ENGINEERING GREENER URBAN SPACES

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Abstract

The City of Mitcham is recognized for its green, leafy suburbs and its significant focus on preserving and enhancing urban tree canopy. According to a report published by Green Adelaide in 2022, the city's average tree canopy cover was 39.8%, an increase of approximately 7% compared to the previous data captured in 2018-19. This progress aligns with the city's strategic initiatives aimed at enhancing tree planting and passive stormwater reuse. However, council’s westernmost suburbs still have substantially less tree canopy cover, with only 10-20% coverage. This lack of shade makes these western suburbs more vulnerable to heat island effects, impacting community health and the environment. To support council’s Tree Strategy (City of Mitcham, 2016) which aims to address this disparity and enhance access to greener, cooler spaces, the City of Mitcham has been implementing passive stormwater infiltration and reuse initiatives through recent projects using Water Sensitive Urban Design (WSUD) techniques. Ongoing implementation of WSUD will play a critical role in the city's urban canopy expansion and more equitable distribution of cooler, greener public spaces. By examining some of these projects and recent research undertaken in the City of Mitcham with our partners at Flinders University, this paper highlights the multifaceted benefits of WSUD on the city’s trees and public spaces. Challenges to implementation of green infrastructure assets in the City of Mitcham are also discussed.

Introduction

Urban trees are essential infrastructure, providing shade, cooling, biodiversity, and community wellbeing. In 2022, the City of Mitcham had an average tree canopy cover of 39.8%, an increase of approximately 7% compared to the previous data captured in 2018-19 (City of Mitcham, 2024). This progress can, in part, be attributed to the Tree Strategy 2016-25 which aimed to plant 1800 trees annually (City of Mitcham, 2016). However, council’s westernmost suburbs were still identified as having substantially less tree canopy cover, with only 10-20% coverage. This low canopy cover makes these western suburbs more vulnerable to heat island effects, impacting community and environmental health.

Sustaining healthy tree canopies in dense urban environments is complicated by the lack of available space, access to groundwater and quality soil, nutrients, and the pressures resulting from adjacent services and assets. These complexities demand thoughtful engineering to ensure trees have access to water, soil, and space to grow. In the City of Mitcham, these challenges are being addressed in part through the integration of Water Sensitive Urban Design (WSUD) applications into streetscape upgrades, stormwater infrastructure projects, general road asset renewal projects and reserve upgrades.

Rather than removing stormwater as quickly as possible as has been done historically, the City’s contemporary approach is to capture and redirect stormwater to support vegetation and to green and cool the urban environment. WSUD applications used include kerb inlets that divert runoff into leaky wells adjacent to trees (referred to herein as 'kerb inlets'), permeable paving that allows infiltration, raingardens, soakage trenches, and bioretention systems that temporarily store and release water to root zones. These interventions are embedded in real projects across the city and are a practical representation of council's key priorities in Climate Change Mitigation and Resilience, and the Natural Environment.

The goal of this paper is to demonstrate how WSUD has been practically applied in the City of Mitcham to improve tree health, expand canopy cover, and enhance equitable access to green and cool public spaces. Applying these techniques in areas with historically low canopy cover and high heat exposure, these projects deliver environmental and social benefits where they are needed most. This paper provides design insights that can be adapted to other urban contexts, showing how engineering and ecology can work together to create more liveable, climate-resilient cities.

Projects

Dorene Street, St Marys streetscape upgrade

Dorene Street was upgraded in association with the Flinders to City Bikeway project to improve alternative transport opportunities across the city. To maximise benefit to the community and improve the comfort of pedestrians and cyclists, the project incorporated a streetscape upgrade that used WSUD to enhance greening and improve streetscape appeal. The project included permeable paving at intersections (Figure 1), with subsurface drainage to direct stormwater to garden beds for passive irrigation and to reduce soil saturation under the road, with excess water routed to the stormwater system. New kerb and gutter works incorporated kerb inlets and bottomless side entry pits to irrigate the additional 40 new verge trees. A swale in a pocket park on the corner of Merriton Avenue (Figure 2) collects and temporarily detains stormwater, promoting infiltration and providing a new source of water for the existing Queensland Box (*Lophostemon confertus*) trees near the swale. The swale and the reserve upgrade also improved biodiversity through planting of more native, drought-tolerant plants and additional trees of different species (Figure 3) to create a green, shady community space. This project showcases sustainable asset renewal and sets a standard for integrating WSUD in urban infrastructure.

