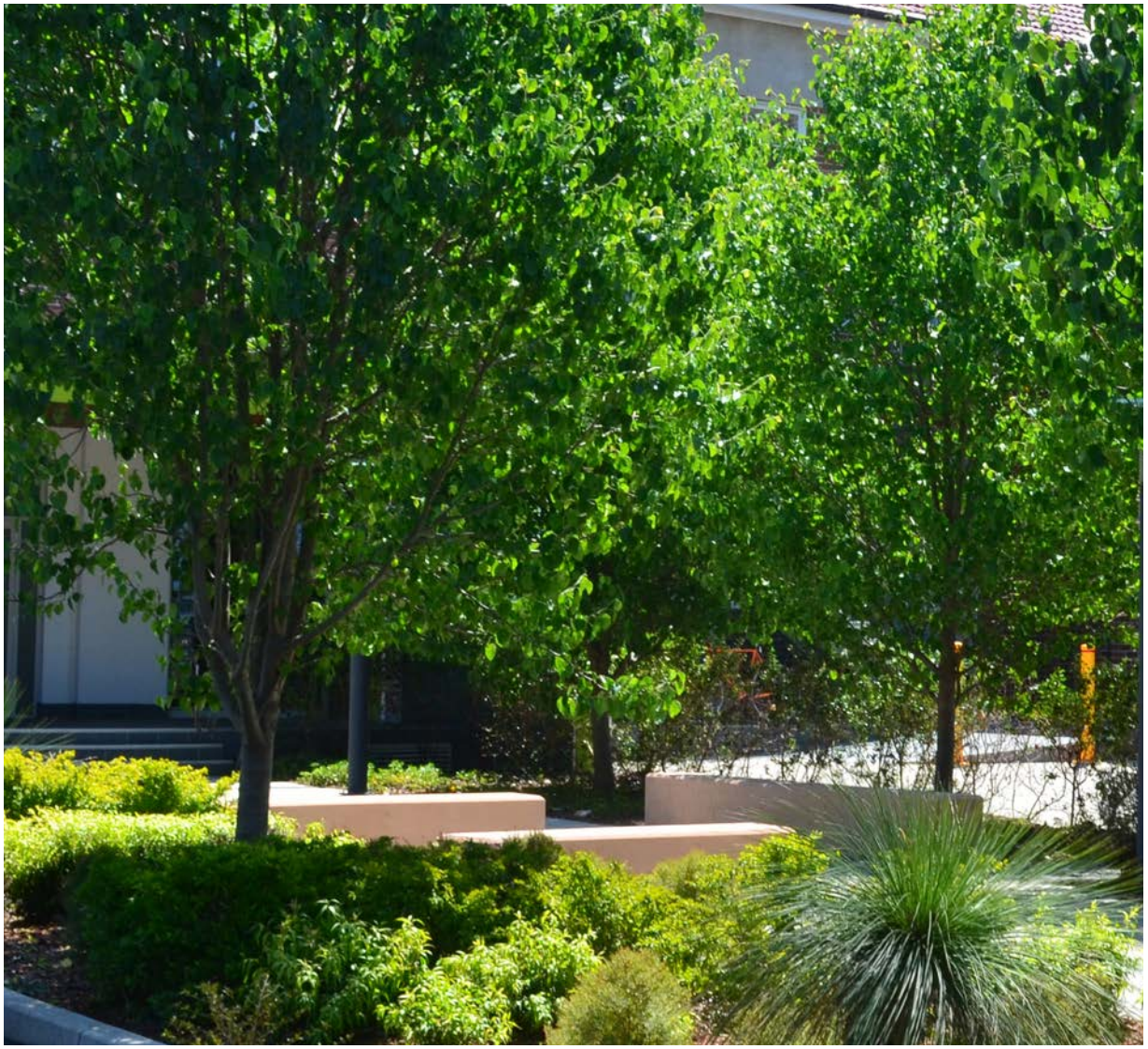
WHICH PLANT WHERE?

Facilitating urban green space

Which Plant Where is about selecting the right plants for the right urban space with an eye on the future.

WHICH PLANT WHERE?



