GREEN INFRASTRUCTURE CASE STUDY:

PUBLIC PARK AND PLAZA

DUNSTONE GROVE-LINDE RESERVE, STEPNEY – ST. PETERS CIVIC PLAZA AND AVENUE OF HONOUR

Green infrastructure is a green network - of green spaces, street trees and other vegetation (including wetlands, rain gardens, and green walls and roofs) - strategically planned, designed and managed to support the liveability, sustainability and resilience of an urban area. Green infrastructure is integrated, connected and multifunctional. It is integrated with development and other infrastructure, it links existing and new green assets across the public and private realms, and it provides multiple social, economic and environmental functions. Green infrastructure is essential infrastructure for our cities and towns.

This is one of a suite of case studies demonstrating how various types of green infrastructure were planned, designed and delivered, how they're maintained, and the challenges and lessons along the way.

Innovative design principles underpin the extensive redevelopment of Dunstone Grove-Linde Reserve and St. Peters Civic Plaza-Avenue of Honour in the Adelaide suburbs of Stepney and St. Peters, respectively. The redevelopment integrates Dunstone Grove-Linde Reserve, St. Peters Civic Plaza and the Avenue of Honour, while creating attractive multi-functional green public open spaces for the community.

Dunstone Grove and Linde Reserve have been transformed from predominantly open lawned areas separated by a concrete channel (i.e. Second Creek) into an integrated green oasis complete with naturalised channel, native understorey plantings, biofiltration beds and Managed Aquifer Recharge (MAR). Meanwhile St. Peters Plaza and the Avenue of Honour has been enhanced with an attractive mix of drought tolerant, local native and exotic species, bio-swale, and raingardens to retain and improve the quality of stormwater entering the St. Peters Billabong and River Torrens to the north-west. A network of shared paths links the spaces - and to the River Torrens Linear Park beyond. Vegetation that is not otherwise passively irrigated by stormwater captured in the swales and raingardens, is actively irrigated with water from the MAR, which also provides irrigation water for other open spaces in the area. Further work is planned to complete the green network including complementary landscaping of Otto Park, refurbished footpaths, gutters and median strips, and more low water use, native street trees on hot and dry east-west oriented streets between the river and the Civic Plaza.

ABOUT THIS SITE

ORGANISATION

City of Norwood, Payneham and St Peters

SETTING

Public Park and Plaza

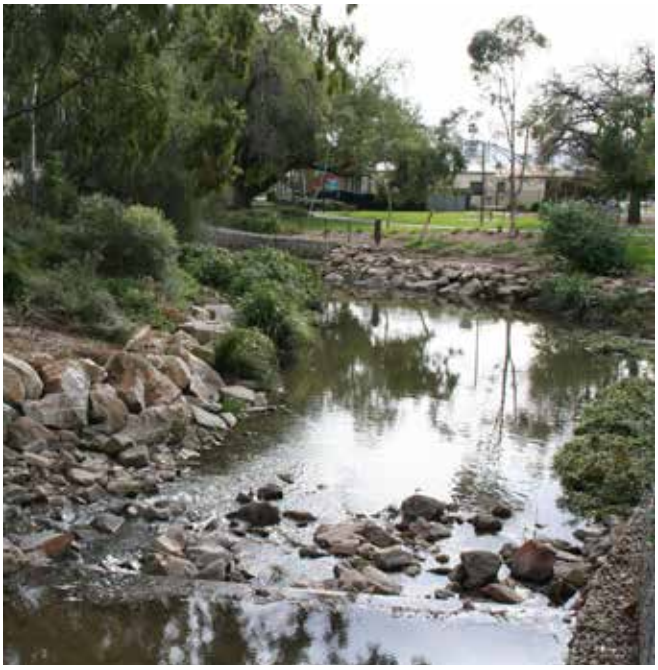
GREEN INFRASTRUCTURE FEATURES

'Naturalisation' of creek

Retention of significant trees plus indigenous understorey plantings Recreation areas, including open grassed area, picnic and BBQ areas and play spaces. Community garden, Biofiltration beds, Street trees, bio-swales and rain gardens.

COST

$7.1 million



[1]*Managed Aquifer Recharge is when water is intentionally placed and stored in an aquifer for later human use or to benefit the environment*

