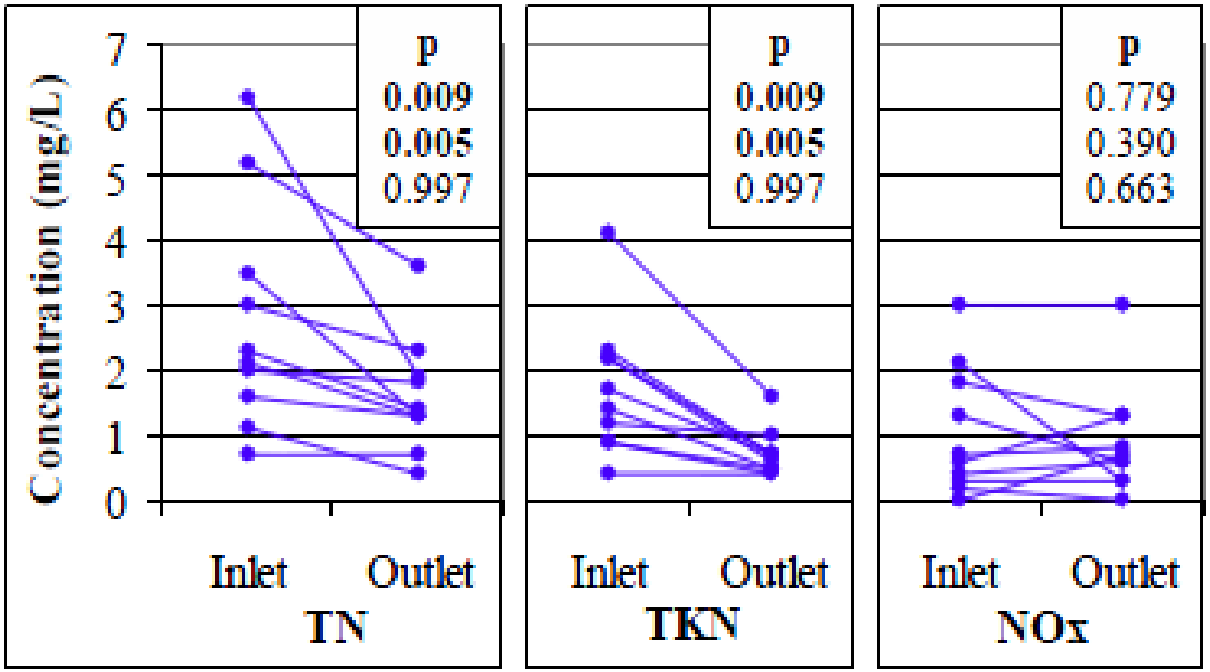
Monitoring Results - TN



- 40% TN ↓
- 70% is TKN
- 30% NOx
- 55% TKN removed
- 11% ↑ NOx

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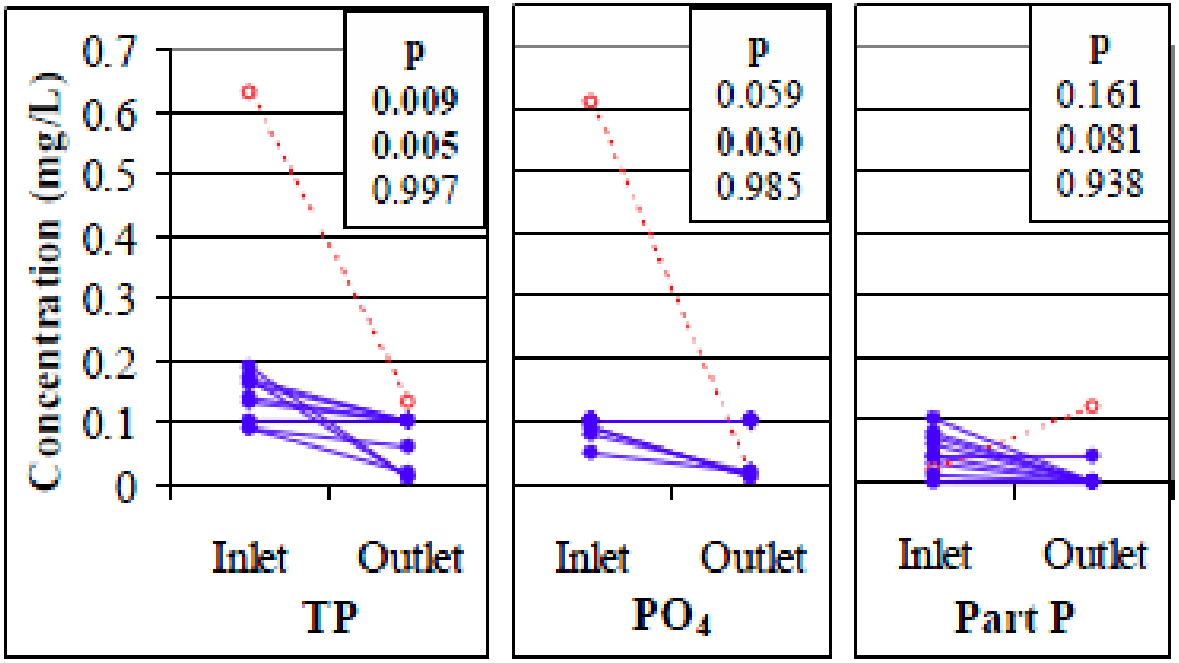
Monitoring Results - TP