Hort Innovation

MACQUARIE University

WESTERN SYDNEY UNIVERSITY

Hawkesbury Institute for the Environment

NSW GOVERNMENT Office of Environment & Heritage

www.whichplantwhere.com.au

THRIVING URBAN GREEN SPACES

More greenery in our towns and cities is imperative for healthy minds, healthy bodies and a healthy environment. A key challenge for greening Australia's urban environments is to ensure that future plantings are made with trees, shrubs and turf that can tolerate the climate conditions that will occur in the near future.

The Which Plant Where program is a five-year research program that will investigate how well current landscaping species will cope under the more extreme climates that Australia's cities will face and investigate opportunities for new species and varieties for the urban context.

The idea of the Which Plant Where project was developed through the 202020Vision national Growing the Seeds tour in 2015. It is being funded via the Hort Frontiers Green Cities Fund, a strategic partnership initiative developed by Hort Innovation that addresses the biggest challenges facing the future of Australian horticulture. Having the confidence that tomorrow's urban plants will survive and thrive in a changing world is crucial for the long-term viability of our industries and for creating a climate-resilient urban landscape.

To ensure that our research and tools are relevant to end-users, the WPW project held five interactive workshops across Australia, bringing together a diverse group of stakeholders including nursery and turf growers, practitioners, developers, landscape planners and designers, as well as state and local government representatives. These workshops attracted over 110 people from 86 organisations. The project will continue to work with all stakeholders over the life of the project.

202020™ VISION 20% MORE GREEN SPACES IN URBAN AREAS BY 2020

MODULE 1

Species Attributes And Climatic Tolerance

The first module will focus on fifty plant species identified in the project's Target Species List, and will develop maps that demonstrate each species' suitability to both current and future climates across Australia.

These maps will be used to demonstrate how well or poorly a particular species will be able to tolerate future conditions in urban centres across Australia as the climate changes, based on our current understanding of species' climatic requirements.

Our research might demonstrate, for example, that a particular species of tree is already at the very limit of its ability to cope with heat, and that the only suitable place to plant this species in the future will be in cool-climate or more temperate locations. This kind of information would be very useful to a council seeking to avoid investing in tree species for street planting that are unlikely to cope with higher temperatures.

We will also use information from national herbaria and other sources to quantify each species' climatic limits - the warmest, coldest, driest or wettest conditions they can cope with. This information will then be tested through the Planting Successes and Failures module of the research programme to ensure that the Interactive Plant Features Tool matches the right plant in the right region with an eye on the future.

We will also be working with growers, nurseries, landscape architects and many others to capture their recordings of major plant traits including:

- growth rate and form
- height
- canopy density
- ground cover
- longevity
- seasonality
- water quality
- allergenicity
- air and water quality influences and urban temperatures
- insect resistance
- ornamental and amenity features
- and biodiversity impacts.

MODULE 2

Successes And Failures

There are many factors that contribute to the success or failure of urban plantings. These factors form the basis for the second module of the Which Plant Where research programme:

- Climate factors from broad scale temperature and rainfall patterns, to urban heat effects, and local microclimate that determine the ability of plants to survive and thrive.

- The environmental conditions to which those species are exposed during establishment (such as soil depth, quality, nutrients, water availability, exposure), as well as pathogen, insect and weed loads, that affect plant survival, performance and health.

By working with stakeholders across the plant supply chain, we can obtain a wide range of data on the factors that make or break a successful urban planting. This way, we can learn from what has previously worked and avoid the factors that clearly contribute to reduced planting success, or even failure, in the urban context.

How Will We Achieve This?

- By identifying partners, such as councils, that are willing to share data and results of historic plantings across a range of urban settings. This will help us to evaluate success rates in relation to environmental and species selection decisions.

- By selecting a range of target locations where we can conduct much more detailed and longer-term monitoring of the sites, with consideration of climatic conditions, soil attributes, watering regime, fertiliser use and the presence of pathogens.

- By establishing new test-planting sites where we plant a range of species and monitor their performance under contrasting climatic and soil attributes. Here, we are particularly interested in species that are only just coping with current temperatures and rainfall regimes to assess how they respond to more challenging climatic conditions.

