Case study – Catch it, keep it, use it: Burnside City Council's B-Pod stormwater retention cells

This is one of a series of case studies aimed at demonstrating the range of WSUD solutions being applied by practitioners in SA

Union Street, Dulwich (Photos: S Tideman (bottom left), Water Sensitive SA)

About the site

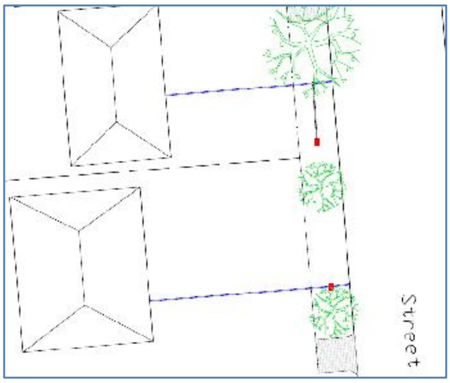
Organisation
City of Burnside

Development type
Subsurface stormwater retention cells

WSUD feature type
Subsurface stormwater retention cells

Cost
$500/B-Pod when installed as part of kerb and gutter asset renewal

Date completed
Ongoing as part of kerb and gutter asset renewal



Typical B-Pod layout along a street

Current model installation[1]

Project planning & design

In 2008, as part of Council's commitment to water sensitive urban design (WSUD), the City of Burnside began installation of a small-scale, subsurface retention systems for capturing stormwater. These systems were designed to deliver water to soil and young trees via infiltration, and to reduce the speed and peak volumes of stormwater flowing to urban creeks.

More than 200 B-Pods have been installed in many streets within City of Burnside since 2013, including:

- Union and Tudor Streets, Dulwich
- Hauteville Terrace Eastwood
- Laurel Avenue, Linden Park
- Treloar Avenue, Kensington Park
- Cuthero Terrace, Ellerslie Street and Brigalow Avenue Kensington Gardens
- Allinga Avenue, Glenunga

City of Burnside's experience shows that B-Pods are best installed:

- in conjunction with kerb renewal – combining excavation and household stormwater (discharge) pipe (HSWP) work
- in wide verges on existing streets – easing work around utilities
- with a lip on the kerb side to keep out silt
- near young street trees – which benefit most from extra water for establishment and are the only ones that Council irrigates, leaving the mature trees to find their own source of underground water.

WSUD features & design criteria

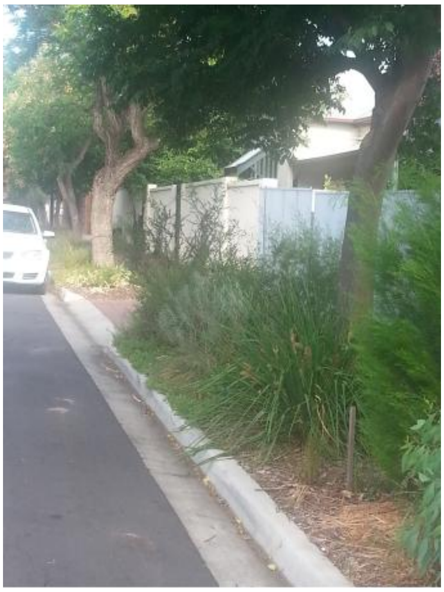
The first model infiltration retention system consisted of a vertical pipe surrounded by "pea gravel" that collected water from the kerb via a 30-50mm diameter pipe. Unfortunately, the inlet pipes were clogged with silt within two years. The second trial introduced the plastic crate system that enabled several "pods" to be linked and refilled during summer by water tanker – but they were too expensive.

The current design consists of a 105 litre plastic crate (AusDrain EnviroModule2 Infiltration Tank, designed 2010) wrapped in geofabric and surrounded by gravel screenings. It collects water directly from the adjacent household roof runoff, which is cleaner. Now nicknamed "B-Pods", these subsurface water cells connect directly to the HSWP) and once filled, discharge via pipes to the kerb and gutter, sometimes with a lateral pipe to enable the B-Pod to be located into the best spot. They are cheaper and easier to install than the first two models and have an inspection plate on the top for inspection and cleaning.