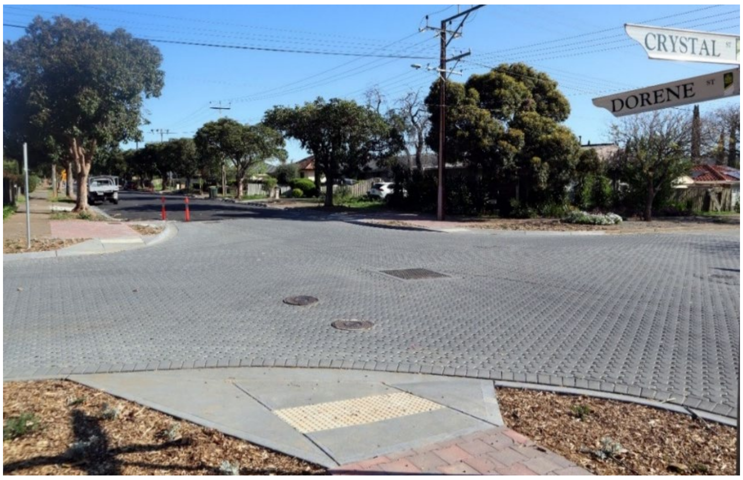

Figure 1: Permeable paved intersection supporting garden beds with subsurface passive infiltration

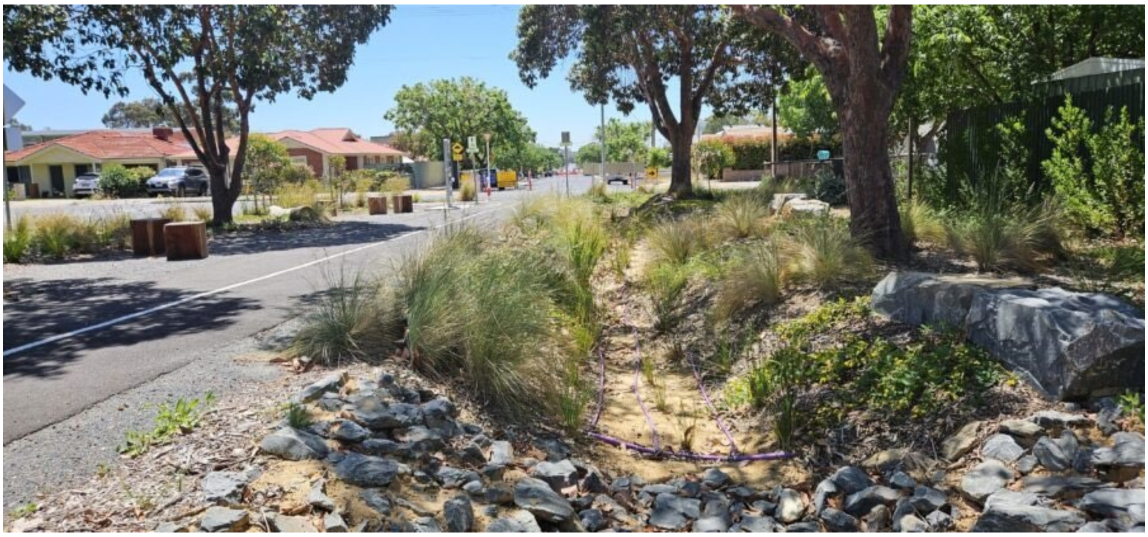

Figure 2: Swale in the pocket park on Dorene Street, St Marys (Image: Water Sensitive SA, 2025)