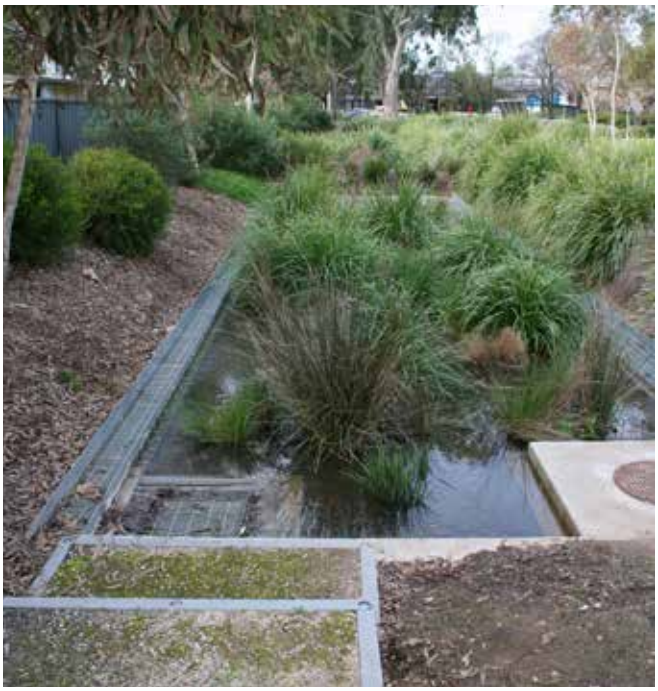
DUNSTONE GROVE-LINDE RESERVE

Dunstone Grove-Linde Reserve is bound by Nelson Street to the east, Payneham Road to the north, Stepney Street to the west and Henry Street to the south. It is adjacent to the Agnes Goode Kindergarten, St. Peters Child Care Centre, Avenues Shopping Centre and St Peters Town Hall Complex, and surrounded by a mix of community, commercial, light industry, institutional (Catholic Church) and residential uses. Straddling Second Creek, with Dunstone Grove located on the eastern side and Linde Reserve on the western side (see map), the extensive open space was gradually acquired over a period of 70 years. The western side, previously owned by Haken Linde, was gifted to the Council in 1913 and was supplemented with land purchases in 1920 and 1957. Council acquired the land surrounding Second Creek, including the former Scout Hall, in 1936 and the section to Payneham Road in 1945. The remainder of the properties fronting Nelson Road and Stepney Street were gradually acquired from 1965 until 1980. This ad hoc acquisition meant there were poor connections between the various elements that limited public use. The removal of the St. Peters Bowling Club (now the community garden) visually and functionally opened up the area and provided opportunities to create an open space reserve.

A Master Plan was developed for Dunstone Grove-Linde Reserve in 2010 with the vision of: "*an inviting, sustainable place that respects the natural environment and is attractive to a broad range of users for rest, recreation and rejuvenation.*" The space was extensively re-developed and re-opened to the community in 2011. Second Creek, a tributary of the River Torrens, was transformed from a concrete channel to a more natural meandering waterway. The cottages, gates, stone weir walls, and significant trees were retained and enhanced with understorey plantings, rain gardens, biofiltration beds (and MAR), a community garden, and BBQ, picnic and play spaces. Shared paths and bridges connect the spaces together, and to the adjacent St. Peters Civic Plaza and the River Torrens Linear Park.

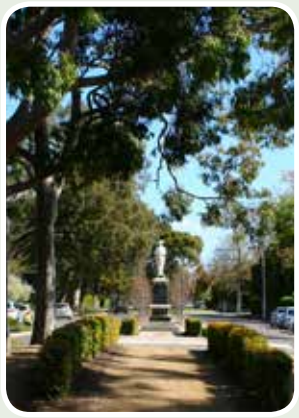
GREEN INFRASTRUCTURE FEATURES:

- naturalisation' of concrete channel (Second Creek) by laying back the channel, creating meanders and using natural-looking edge treatments including etched and painted walls, gabions, rocks and grassed terraces and lining the channel with a rock mattress
- retention of significant native and European trees and introduction of a common pallet of native understorey species of local provenance where appropriate, that provide textural appeal and year-round colour, as well as habitat
- open grassed area, picnic and BBQ areas that can be used for festivals and outdoor fitness classes or quiet reflection, as well as providing play spaces with special provision for toddlers and young children
- cycling and walking paths within the reserve - connecting to adjacent shopping and community spaces, as well as the St Peters Billabong and the River Torrens Linear Park *Karrawirri Parri*), and incorporating a bridge over Second Creek with dual rails to enable cyclists to pass safely
- raingardens adjacent the Nelson Street carpark and biofiltration beds in the north western corner that clean stormwater for on-site MAR and provide a 'backdrop' landscape feature
- a community garden on the old St Peters Bowling Club site
- use of see-through fencing for the adjacent kindergarten, child care centre and houses that allows adjacent private open space to be 'borrowed'.



The City of Norwood Payneham and St Peters have installed compact on-site Managed Aquifer Recharge and rain gardens at Dunstone Grove-Linde Reserve to harvest and reuse stormwater whilst retaining large, flexible open space and enhancing green connections along a naturalized Second Creek to the St Peters Civic Plaza and the River Torrens.

River Torrens



St Peters
Billabong

St Peters St.
Avenue of Honour

St Peters
Plaza

Dunstone Grove

Linde Reserve

Second Creek

Map of Dunstone Grove-Linde Reserve – St Peters Civic Plaza & Avenue of Honour, Stepney

LANDSCAPING

As part of the redevelopment numerous large exotic and native trees were retained to provide shade and a 'natural' feel to the spaces. Tree species include River Red Gum (*Eucalyptus camaldulensis*)), Spotted Gum (*Corymbia maculate*), English Elm (*Ulmus procera*), Ash (*Fraxinus* sp.), Poplar (*Populus* sp.), Lemon-scented Gum (*Corymbia citriodora*) and Peppertree (*Schinus areria*).