- TP ↓ 65%
- 65% of TP = PO_4
- PO_4 ↓ 50%
- Part P ↓ 85%
- HydroCon pipes designed for TP removal

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Summary Performance

- TSS in excess of 85%
- TP 65%
- TN of filter 40%
- TN removal in litter baskets unknown – perhaps 17%.
- Best Practice clearly demonstrated
- Filter footprint = 0.75% of catchment (excluding 2 Ha of pervious parkland).

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Sand Filter Site Investigations

- Filter inspected in Nov 2005 & July 2014
- 2005 investigation:
  - Triggered by no outflow during sampling
  - Excavated test hole to geofabric layer
  - Used hydrant (3l/s) to wet filter to saturation & o/flow
  - Tested porosity of geofabric
  - Reuse system not yet operational
- 2014 Investigation:
  - Excavated test hole to geofabric
  - Collected samples – testing of PSD by UTS planned
  - Reuse system operational for 7 years

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2005 Investigation

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Porosity of geofabric

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Condition of HydroCon pipe

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2005 Conclusion

- Geofabric not at all blocked despite biofilm growth
- During spring – rooting depth of grass was down to bottom of media surrounding HydroCon pipe and significant (density) elsewhere.
- Some caking of fines on pipe wall
- Use of hydrant – peak flow of 3 L/s easily accommodated in pipes without surcharge – beyond this not sure of capacity.
- Water ponded in base of filter together with prolonged delay to the onset of outflow indicated unplanned reservoirs formed in the base of the filter.
- No clogging evident, excellent surface hydraulic conductivity evident.

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2014 Investigation

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2014 Investigation

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2014 - continued

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2014 - continued

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FreightCorp

Conclusions - 2014

- Despite poor maintenance bioretention system in excellent condition
- Working to trap significant quantities of sediment
- Can't comment on other parameters
- Filter media & geofabric remains highly permeable – harvesting water routinely in summer – must be working no need to test.
- Unfortunately Council not tested or metred harvested water.
- Council very happy with system

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Grassy Vs vegetated

- Maintainability
  - Can you easily remove sediment
  - Can you easily maintain vegetation
  - Can you mow it? Council's can mow, Council's maintenance crew can't maintain vegetation well
  - Trained staff/capacity
- Affordability
  - $5-$10/m^2 vegetated (Ponds NSW)
  - $2.50/$m^2$ grassy (Eduction every 2 years - $3k/event)
- Livability
  - Sterilise open space
  - Landscape amenity

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Grassy Vs vegetated

- Affordability Continued:
- At 20 dwellings/Ha – stormwater levy - raise $600/annum.
- At 50 dwellings/Ha → $1,500 in levies
- Vegetated system = 1.5% = 150m^2/Ha
- Maintenance cost = $750 - $1,500/Ha/annum
- Grass system = 0.75% = 75m^2/Ha
- Grassy system maintenance cost = $187.50/Ha/Annum
- Grassy system are 1/8 to ¼ of cost to maintain

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Grassy Vs vegetated

- Renewal Costs
- Vegetated system - 10 year replacement of top 100mm layer & all vegetation
- Not required with HydroCon pipe
- Will eventually need to replace HydroCon pipe – about 25 yrs