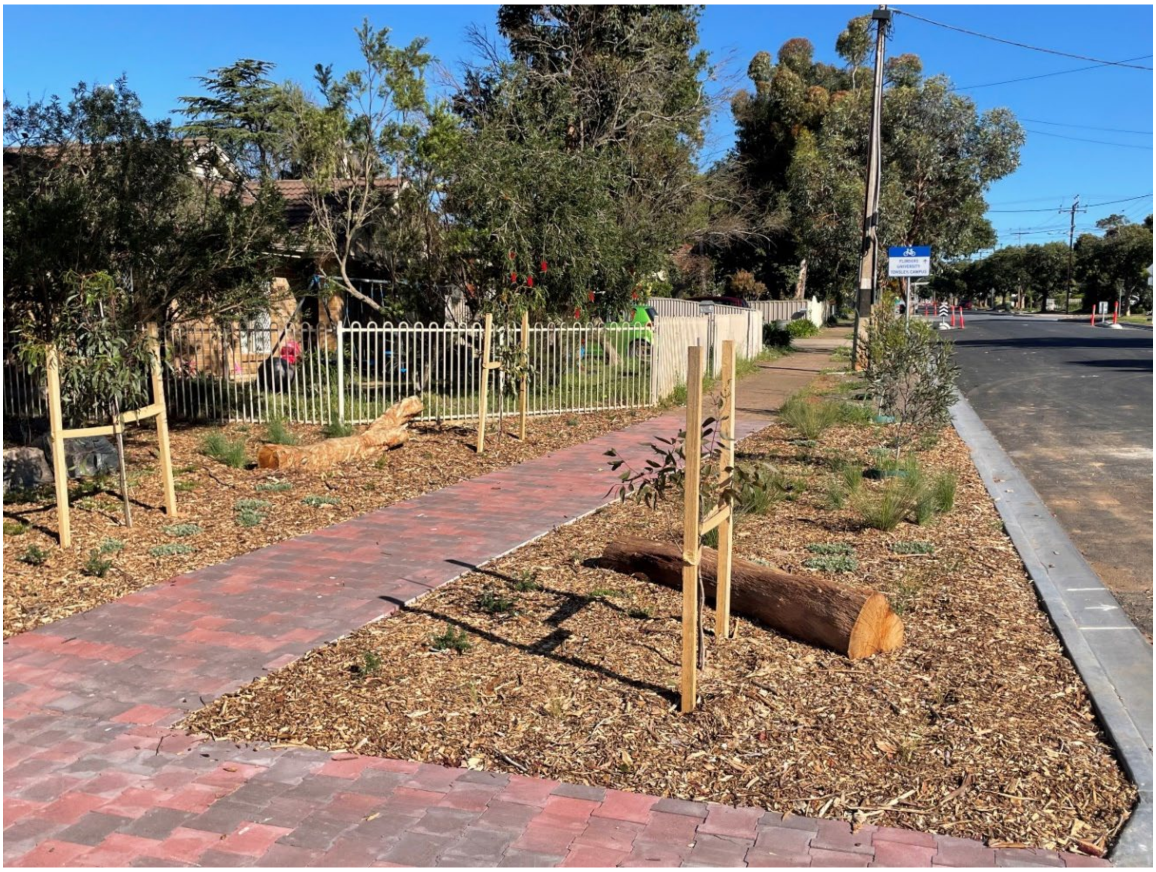

Figure 2: Red-flowered mallee (*Eucalyptus erythronema*) trees planted as part of the Dorene Streetscape Upgrade

Pasadena Biodiversity Corridor

The Pasadena Biodiversity Corridor is a green infrastructure initiative designed to enhance urban biodiversity, stormwater management, and community amenity across several connected reserves. Stage 1 of the project (Oct 2021 – Jan 2022) integrated WSUD principles with ecological restoration and public space upgrades including the daylighting of an old creek line through the corridor (Figure 4).