The redevelopment aimed to integrate the plantings across Dunstone Grove and Linde Reserve to give the sense of a single park. The existing tree cover was enhanced with an understorey layer promoting urban biodiversity, particularly through the use of low-growing native species rarely found within small reserve areas. The design criteria were texture and year-round colour (achieved with shrubs such as *Grevillea*, bottlebrush, *Eremophila* and *Westringia*). Additionally, a number of trees were planted along the edge of the naturalised channel, car parks and play spaces to provide more shade and enhance the aesthetics.

SECOND CREEK NATURALISATION

As part of the redevelopment, the concrete channel (i.e. Second Creek) that traverses the reserve was replaced with rocky banks and pools that create a softer, more natural creek system, as well as providing a point to harvest stormwater for the MAR scheme. The retention of mature shade trees has ensured that the aquatic habitats have patches of sun and shade, which increase habitat complexity and productivity as well as maintaining cooler water temperatures in summer. Diverse and dense understorey plantings encourage use of the water by birds and reptiles.

STORMWATER HARVESTING AND RE-USE

Two compact biofiltration beds (~115 m2) were installed along the edge of Linde Reserve to clean stormwater for on-site MAR. Recycled stormwater is used to irrigate the reserve and other Council parks and gardens in the area. This reduces reliance on potable water for irrigation and enables public open space to be kept green during dry periods. The two beds contain native plants such as mat rush (Lomandra longifolia), knobby club rush (Ficinia nodosa) and rushes (Juncus sp.). The varying soil profiles, leaf litter and the daily cycling of wet and dry cycles promotes a variety of microbes to remove pollutants and organic matter from the stormwater harvested from Second Creek.

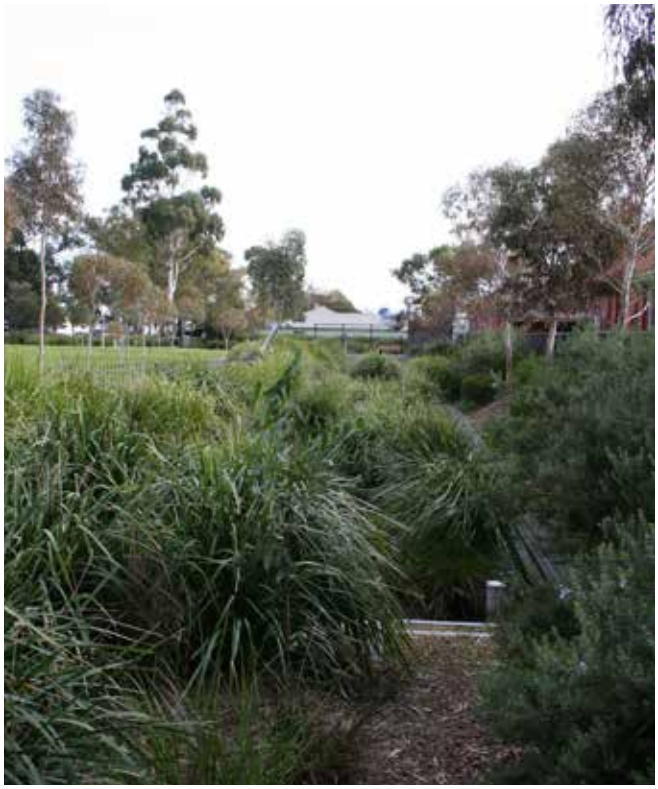
The shallow depth and intermittent water regime also minimises habitats and breeding grounds for mosquitos, and negates the need to fence off the beds for public safety. The beds provide a 'natural' and unobtrusive backdrop to the large kick-around grassed areas and the path that links the Stepney Street carpark to the restored Nelson Street Cottages.

It is estimated that only 2% of the total annual flow of Second Creek is harvested, thus having minimal impact on environmental flows while effectively reducing mains water use. An interpretative sign in the park explains how the biofiltration beds function as part of the wider stormwater harvesting and reuse scheme.