Development type
Urban streetscape
WSUD feature type(s)
Passive infiltration via subsurface stormwater retention cells
No. of WSUD features
More than 200 since 2013
Total volume of stormwater storage
1.77 ML p.a. based on 200 B-Pods capturing 108L on 82 rain days = 8,856L/B-Pod/year
Total impervious area of contributing catchment
18,462m^2
Percentage reduction in Union Street catchment (3.4Ha)

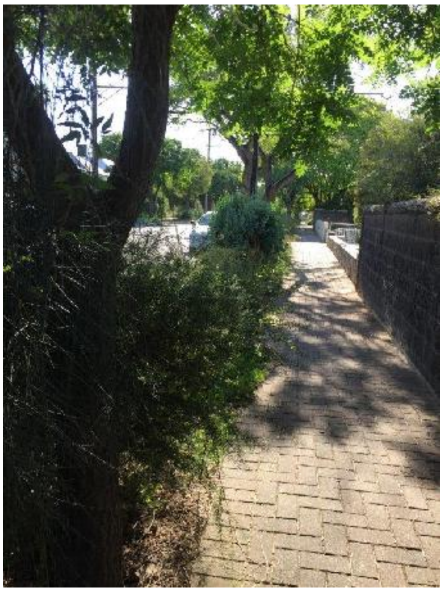
- **Total annual runoff = 1%**
- 1 year ARI peak flows = 2.7%
- 1 year ARI peak runoff volumes = 6.9%

when roof runoff from 38 out of 46 homes is diverted to B-Pods (Goyder Institute for Water Research)



Union Street, Dulwich

Laurel Avenue, Linden Park[1]



Union Street Dulwich[2]

Challenges & learnings

- The initial design, fed from the kerb and gutter, was subject to clogging as the inlet had no sediment barrier. Direct harvesting from HSWP with the current B-Pods is much better due to higher water quality.
- Current B-Pods take more time to fill with supplementary water, when needed, because they are not linked like the first two models were, which may add to labour costs.
- A relatively small volume of water (c.100-200L) is captured by each B-pod, typically representing around the first seven minutes of each rainfall event.
- Compliance with design specifications, and therefore effective pod volume, varies due to contractors over excavating and increasing surrounding volume of gravel fill in order to facilitate construction.
- Larger volume B-pods do little to improve runoff capture rates in the restrictive clay soils.
- Infiltration rates and runoff volume reductions vary greatly depending on subsoil composition, i.e. 1%, 8% and 18% reduction in runoff volumes in clay, sandy clay and sand respectively for the standard volume B-pods (Myers et. al. 2014).
- Construction cost varies depending on ability to combine with kerb and gutter replacement works and the contractor's experience in B-pod installation.
- While the home owner is generally legally required to maintain stormwater infrastructure from the dwelling to the kerb, Council maintains the B-Pod assets.

Photo sources: 1. City of Burnside; 2. S.Tideman

Streetscape health benefits

The main purpose of the B-Pods is to water street trees, with reduction of stormwater peak flows a secondary benefit. Street trees provide enhanced aesthetics, psychological benefits, cooler streetscapes due to shading and evapotranspiration, and can improve water quality by treating stormwater before it enters local waterways (Ely 2008). Street trees also help to mitigate some of the effects of urbanisation on the natural water cycle by:

- Drawing water out of the soil and releasing it into the atmosphere through open leaf pores (transpiration), when actively growing.
- Capturing rainfall in their canopies that would otherwise run-off as stormwater, noting that the volume captured increases as the tree canopy grows.
- Growing extensive root networks that facilitate infiltration in otherwise compacted soil, which helps to recharge groundwater if water passes the root zone.