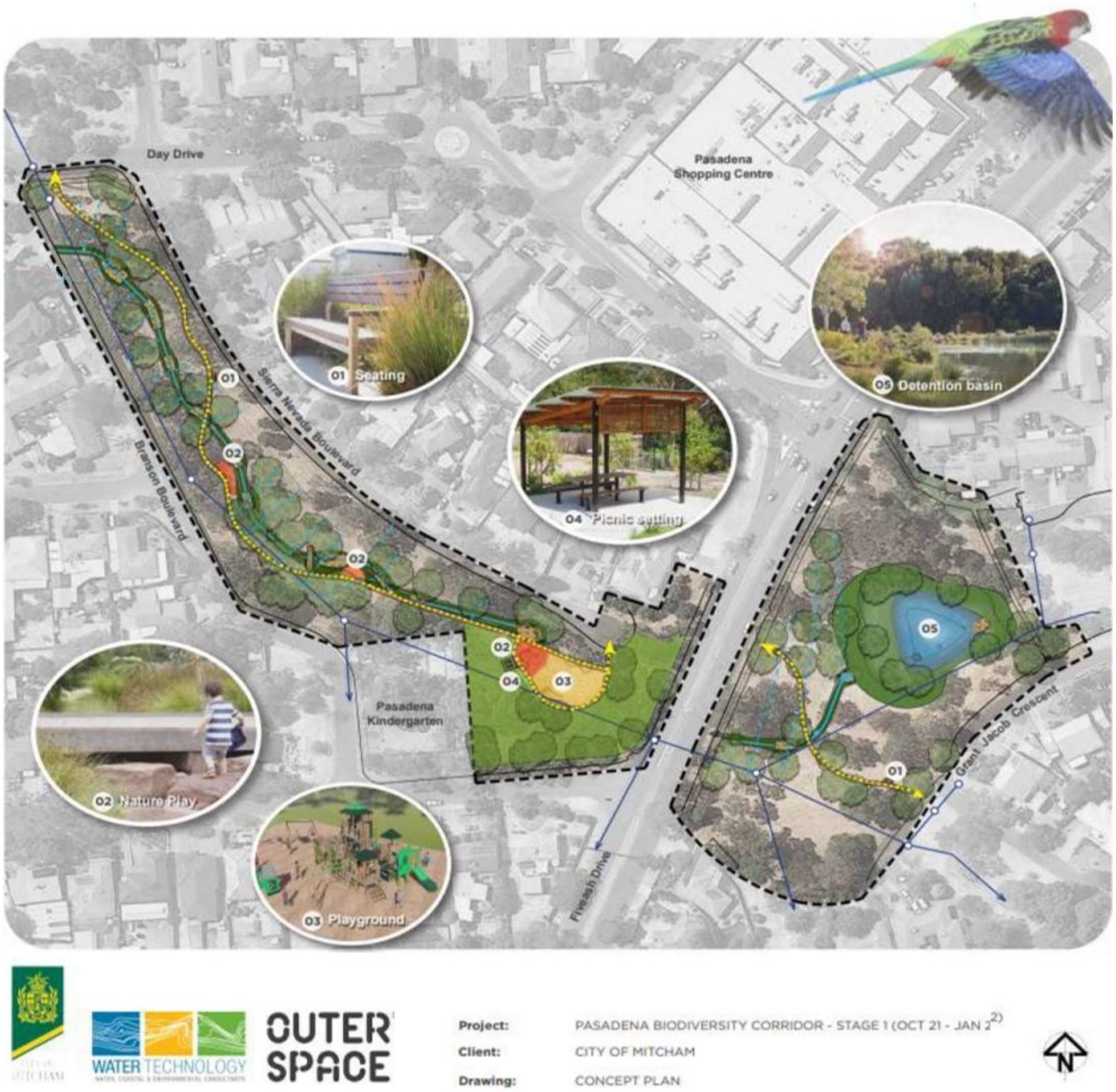

Figure 3: Concept plan of Pasadena Biodiversity Corridor Stage 1 (Oct 21 – Jan 22) with swale and detention basin layout.

Key features included:

- A low-flow stormwater diversion to a vegetated creek/swale system.
- Swales with rock riffles planted with native biofiltration reeds and sedges to cleanse stormwater (Figure 5).

- Soakage trenches supporting native tree species including eucalypts, watered by infiltration from swales.
- A walking trail connecting Sierra Nevada Reserve, Grant Jacobs Reserve, and Branson Reserve, improving accessibility and neighbourhood connectivity.
- Nature play elements, seating, and open lawn areas to encourage community use and interaction with the landscape.

This project involved daylighting a previously buried creek through the implementation of a low-flow stormwater diversion into a vegetated swale system. The initiative successfully revitalised a hot, dry reserve with limited biodiversity transforming it into a reserve that provides enhanced habitat, recreational opportunities, and a cooler, greener environment, while also improving stormwater management practice.