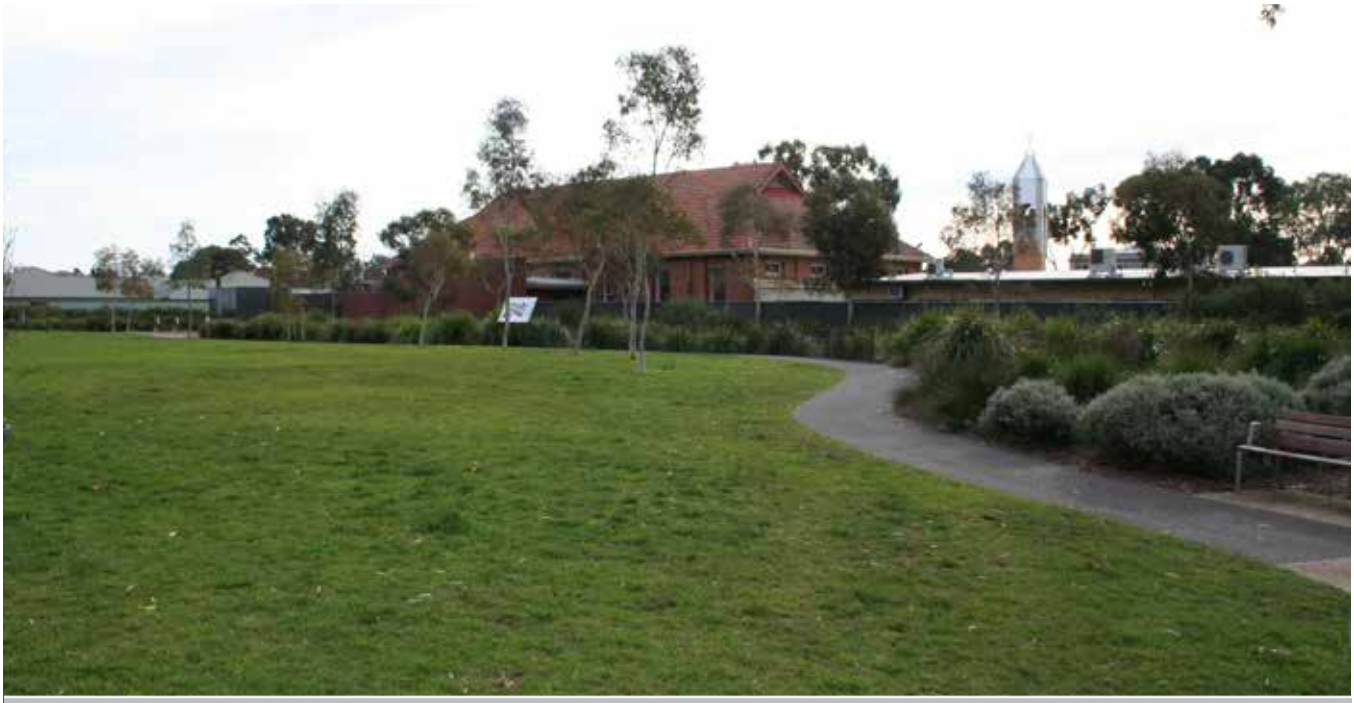
STORMWATER HARVESTING AND REUSE INCL. MAR

- A pool in Second Creek to collect water for harvesting
- Water is pumped through a grilled inlet from this pool into a chamber for testing.
- If suitable for MAR
- (<40 NTU), it is screened twice to remove gross pollutants and fine particles before being pumped to the biofiltration beds
- Daily wet and dry cycles encourage biofiltration by a range of plants and microbes in the beds
- Cleansed water is tested for pH, conductivity, turbidity, temperature and redox potential
- If acceptable, the water is mechanically screened and UV treated before being pumped to 200,000 litre tank under the adjacent basketball court
- EPA compliance limits are <10 NTU, pH 6.5-8.5, salinity <1500 mg/L for injection
- If not acceptable, the water is sent back to the creek
- When full, the tank water is injected into the underlying bedrock aquifer
- The bedrock starts at 90m below ground with fractures at 111m, 132m, 138m & 156m. The total depth of the bore is 168m

For more information on the Stormwater harvesting and reuse scheme, see www.watersensitivesa.com/resources/wsud-projects-title/case-studies-page/.



Roof gardens provide much needed green space in urban environs and good insulation – protecting the building from direct sun and stabilising the building's temperature.



Linde Reserve

RECREATION AREAS

The use of compact biofiltration beds instead of a large constructed wetland to clean the stormwater for MAR has enabled the majority of the reserve to be used as a significant open space with grassed areas for ball games, picnic and BBQ area, play spaces including interactive Matilda's Playground, and winding paths shared by pedestrians and cyclists. The lawned areas are large enough to hold festivals or cater for multiple group activities ensuring that the park is continuously in use.

A basketball court, with specialised play surfaces and other sound dampening design features, sits over the underground MAR storage tank; making good use of the space. Fencing is minimised and opportunities for interaction and exploration of nature are maximised.

