NURSERY PAPERS
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Accelerating uptake and removing barriers to green roofs in Australia

The benefits and function of green roofs in urban environments are well documented, with green roofs an established tool for creating cooler, more biodiverse and liveable cities. However, the number and area of Australian green roofs is increasing at an incremental pace compared to other regions worldwide, with the green roof industry concentrated to a small number of companies, and unlike overseas there are currently very few nurseries specialising specifically in green roof plants.

This nursery paper outlines the aims, progress and outputs of a four-year industry-focused research project that seeks to expand the Australian green roof knowledge base around green roof plant selection, green roof management and maintenance, and the restorative benefits of green roofs for people.

SUMMARY

- This project, *Researching the benefits of demonstration green roofs across Australia* (GC16002), has been developed to accelerate the uptake of green roofs in Australian cities and promote green infrastructure as a way of mitigating the negative impacts of urbanisation such as the heat island effect, stormwater runoff and lack of green space and access to nature.
- Researchers have worked with industry to identify the key actions needed to increase the uptake of green roofs and other green infrastructure, creating a Roadmap for Green Roofs, Walls and Facades for Australia.
- The project has developed Maintenance Guidelines for Australian Green Roofs to assist designers, planners and building owners and managers to improve the long-term performance and beneficial functions of green roofs. The project will also produce guidelines for green roof plant selection and recommended evidenced-based plant palettes for Australian green roof types to inform and expand the range of plants used.
- Project outputs are designed with, and for industry, government and other end users to ensure their wide application and adoption. As the green roof market develops there is significant potential for the nursery industry to meet the increasing demand for high quality, species diverse green roof plants.

BACKGROUND

Rapidly growing urban populations, increasingly hot cities and the need for green space and access to nature are key reasons for integrating more green infrastructure into cities. Green roofs provide environmental benefits and greener developments can enhance human well-being and productivity, and increase the rental and resale value of properties compared to traditional grey infrastructure.

However, significant barriers to green roof adoption in Australia remain, including lack of information and uncertainty around construction, costs and maintenance, and a low level of knowledge around appropriate plant species and their horticultural requirements. Green spaces and green infrastructure are vital to human health and well-being, but there is little information around the most beneficial green roof designs and plant species to meet this need.

Researchers from the University of Melbourne have been studying green roofs for over 10 years and have joined with colleagues from the University of NSW and industry partners to investigate how these barriers may be overcome in the levy funded project *Researching the benefits of demonstration green roofs across Australia* (GC 16002).

The team brings together expertise in green roof plants, green roof design, environmental psychology and business. This project is funded by Hort Innovation through the Green Cities fund, with additional funding from City of Melbourne, the Department of Environment, Water, Land and Planning (VIC) and the Australian government. Research aims are closely linked to the Hort Innovation funded projects *Expanding the Living Architecture in Australia* (GC15001) and *Integrating Plant Life into Building and Infrastructure Ratings Tools* (NY16007).

This communication has been funded by Hort Innovation using the nursery research and development levy and contributions from the Australian Government.
Hort Innovation Strategic levy investment | NURSERY FUND

THE RESEARCH

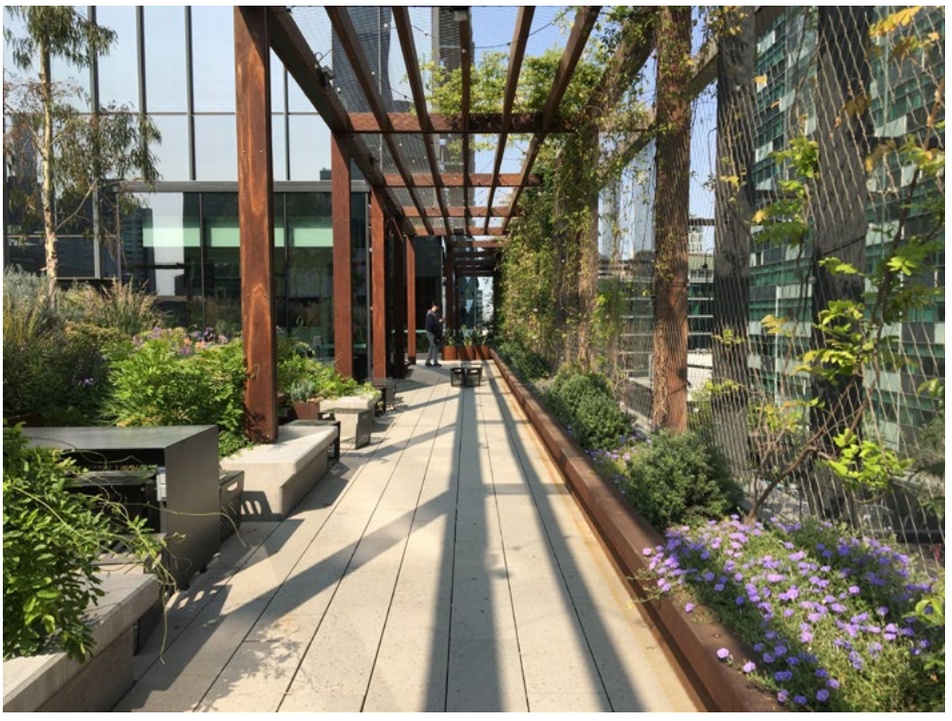
This research project addresses several known barriers to green roof implementation in Australian cities – in particular key knowledge gaps around appropriate plant palettes for Australian green roofs, human preference and the restorative benefits of different types of green roofs and plants, and green roof maintenance requirements. The project is looking at the role of demonstration sites in generating information to address these knowledge gaps, and how these sites can be a focal point for knowledge exchange amongst researchers, industry, governments and other stakeholders.