We are also interested in the additional benefits that urban greening brings to our cities and towns, such as greater numbers of birds, insects and other wildlife, cleaner air and cooler temperatures at street level, and associated benefits to human health and well-being.

MODULE 3

Heat And Drought-Tolerant Species That Will Thrive

Some plants can cope with adverse weather conditions better than others, and it is important to understand just how much heat and drought stress each of our target species could potentially tolerate.

Using both glasshouse and field trial sites, we will be subjecting our target species to some of the toughest conditions they are likely to face over the coming century, including:

- Lengthy or intense heatwaves, along with
- Extensive drought periods or periods of drought followed by intense rainfall
- High average temperatures at unusual times of the season

This regime will help us understand the abilities of different plants to cope when they are exposed to more than one climate stressor simultaneously. Watering is clearly a crucial element of a plant's success, and so we will test different watering regimes combined with different soil types and media to obtain information on a plant's water use efficiency and drought tolerance. In the real-world, plants can be affected by multiple factors at once so it is important for us to impose a combination of conditions that are 'realistic but tough' so that we can see how the plants really respond.

A Sound Research Process Is Critical

One of the most important factors in any research process is to ensure that the results are based on credible, trusted, best-practice research so that stakeholders can be confident that their decisions are based on the most up-to-date information available.

That's why all of our research has to adequately account for realistic climate change, carbon dioxide, heat and temperature, and drought predictions combined with feasible production and management processes for trees and other plants. We will achieve this by working with growers and our partners where possible, and applying the very best established methods of designing research for repeatability, credibility and accuracy.

MODULE 4

Interactive Plant Features Tool

The interactive database will use the data collected in Modules 1, 2 and 3 to build a national tool that helps to select plants against a range of filters. Previously-developed tools provide a good number of options to select plants for purpose, colour, flowering, height or availability, but there are none that are backed by extensive testing of plants under current and future climatic conditions.

The Interactive Plant Features Tool aims to offer a large range of filters that include not just plant features but also factors such as safety, amenity value, location and co-benefits. This comprehensive tool will provide guidance and the understanding needed for successful urban plantings across Australia's urban environment now and into the future.

Major planned features of the Interactive Plant Features Tool include:

- Maps that show the changes in climate suitability for plants under predicted climate change scenarios
- Filters that reflect common urban planting needs, such as rooftops, verges, water-sensitive design, parks or urban forests.

Value-added characteristics may include heat mitigation, wildlife and biodiversity benefits, pollinator-friendliness or tolerance to urban constraints such as footpaths.

The expected release date of the Interactive Plant Features Tool is 2021.