B-Pods are likely to assist this process by increasing the volumes of water infiltrating into the soil and recharging the groundwater, which the mature trees are likely to access during periods of low rainfall. The B-Pod interception of the first flows mimics pre-development soakage patterns. Where hard surfaces cover more than 90% of the surface area, infiltration of water around street trees may be the only opportunity to direct water into the soil profile and recharge aquifers. B-Pods also greatly benefit establishment and survival of young trees by reducing water stress and can provide water to other plants on the verge.

The relative contribution of B-Pods to tree water use and the water balance may be greater during drought periods or in drier catchments where mature street trees need more supplementary watering than required under the Burnside City climate and soil types.

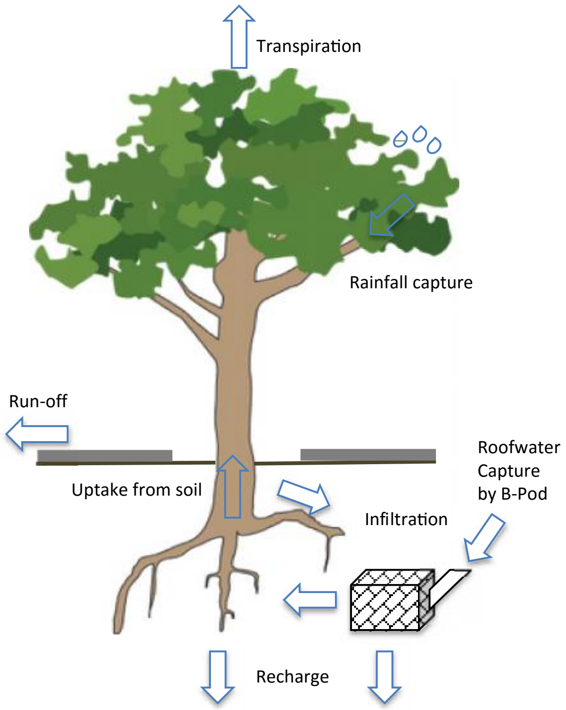


Figure 1: Street tree water cycle showing roof water capture and enhanced infiltration and recharge by the B-Pod.

Tree illustration based on generic tree by Dieter Tracey on IAN Image Library http://ian.umces.edu/imagelibrary

Community engagement

A community driven streetscape revitalisation project has gone from strength to strength since the installation of the B-Pod infiltration systems in Union Street, Dulwich. A group of both avid and novice gardeners have been regularly taking to the streets of this inner suburb of Adelaide since 2012, adding colour, texture and shade to the landscape, predominantly through the addition of waterwise native species in the road verge. Soon after this community planting project began Council needed to replace the kerb and gutter in the street. The asset renewal project was broadened to include the installation of B-Pods in conjunction with the new kerb and gutter.

Peppermint gums and she-oak trees planted by the community, are now thriving in amongst the original scattered street trees, thanks in part, to their proximity to the sub-surface water source provided by the B-Pods. Espalier vines are one of the more novel additions to the streetscape.

The significant tree growth observed by the community is also credited for providing shade to the understorey grasses and groundcover plantings, aiding their establishment and ongoing survival. While the water provided to the infiltration systems in the street verge support the plantings, supplementary watering over summer months has been essential during the establishment phase.

The renewed streetscape has created a unique, shaded environment that provides a place for local residents to interact, and together with the planting program, has fostered a sense of community

While the residents of Union Street represent a highly engaged community group, since 2013 and over ten streetscale projects, only one resident has not been in favour of the installation of BPods.