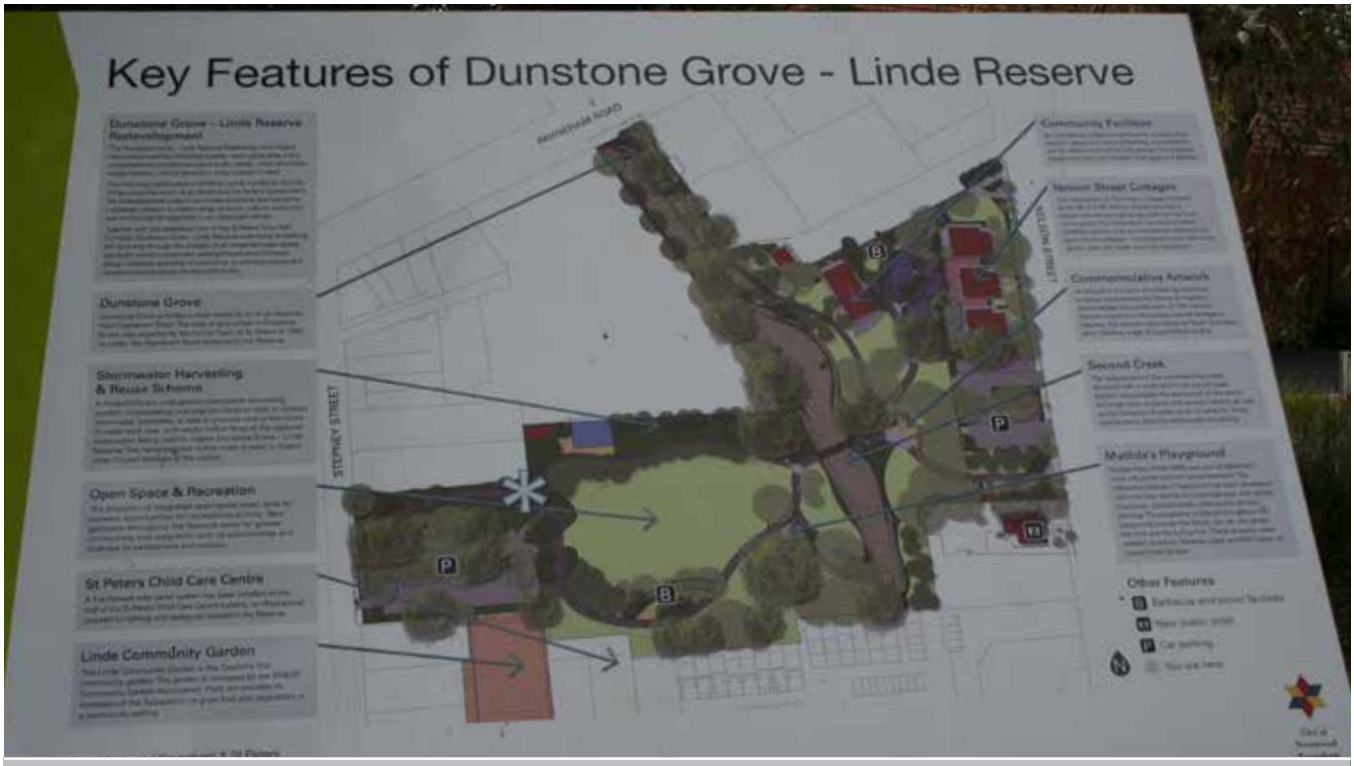
LINDE COMMUNITY GARDEN

The Linde Community Garden is located in the south-western corner of the park, just off Stepney Street, and is managed by the not-for-profit Norwood, Payneham and St. Peters Community Garden Association Inc. The garden provides members the chance to grow their own produce (vegetables, herbs and fruit) and provides a meeting place to share skills and ideas.

Hands-on learning opportunities for members to-date have included composting, building a worm farm, propagating plants from seeds and building a wicking garden which consists of self-watering beds that incorporate a water reservoir and water plants from below rather than above.

The garden is also a model for good environmental practice, demonstrating ways to save water, reduce waste and promote biodiversity. The MAR scheme provides all the irrigation and non-potable water requirements for the Community Garden.

Linde community garden



Interpretative signs at several key points in the reserves and the civic plaza explain the functions of elements such as the biofiltration beds and key features of the reserve as a whole

ST. PETERS CIVIC PLAZA AND AVENUE OF HONOUR

St. Peters Civic Plaza and the Avenue of Honour are key civic spaces for the Norwood, Payneham and St. Peters residents.

In 2014 they were redeveloped to complement and expand on the adjacent refurbished St. Peters Town Hall complex and upgraded Dunstone Grove-Linde Reserve across Payneham Road.

St. Peters Street, adjacent the St. Peters Town Hall, was redesigned to create a pedestrian and cyclist friendly environment, which can be temporarily closed to through traffic to expand the community open space and enable larger community events to occur, whilst providing an important link between Dunstone Grove-Linde Reserve and the River Torrens Linear Park.

The Avenue of Honour was upgraded was to create a dedicated site to serve as a commemoration to all Australian soldiers killed in action.

Low voltage electrical and telephone networks between Payneham Road and the roundabout on the corner of St. Peters Street and First Avenue were undergrounded to maximise the amount of community open space and enhance the visual amenity of St. Peters Street. Some of the existing trees were removed and replaced with new trees and landscaping, including rain gardens, to improve the amenity of the locality and the quality of stormwater discharging to the River Torrens.

Indigenous plants were used, where appropriate, to strengthen the biodiversity corridor from Dunstone Grove-Linde Reserve to the River Torrens Linear Park.

STREET TREE PLANTING

Street tree planting was based on the following principles:

- being appropriate to the scale of the spaces;
- provision of continuity and consistency;
- diversity of species to reinforce identity and promote ecological diversity;
- provision of effective shade cover and attractive forms;
- a mix of evergreen and deciduous trees, as well as native and exotic species; and
- low-water use and low-maintenance requirements.