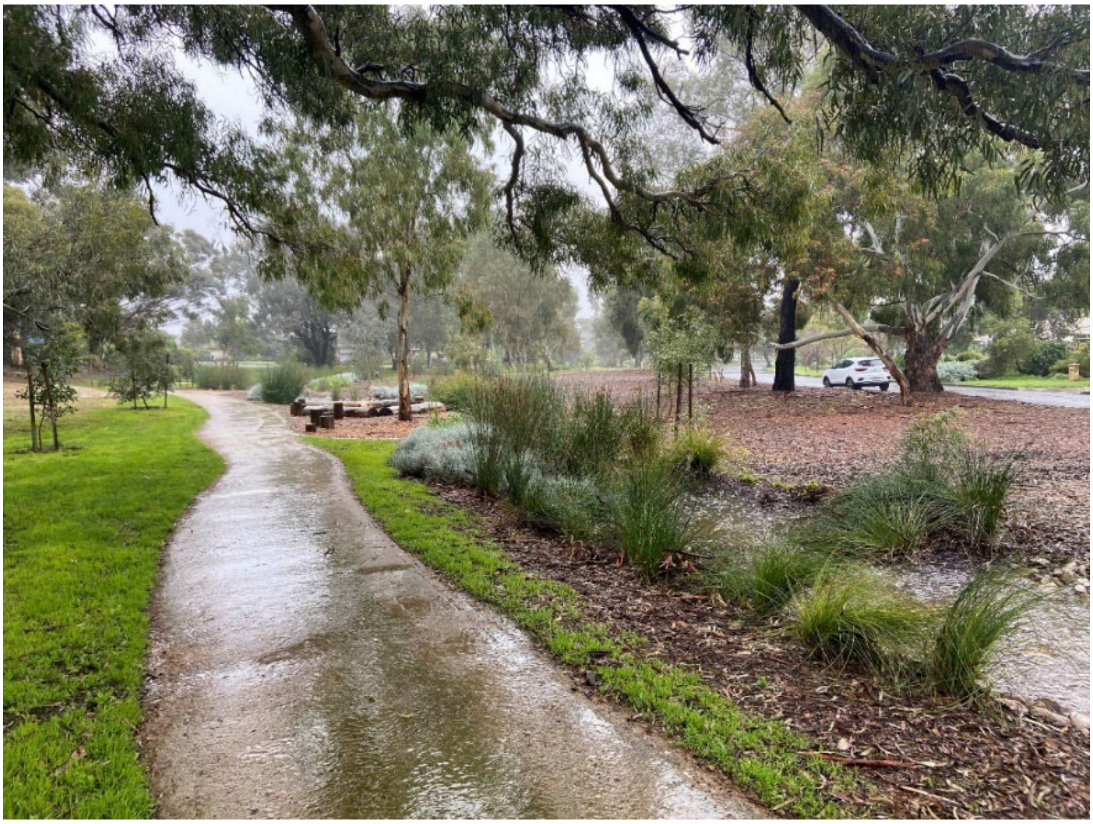

Figure 4. Pasadena Biodiversity Corridor post-construction showing the daylit creek

With the support of a grant from the Disaster Ready Fund from the Australian Government and Green Adelaide, Stage 2 of this project, titled *Pasadena Smart Stormwater Project* (Figure 6) will use smart controls to temporarily detain stormwater upstream from the Pasadena Biodiversity Corridor to reduce stormwater peak flows and maximise reuse. This innovative design is expected to provide stormwater flows in the swale for nearly three times longer than without the detention storage, and twice as long as a passive storage alternative in the proposed upstream catchment. The project will further support new and existing trees and plants along the Pasadena Biodiversity Corridor, improving survival rates and promoting canopy growth. Further to this, council is investigating opportunities to extend the greening and cooling of Branson Reserve, Pasadena Reserve, and Eyre Boulevard Reserve in Pasadena through swales, soakage trenches, and planting opportunities.