Risks & uncertainties

- There is potential for soil moisture change to impact on adjacent fence and house foundations or on road pavement. No footpath cracking or disturbance has been observed or reported by the public around the installed B-Pods.
- The functional lifespan of B-Pods is uncertain. It is likely that the geofabric will be the first point of wear and if that breaks down, then soil will enter the retention cell and block it.
- Cost to benefit ratios are unknown because the costs for maintenance and water savings are not specifically documented.
- Possible impacts on tree roots when installing the B-pods (mitigated by choosing the installation point carefully).
- Operation under a changing climate. The B-Pods are less effective at reducing peak flow rates during higher ARI events according to the Goyder modelling. However, the latest research suggests that there will be less uniform temporal patterns of rain - more intense peak rainfall and weaker precipitation during less intense times - as temperatures increase under climate change (Wasko & Sharma 2015). This may increase the need for stormwater peak flow management.
- B-Pods combined with other passive infiltration devices are an important tool in addressing the imbalance in the urban water cycle due to increasing impervious surface, however they will be limited by the relatively small volumes of water (100-200L) that are captured at each event.
- If installing after stormwater harvesting schemes have been established downstream the reduction in harvestable flows would need to be considered.
- Increase in groundwater recharge is often beneficial for an aquifer however in some circumstances, such as with shallow watertables, increasing recharge can raise levels and cause problems for urban infrastructure and soil salinisation.

Project delivery

Civil design
City of Burnside

Constructed by
City of Burnside

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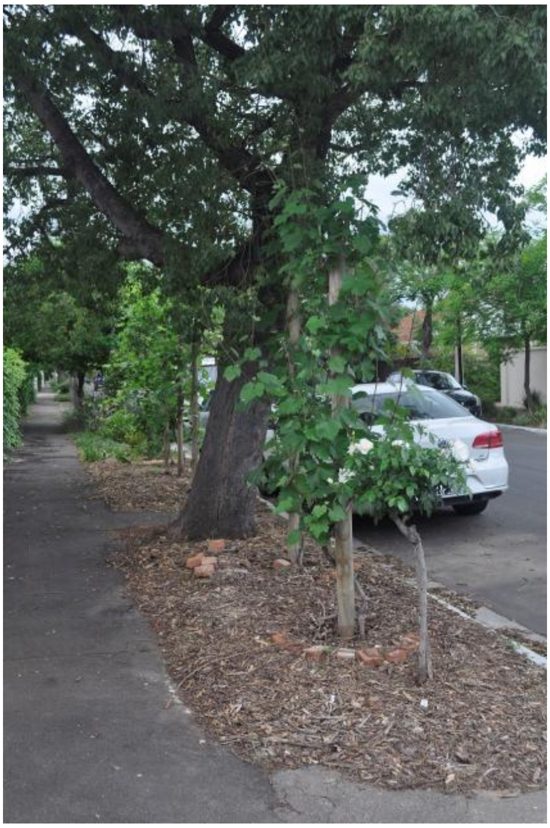
Next steps

- Investigate infiltration rates, tree water use and rates of groundwater recharge with and without B-Pods.
- Monitor young tree health and growth rates during establishment with and without B-Pods.
- Inspect the existing 200 B-Pods and determine a rate of siltation, if observed.
- Determine cost savings due to decreased supplementary watering and increased survival of young street trees.



Union Street, Dulwich, espalier vines in the verge

References

Ely M (2008) Thinking like a tree: Developing a framework for tree sensitive urban design. Discussion paper, School of Architecture, Landscape Architecture and Urban Design, The University of Adelaide. Accessed 27 August 2015.

Myers B, Pezzaniti D, Kemp D, Chavoshi S, Montazeri M, Sharma A, Chacko P, Hewa GA, Tjandraatmadja G & Cook S (2014) Water sensitive urban design Impediments and potential: Contributions to the urban water blueprint (Phase 1) Task 3: The potential role of WSUD in urban service provision, Goyder Institute for Water Research Technical Report Series No. 14/19, Adelaide, South Australia

Wasko C and A Sharma (2015) Steeper temporal distribution of rain intensity at higher temperatures within Australian storms. Nature Geoscience 8, pp. 527–529 (2015) doi:10.1038/ngeo2456