GREEN INFRASTRUCTURE INCLUDES:

- an attractive mix of drought tolerant, local native and exotic species that create shade, visual interest and habitat and have low long-term maintenance requirements; and
- bio-swales and rain gardens integrated into the streetscape to retain and treat stormwater, in accordance with Water Sensitive Urban Design (WSUD) principles, to improve the quality of stormwater entering the St. Peters Billabong and River Torrens and to passively water the trees, shrubs and grasses in the swales and gardens.

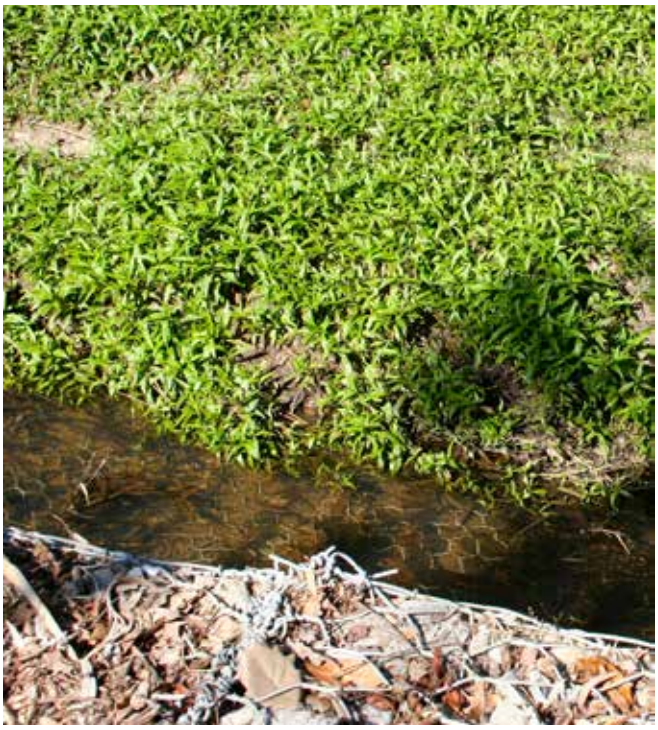
Harvested and cleaned water from the MAR is used to irrigate landscaping in and around the St. Peters Town Hall Complex. A distribution line from the Linde Reserve MAR connects with other reserves within St. Peters

WATER SENSITIVE URBAN DESIGN

The St. Peters Civic Plaza and Avenue of Honour Project integrate WSUD features into the street profile for improved water management. The rain gardens and bio-swales take initial street run-off, with excess water going into the culvert to discharge into the St. Peters Billabong and River Torrens.

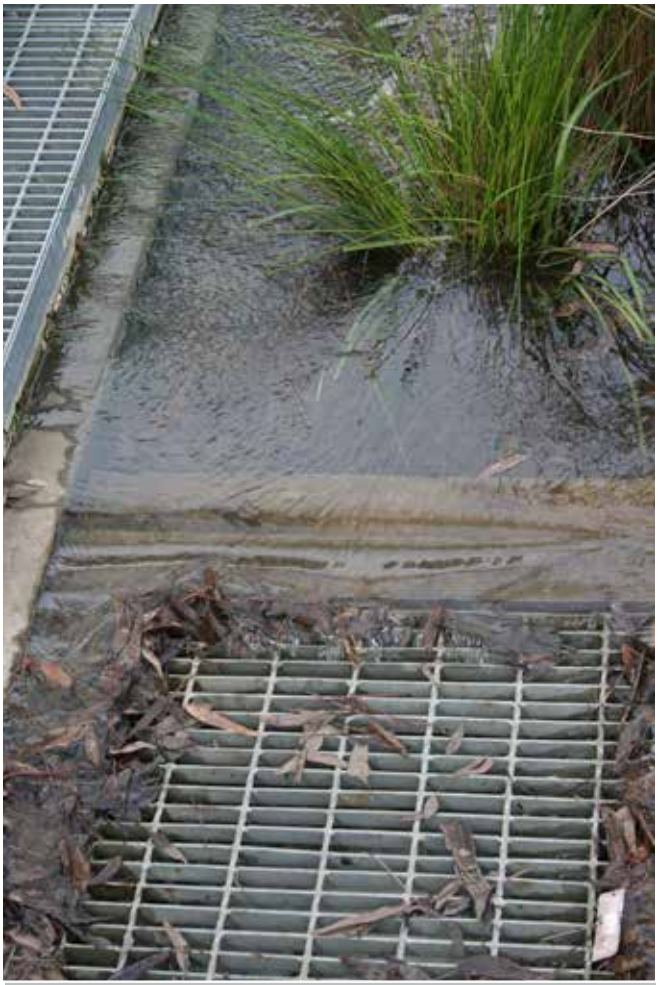
CHALLENGES AND LESSONS (BOTH PROJECTS):