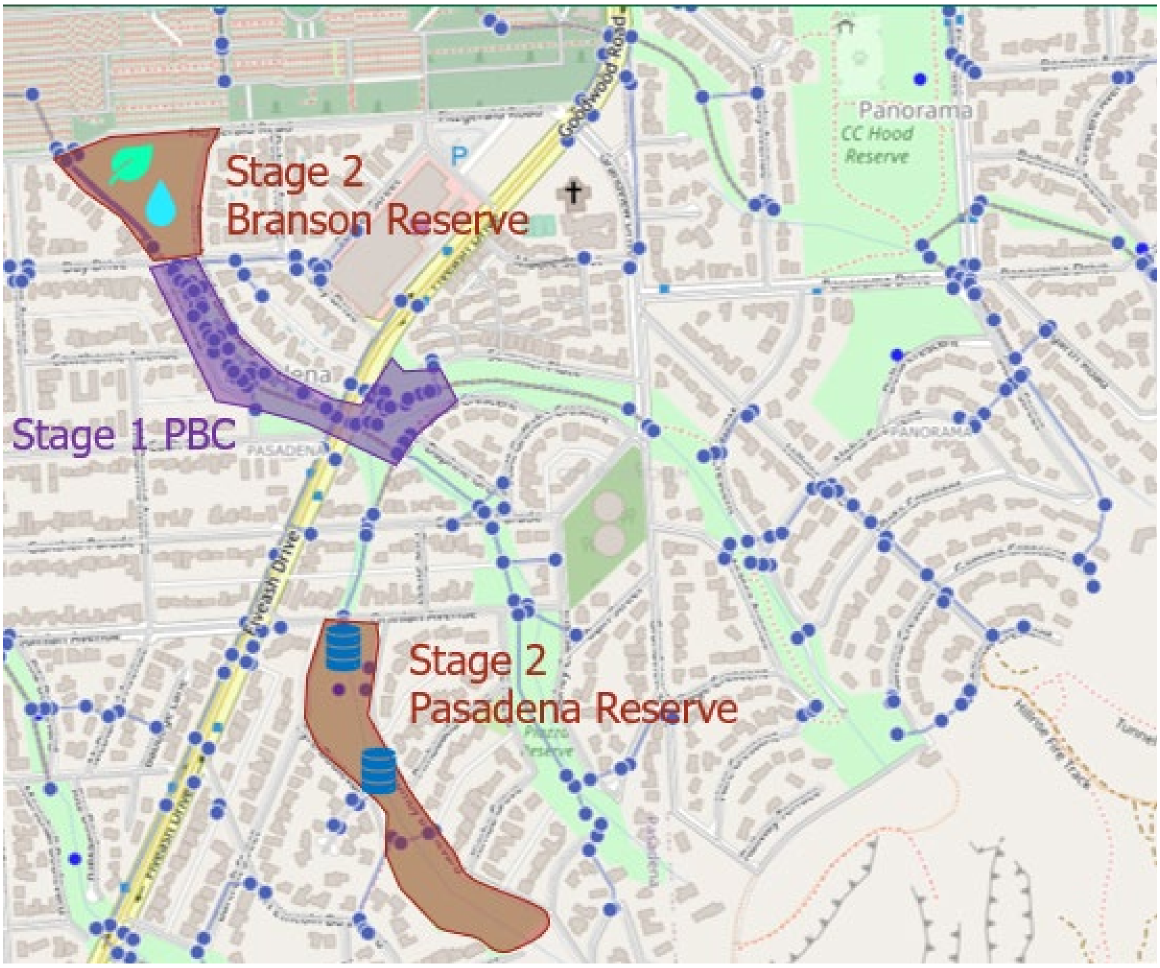

Figure 5: Proposed Pasadena Smart Stormwater Project Areas (Stage 2)

Research

The City of Mitcham has invested in confirming and quantifying the benefits of these techniques by working with local universities to research their application. The research has been aimed at improving understanding of the specific benefits that can be achieved including understanding how the WSUD techniques support tree health and the community.

Kerb inlets and permeable footpaths

Kerb inlets are used to reduce nuisance ponding and support tree health across the City of Mitcham; they and permeable paving are now routinely integrated with into kerb renewal projects (Figure 7). Permeable footpaths are now installed as standard, with costs now comparable to impermeable paved footpaths (Table 1). By increasing infiltration opportunities and supporting street tree health these assets are helping to reduce footpath maintenance caused by tree root ingress, which is supported by local research (Johnson, 2015). Kerb inlets have been shown through local research to be effective in supporting tree health by increasing access to water (Gleeson et al., 2022). This research found that kerb inlets improved the physiological functioning of White Cedar (*Melia azedarach*) trees during dry seasons through a 21% increase in transpiration of street trees (Gleeson et al., 2022), and that over a 3-year period White Cedar saplings adjacent to kerb inlets grew 65% more in height and 60% more in diameter compared to saplings without passive stormwater infiltration nearby. These findings strongly support the wider roll-out of WSUD to achieve community benefits from enhanced street tree growth and function.

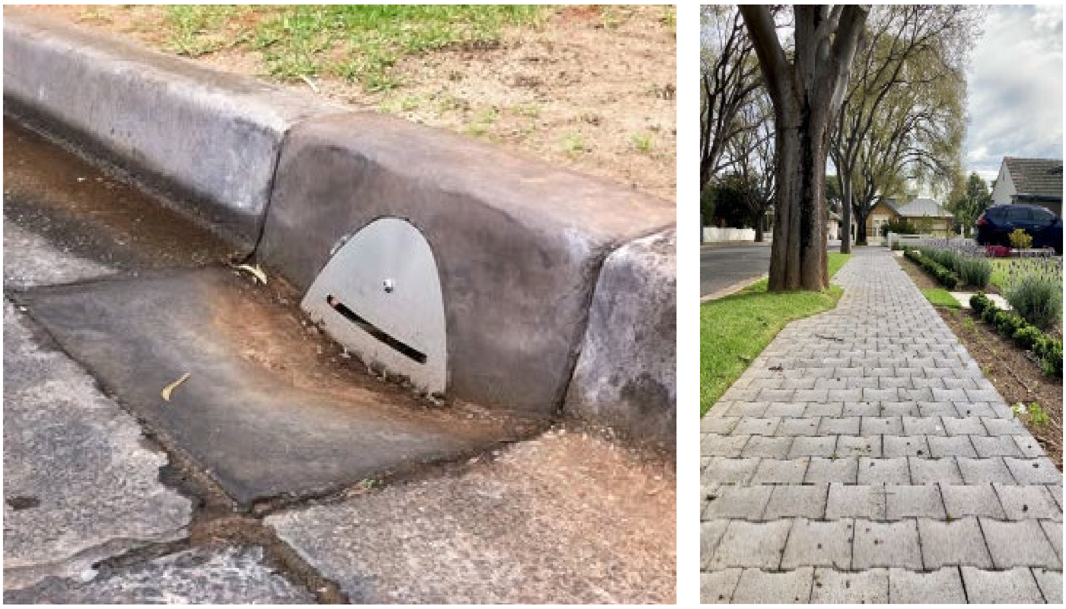

Figure 6: Kerb inlet and permeable footpath installed in the City of Mitcham

Table 1: City of Mitcham's Adopted Unit Rates from April 2024 for footpath construction based on project actuals and industry data

Major Road	Concrete Block Paved	$122.70/sqm
	Concrete Block Paved - Permeable	$130.87/sqm
Minor Road	Concrete Block Paved	$108.58/sqm
	Concrete Block Paved - Permeable	$115.87/sqm

Guan et al. (2025) indicated that harvesting stormwater through kerb inlets can lower the air temperature within the canopy by 0.5°C on summer days for Jacaranda trees, with slightly less pronounced effects for Queensland Box trees. The onset of this cooling benefit varies with rainfall patterns, but once it begins, it can persist for several months. Kerb inlets have also been shown to support a cooler environment in the canopy for longer than the same tree species in a similar location without a kerb inlet. The research found that kerb inlets near White Cedar (*Melia azedarach*) street trees led to an average of 3.6 degrees Celsius average cooling in the tree canopies through summer days of up to 35 ^{o}C, with the cooling peaking at approximately 3 pm. This research also indicated that these benefits could be optimised using kerb inlets on anisohydric species, which would allow their root zones to dry out further than White Cedar trees and increase the soil storage potential for passive infiltration.