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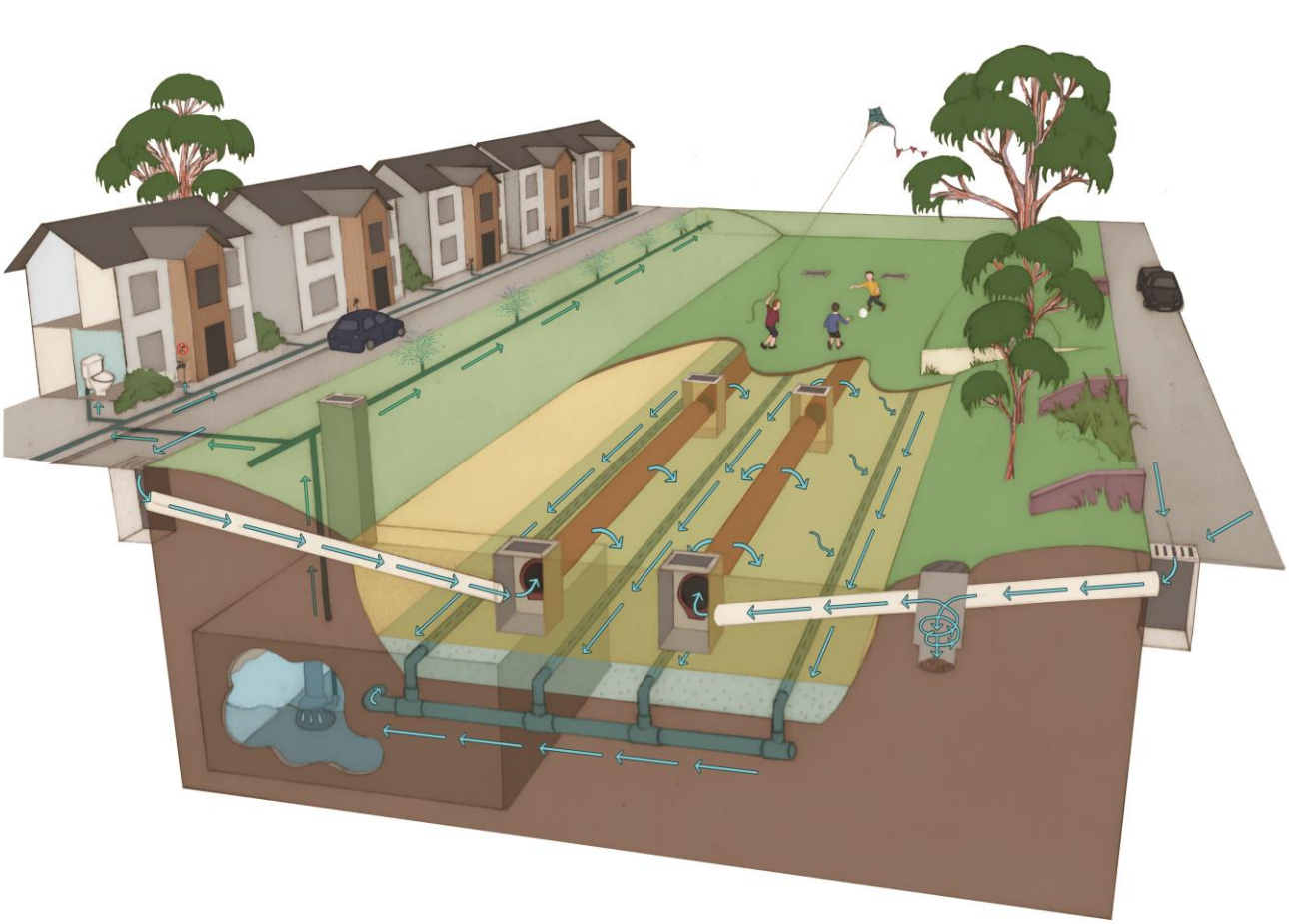
Livability – open space or private space



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Lyne Park

Conclusions

- Grassy bioretention systems perform well and with good design can achieve best practice
- Geofabrics can be used in bioretention systems with the right filter media.
- As close to a maintenance free system as we are ever likely to get.
- Councils are good at maintaining grass
- Can take the punishment of Council budgets being 1/8 to ¼ of cost to maintain cf vegetated bioretention.
- The create livable open spaces where they do not sterilise and privatise the limited open space.

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Footy on a
bioretention system
– yes you can!