- The sense of connectivity across the site is very important. Simple and attractive entrances complemented by a flexible and open path layout, few fences and strong recognition of the creek are key features that enable the community to use the whole area and interact with green infrastructure elements rather than just simply using open space.
- Retaining mature trees was a design challenge but ensured shade, structure, function and a natural feel of the pace.
- Selecting native plants primarily for their landscape characteristics and secondarily for local provenance that restores remnant vegetation means that the reserves and especially the WSUD features showcase landscaping plants that residents can and will use in their own gardens to increase urban biodiversity.
- Landscaping along the creek sought to soften the banks while still providing lines of sight for safety. A series of three buoys have been installed as first, second and third grab safety devices in case anyone enters the stream during high flows.
- Sediment accumulation on the rock mattress in the channel has enabled colonisation by native aquatic plants (e.g. Slender knot weed, Persicaria decipiens) that provide enhanced aesthetics and habitat. Partial removal or trimming may be required if the channel capacity becomes compromised by excessive growth.

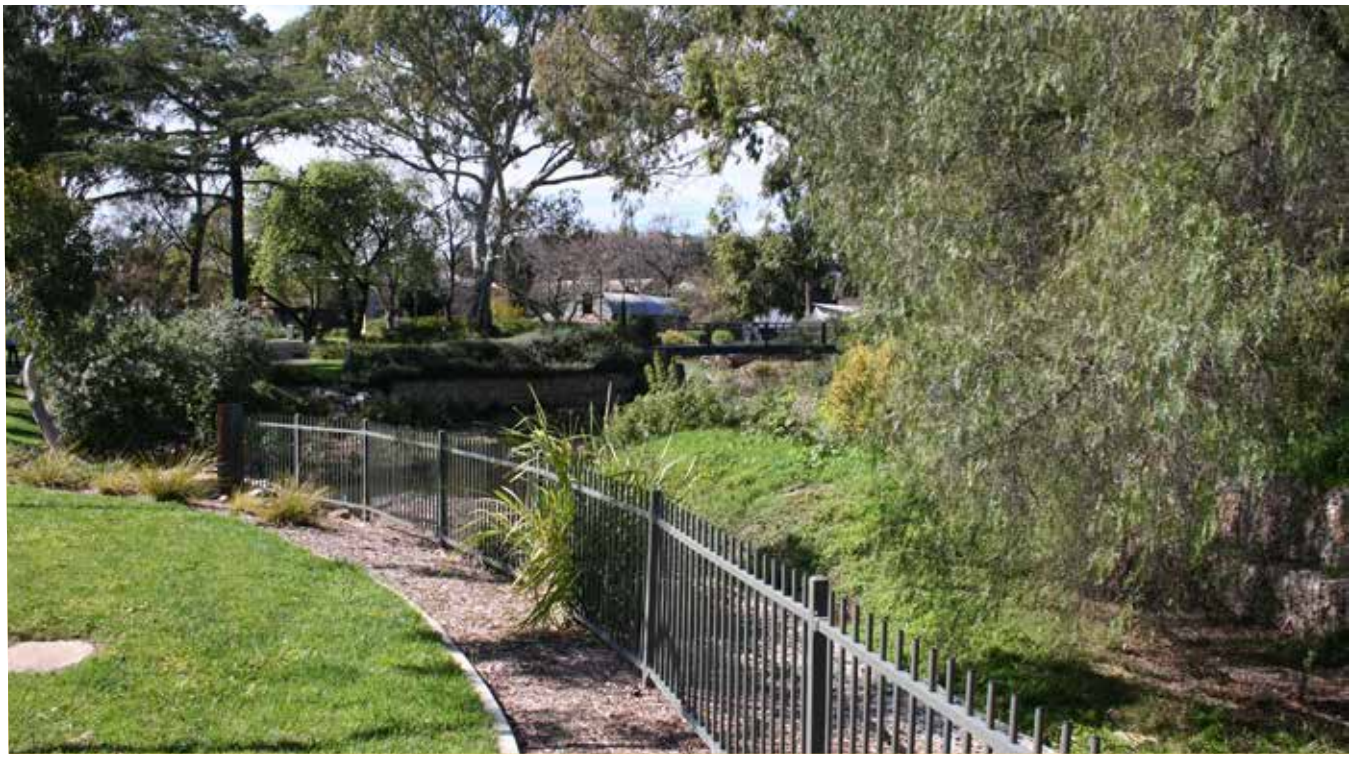


- The use of compact and efficient biofiltration beds along the 'back fence' (instead of a constructed wetland) and placing the basketball court on top of the storage tank has enabled the available space to accommodate MAR and recreation, rather than Council having to choose between those functions.
- Rain gardens collect water runoff from car parks using notches in gutters and hidden collection chambers. The plants are well watered and shade parked cars.
- Sediments entering the system are major impediment that restricts the number of days of MAR that can occur. Turbidity in the creek water tends to be highest in the early part of the season (May), whereas, late winter rains have lower particulates and result in higher injection volumes. High intensity rain in winter that cause erosion can result in shutdown of the MAR for extended periods. Management of sediment needs to occur on a catchment wide scale to enable optimal use of urban MAR schemes.
- While the key limitation to the MAR is turbidity, the reuse of stormwater in the community gardens means that E. coli counts are also important, although to-date the water cleansed by the biofiltration beds has not exceeded the *Environment Protection (Water Quality) Policy 2015* (Water Quality Policy) limits for E. coli or nutrients.
- Only having one bore means that water cannot be injected and extracted at the same time which limits opportunistic summer injection when irrigation water is being extracted. Opportunistic injection is also limited by the turn-around time for water samples to satisfy Water Quality Policy compliance, which means that the recharge mode is switched off from October until the storm water from the first wet season rains can be analysed (typically late April). To date more water has been extracted than injected and cost neutrality has not yet been achieved but it is expected that over the long term the biofiltration beds will achieve both water and cost savings.
- The target stormwater capture volume of 30 ML per year was developed from sustainable yield and aquifer tests involving drilling and aquifer pump tests. Monitoring during operations has shown that the target is achievable and that the aquifer can be re-pressurised each injection season (April to September) after summer extraction in a sustainable manner.

Rain garden



Rain garden



COMMUNITY ENGAGEMENT AND BENEFITS (BOTH PROJECTS)

- Outcomes from interactive workshops with the Reference Group, council officers, building users and students from Norwood Primary School helped shaped the Master Plan in 2010.