St Marys Street Reserve Soakage Project

The City of Mitcham has collaborated on research projects with Flinders University and the University of South Australia to understand the benefits of passive infiltration using soakage trenches, to inform planning for future urban environments. One of these projects, the *St Marys Street Reserve Soakage Project* saw the construction of two soakage trenches in March 2024, each with a capacity of 10 kL (Figure 8), to investigate the effects of stormwater infiltration on ground movement in highly reactive clay soil (Cameron et al., 2023; Karim and Cameron, 2025) and on transpiration of mature trees and their contribution to cooling the suburban park (Guan et al., 2025). The soakage trenches were the only direct source of water available in the southern half of the reserve other than rainfall and they were constructed independent of the local stormwater system, to allow the effects of controlled quantities of infiltrated water to be studied.

Guan et al. (2025) observed that, on average, Mitcham's WSUD features reduced street-tree canopy surface temperatures by 1.5°C during summer. Monitoring also showed that two Grey box tree (*Eucalyptus microcarpa*) nearest to the soakage trenches in St Marys Street Reserve did not show any signs of water stress throughout the drought conditions of the 2024-25 summer. This suggests that capturing rainfall and using WSUD to boost soil moisture can help urban trees better withstand drought conditions.

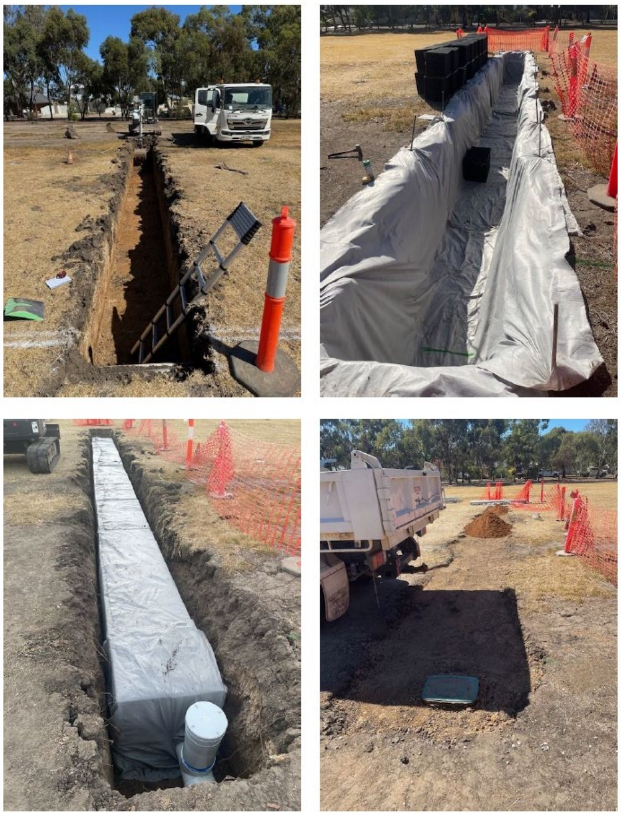

Figure 7: Soakage trench construction in St Marys Street Reserve in 2025 (*Images: Rajibul Karim and Don Cameron*)

Challenges

While the City of Mitcham has made significant progress in implementing WSUD and expanding its urban forest, ongoing delivery and sustainability of these initiatives is challenging.

Limited availability of space

One of the most pressing constraints is the availability of suitable land for WSUD and tree planting. Many suburbs within the City of Mitcham are densely developed with limited space in street verges, between driveways, and near kerbs, underground utilities and services, and footpaths. Opportunities for WSUD are also limited in public open space, where community pressures exist for alternative land uses such as active recreation, playgrounds, carparks and clubrooms. This spatial limitation is particularly acute in western suburbs, where canopy coverage is lowest and urban heat impacts are highest. Creative solutions to making space for trees and WSUD treatments, such as planting trees in the road or reclaiming paved verges, are being explored to overcome this barrier.

Funding and resource constraints

Delivering WSUD, greening, and research projects requires ongoing investment. While the City of Mitcham leverages grants wherever possible, financial support for this work can be difficult to obtain especially for ongoing maintenance and for research to inform and support further implementation.