Plant traits and species for Australian conditions

One of the areas of uncertainty, and an existing barrier to greater green roof adoption, is knowing which plant species perform best under Australian conditions for different green roof types. This project is trialling a range of native and exotic candidate species on shallow, experimental green roofs under southern Australian climatic conditions – typified by cool, wet winters, and hot, dry summers.

Plants for this experiment were selected based on traits that confer drought and/or heat tolerance, with many species originating from natural habitats that have conditions comparable to green roofs. Researchers screened 289 species and selected 75 for performance trials based on knowledge of their biology, observed performance on the University of Melbourne's demonstration green roofs or their use on Mediterranean green roofs overseas.

Trials commenced in Dec 2020 and will run until March 2022 to assess performance (growth, flowering, condition) as well as plant heat response and irrigation requirements, particularly over summer. Trials are being complemented by plant trait analysis to identify which traits give plants the best advantage under Australian conditions. A major output of this research stream will be guidelines and recommendations for green roofs plants that can be used by architects, landscape architects and designers, building owners and managers, the building and nursery sectors.



Skypark, Melbourne 1. **Image:** Rachael Bathgate

Maintenance Requirements for Different Green Roof Types

High quality maintenance is critical for green roofs to function and provide the benefits for which they were designed – for example cooling, stormwater control and places for people to socialise and interact with nature. Green roof maintenance differs from general landscape and horticultural maintenance. Maintenance needs to be considered in the design phase and be adequately resourced. Lack of adequate maintenance can lead to plant death and poorly functioning green roofs that are unattractive which is a disincentive to those considering installing new green roofs as well as being costly to remediate.

In this project, researchers have worked with industry professionals in the area of green roof design and installation, horticulture, teaching, and green roof plant production to develop *Maintenance Guidelines for Australian Green Roofs*. Due for publication in Nov 2021, these guidelines have been developed to provide the detail necessary to develop a comprehensive maintenance plan for individual green roof projects with the guidelines covering different green roof types, including roof gardens, biodiversity roofs, large-scale shallow green roofs and productive (food producing) green roofs.

Designing green roofs for human wellbeing and productivity

Previous research has demonstrated that viewing green roofs can provide restorative benefits as well as increasing the viewer's ability to focus and complete work tasks. This has implications for the productivity of people working in cities and illustrates that green roof wellbeing benefits are not just for people on green roofs, but for people in surrounding buildings that overlook green roofs. In this project we are building on these findings and investigating the types of green roof plants that are attractive to a wide range of people, and preferred green roof designs.

Together this information will help us better understand the characteristics that increase the mental well-being of those viewing and using green roofs. These results will inform the guidelines and recommendations for green roof plants, as outlined above.

Roadmap for Australian Green Roofs, Walls and Facades

While research data around different aspects of Australian green roofs continue to grow, there is a lack of government policies and regulatory incentives to drive the green roof industry forward, and no national or state-based plans for achieving sufficient coverage of quality green roofs for environmental and social benefits. To address this need, researchers joined with over 60 multidisciplinary green roofs stakeholders in two workshops in Sydney and Melbourne to identify key actions for overcoming regulatory and knowledge barriers to green roofs – creating a positive vision for flourishing future green cities. Stakeholders represented a wide range of sectors – from property, state and local government, building, water authorities, traditional owners, academics, nursery, green roof, wall and façade designers and installers, sustainability experts, major infrastructure and architects. The outcome is the *Roadmap for green roofs, walls and facades in Australia's urban landscapes 2020-2030*. Twenty-three actions were identified within five key strategies:

- Gather and share knowledge
- Collaborate and advocate
- Promote government coordination and national leadership
- Develop and implement policy mechanisms to incentivise green roofs
- Enhance skills and expertise in the green roof sector
- Design for success – ensure adequate maintenance, function and form for green roof benefits

Discussions amongst stakeholders are now underway on how to progress actions outlined in the Roadmap.