- Community access into and through the reserve has been greatly enhanced. The car parks are shady, the banks and bridge over Second Creek bring people to the river and the shared paths facilitate easy movement to the library and other indoor community facilities.
- The layout and landscape features attract a broad range of users and events such as festivals, group fitness classes and fetes. The playgrounds cater for children of all ages and abilities and the integrated open spaces offer many opportunities for recreation.
- Community members are able to grow food, interact each other and learn new skills at the Linde Community Garden.
- The cottages on Nelson Street provide a social networking hub for the local community. Disability access, plumbed rainwater, solar hot water and roof insulation were included in their restoration.
- The sight-lines along the Avenue of Honour on St. Peter Street have been enhanced and it now provides a dedicated place to commemorate all Australian soldiers killed in action.
- Artworks are scattered through the reserve in obvious and hidden spots to invite reflection, exploration and play. Three bronze figures near the Second Creek bridge acknowledge the contribution of 19th Century German migrants to the cultural character of Stepney whilst Matilda's Playground has a fantasy theme with fairies, the cat, the spider, the wolf and the tuning fork sculptures. The water themed art piece outside the St. Peters Civic Centre brings the water theme into this more formal setting.

MONITORING AND MAINTENANCE (BOTH PROJECTS)

Monitoring and maintenance of biofiltration beds and MAR is undertaken by Council's Open Space Team and Australian Groundwater Technologies (AGT). It comprises:

- Occasional raking of the beds
- Occasional removal of plant material to a cover of approximately 50% in order to maintain adequate infiltration rates
- Annual turnover of the biofiltration-beds to reduce plant root mass and maintain permeability.
- General inspection of MAR infrastructure
- Annual major service of MAR infrastructure in May prior to the injection season to ensure UV lights are effective, valves are functional, instruments are calibrated and the data system working.
- Uploading technical data to the Department for Environment, Water and Natural Resources website for licensing purposes
- Monitoring, reporting and maintenance costs for the biofiltration beds and MAR are approximately $30,000-40,000 per year.

COST (BOTH PROJECTS)

This refurbishment of Dunstone Grove-Linde Reserve was funded jointly by the City of Norwood, Payneham and St. Peters and the Australian Government ($4.5m).

The St. Peters Civic Plaza and Avenue of Honour was funded jointly by the Australian Government, State Government and the City of Norwood, Payneham and St. Peters ($2.6M).

FUTURE OPPORTUNITIES (WIDER AREA)

As assets in the area between the St. Peters Street Streetscape and St. Peters Billabong are due for renewal they will be upgraded to enhance the connection to Dunstone Grove-Linde Reserve with better pathways, more shady street trees and rain gardens.

Nearby Otto Park will also be refurbished in a manner that reflects its commemorative significance and the adjacent green infrastructure.

PROJECT DELIVERY

DUNSTONE GROVE-LINDE RESERVE MASTERPLAN

QED Pty Ltd, Wallbridge and Gilbert, and Suter Planners, 2010.

DESIGN

HASSELL, Wallbridge and Gilbert, BESTEC, Aquatek and Australian Groundwater Technologies, 2011

CONSTRUCTION

CATCON on behalf of the City of Norwood, Payneham & St Peters

ST PETERS CIVIC PLAZA AND AVENUE OF HONOUR MASTER PLAN AND DESIGN

Oxigen, Wallbridge and Gilbert, BESTEC and Disability Consultancy Services, 2012

CONSTRUCTION

Gridlock on behalf of the City of Norwood, Payneham & St Peters

MAINTENANCE

City of Norwood, Payneham & St Peters and Australian Groundwater Technologies (AGT)

CASE STUDY CONTRIBUTORS

Rob Gregory and Ben Willsmore (City of Norwood, Payneham and and St. Peters) and Paul Magarey (AGT)

FOR FURTHER INFORMATION

City of Norwood Payneham and St Peters