Maintenance and asset integration

Integrating WSUD into existing urban infrastructure introduces maintenance and asset renewal complexities. Some WSUD treatments can require ongoing inspection and cleaning to function effectively, other treatments create obstacles for existing asset maintenance such as road sweepers; these complexities need to be planned for and managed. The City of Mitcham reduces maintenance frequency of these assets where possible, through integrated design and engagement with maintenance and operation staff, but a process and commitment to continuous improvement is required to facilitate this.

Discussion

The City of Mitcham's WSUD and urban greening initiatives highlight both the tangible benefits and the practical challenges inherent in transforming urban landscapes for climate resilience. The evidence that kerb inlets significantly increase soil moisture and generate measurable canopy cooling, particularly on hot days, demonstrates the real-world potential of passive stormwater infiltration to reduce urban heat, improve tree vitality, and enhance community amenity. Widespread implementation of such interventions is not without obstacles, however. Limited space, especially in densely developed suburbs impacted by heat island effects, demands creative, context-specific solutions. Planting trees in roads or reclaiming paved verges are innovative approaches, but they also require careful design to avoid conflicts with other services and maintenance regimes and to ensure long-term functionality.

Funding remains a perennial challenge. Reliable and sustainable financial support is needed not only for capital works and asset renewals but also for the continued research and monitoring necessary to adapt WSUD and greening strategies over time especially in the context of the changing climate. The integration of new assets into the existing urban matrix further complicates maintenance regimes and asset renewal cycles, highlighting the need for robust cross-departmental collaboration and commitment to continuous improvement.

Ultimately, the research underscores the importance of maximising the use of available space for the benefits of the environment and the community. The potential to cool the environment by increasing passive access to water for trees through WSUD techniques, offers a valuable direction for future planting and urban planning.

Conclusion

The City of Mitcham's experience shows that integrating WSUD approaches, such as kerb inlets, soakage trenches and swales with strategic tree planting can deliver substantial cooling benefits and enhance urban resilience. While the operational and logistical challenges are not insignificant, ongoing innovation and collaboration have enabled the City of Mitcham to make meaningful progress. Future expansion of these efforts will depend on continued research, adaptive management, and the ability to navigate competing demands for limited urban space.

In summary, the work being undertaken by the City of Mitcham affirms that the combined application of urban greening and water-sensitive urban design is both feasible and impactful, provided that the barriers are addressed through an integrated, well-resourced approach. This work not only contributes to a cooler, greener city but also sets a precedent for broader adoption of similar strategies in other urban contexts facing similar pressures of densification and climate change to improve our urban spaces for the benefit of the environment and the community.

Acknowledgements

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References

Cameron, D., Karim, M.R., Johnson, T. and M.M. Rahman, 2023. Influence of weather, soil variability, and vegetation on seasonal ground movement: a field study. *Geotechnics*, *3*(4), pp.1085-1103.

City of Mitcham, 2016. *TREE STRATEGY 2016 – 2025*. https://www.mitchamcouncil.sa.gov.au/__data/assets/pdf_file/0040/89959/Tree-Strategy.PDF

City of Mitcham, 2024. *Urban Tree Canopy Data Capture and Reporting,* Council Member Presentation, 4 June 2024.

https://www.mitchamcouncil.sa.gov.au/__data/assets/pdf_file/0026/1617281/20240604-Tree-canopy-mapping-presentation-Information-Session-4-June-2024.pdf

Gleeson, X., Johnson, T., Lee, G., Zhou, Y. and Guan, H., 2022. Enhanced passive stormwater infiltration improves urban *Melia Azedarach* functioning in dry Season. *Front. Clim.* 4:783905. doi: 10.3389/fclim.2022.783905

Guan, H., Zhang, Z., Yang, W., Gleeson, X., Liu, B., Liu, W., Bruce, D. and I. Moffat, 2025. *Environmental Benefits of Water Sensitive Urban Design Features in the City of Mitcham. 6 June 2025,* Flinders University. https://fac.flinders.edu.au/items/a2035fbe-0b57-488c-86f4-242ea0f3cc34

Johnson, T., 2015. Trees and permeable paving: future symbionts, *TREENET Proceedings of the 16th National Street Tree Symposium*, Adelaide, South Australia, Australia https://treenet.org/resource/trees-and-permeable-paving-future-symbionts/

Karim, R. and D. Cameron, 2025. 'St Marys Street Reserve Ground Movement Study, Final Report – May 2025'. University of South Australia, unpublished report for City of Mitcham.

Water Sensitive SA, 2025. Dorene Street Upgrade St Marys. *https://www.watersensitivesa.com/wsud-projects/dorene-street-upgrade-st-marys/*