The Burnley Demonstration green roof, University of Melbourne.
Image: Green Infrastructure Research Group.

Key Project Milestones

This project has produced some valuable outputs that, when combined with existing industry and government initiatives, have the potential to significantly expedite the installation of green roof and green infrastructure in Australian cities, and bring rooftop greening to comparable levels of our overseas counterparts. Some project milestones have been completed and some are planned for summer 2021-22.

Ten years of greening a wide brown land

Researchers have charted the progress of the Australian green roof industry and related research over the last ten years in the peer reviewed paper: *Ten years of greening a wide brown land: A synthesis of Australian green roof research and roadmap forward* (Williams et al. 2021) which also incorporates the findings of the industry summits.

Maintenance Guidelines for Australian Green Roofs

Available online from Nov 2021, these maintenance guidelines are freely available for all users and are aimed at improving the knowledge and skills of those designing, managing and maintaining green roofs. The University of Melbourne hosted an online workshop on green roof maintenance, where academic and industry experts shared their knowledge with over 60 people. The guidelines are complemented by a research paper currently in development – for publication in an industry-focused journal.

Plant species and plant palettes for Australian green roofs

With plant survival, growth and condition critical to how green roofs look, selecting the right plants is essential in green roof design. We are incorporating information on plant performance of 75 test species, plus information on over 150 species planted on Burnley demonstration green roofs and psychological studies into human preference and response to green roof species and designs. Guidelines are planned for publication over summer 2021-22.

Roadmap

The development of a roadmap for green roofs was seen as an important first step arising from the 2020 green roof, wall and façade stakeholder workshops. A plan for actioning recommendations within the *Roadmap for green roofs, walls and facades in Australia's urban landscapes* has started, but requires further input from all stakeholders to increase the momentum.

Next Steps

Our final project workshop in Dec 2021 will include research presentations and workshops on green roof maintenance, plant selection and green roof design. Project materials will be available on the project website and through Hort Innovation.

Implications for nursery industry

Functioning, flourishing green roofs need plants that can withstand the unique environments of these engineered green infrastructure systems. Increasing plant knowledge and expanding the palette of green roof plants for Australian conditions can open new market opportunities for growers and create more biodiverse, interesting, and resilient green roofs. This project has contributed a number of resources and new information for the Australian green roof sector and aligned industries – particularly around the types of plants, designs and maintenance requirements for green roofs. This evidence-base can inform industry training, increase the demand-supply of new species and encourage governments to develop positive, supportive policies to increase the number of green roofs across Australia.

The number and area of green roofs in Australia is low compared to other countries, for example some states in the USA, where green roofs are encouraged, and sometimes mandated, through a range of policies. **Image:** N Williams.

LINKS TO RESOURCES

- Find out more about NIASA Best Management Practices and EcoHort certification: ***https://girg.science.unimelb.edu.au/researching-the-benefits-of-demonstration-green-roofs1/***
- Hort Innovation project page: Researching the benefits of demonstration green roofs across Australia (GC16002) ***https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/gc16002/***
- Green roof, wall and façade summits. Summary findings. ***https://cpb-ap-se2.wpmucdn.com/blogs.unimelb.edu.au/dist/c/359/files/2019/08/Summit-summary_Web2019.pdf***
- *Roadmap for green roofs, walls and facades in Australia's urban landscapes 2020-2030* ***https://cpb-ap-se2.wpmucdn.com/blogs.unimelb.edu.au/dist/c/359/files/2020/06/Roadmap-for-Green-Roofs-Walls-and-Facades-Report.pdf***
- Williams N. et al. (2021) Ten years of greening a wide brown land: A synthesis of Australian green roof research and roadmap forward. Urban Forestry and Urban Greening 62: 127179 ***https://doi.org/10.1016/j.ufug.2021.127179***
- Williams K. et al (2019) Appraising the psychological benefits of green roofs for city residents and workers. Urban Forestry and Urban Greening 44. ***https://www.sciencedirect.com/science/article/abs/pii/S1618866719303279***