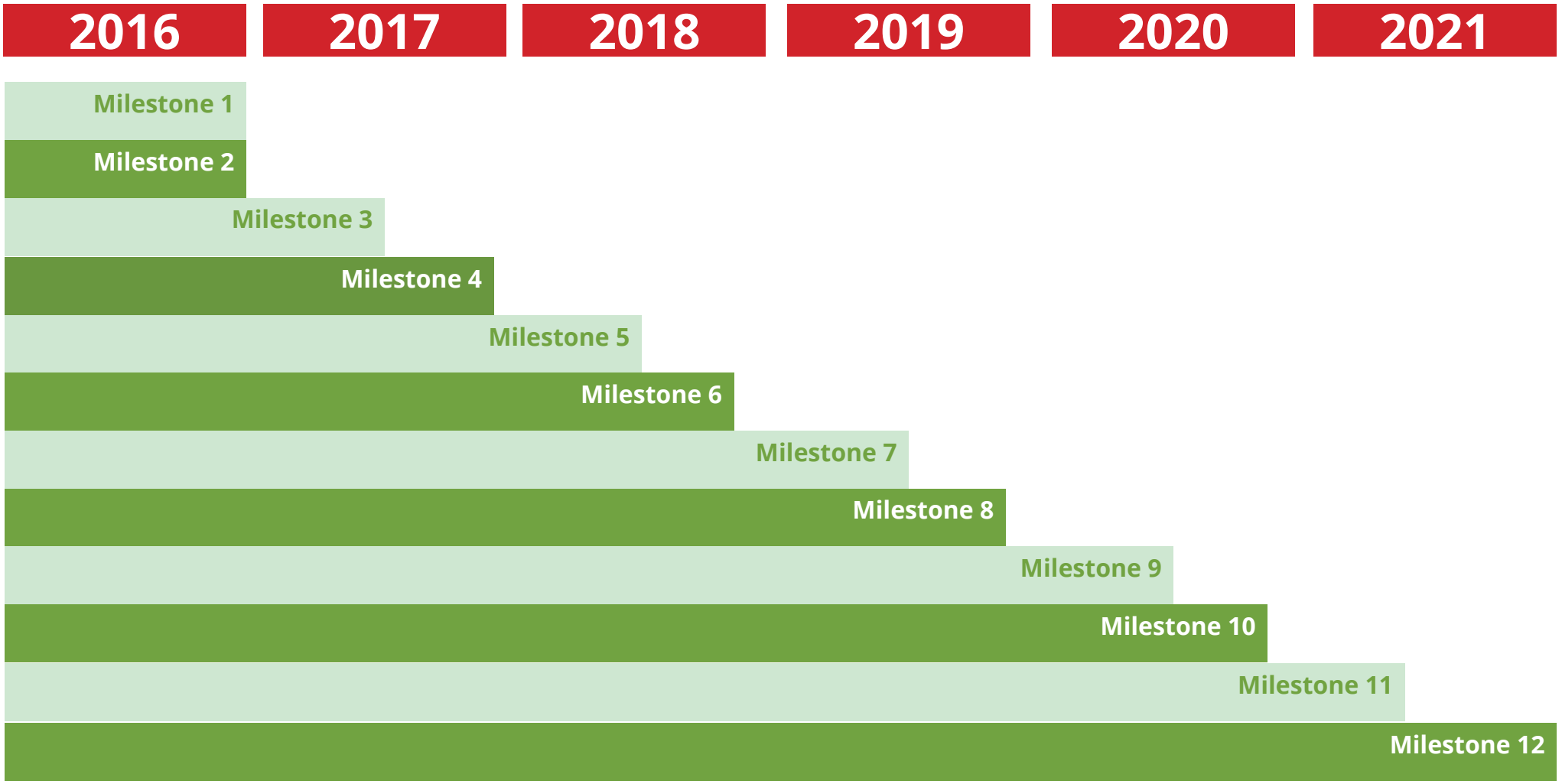
Best-Practice Technical Design Guide

Supporting the Interactive Plant Features Tool will be a technical design guide that bases its recommendations for urban plantings on the best research and industry knowledge available.

MAJOR DELIVERABLES

MILESTONE	CRITERIA
Milestone 1 & 2	Stakeholder engagement, form advisory group, identify possible demonstration sites.
Milestone 3	Finalise species list, identify success/failure planting sites.
Milestone 4	Standardised screening protocol, establish growth trial sites.
Milestone 5	Finalise species trait database and bioclimatic tolerance data.
Milestone 6	Expand growth trials with nurseries.
Milestone 7	Finalise maps of species distributions. Develop co-benefit assessments at 5 sites.
Milestone 8	Develop factsheets of co-benefits of urban planting.
Milestone 9	Complete bio-monitoring site data collection. Finalise climate screening of 50 species, develop factsheets for 25 species.
Milestone 10	Module 2 Hold workshop on biomonitoring outcomes. Module 3 Conduct final stakeholder workshop on screening, finalisation of commercialisation plan. Module 4 Beta version of online tool.
Milestone 11	Module 2 Scientific Paper on success/failure of plantings. Module 4 Completion and launch of online tool, conduct final stakeholder workshop.
Milestone 12	Final reporting.

PROJECT TIMELINE



RESEARCHER PROFILES

Professor Michelle Leishman is the Chief Investigator for the Which Plant Where? research program based at Macquarie University.

Professor Leishman has a wealth of experience and expertise in climate change impacts on plants across a wide range of contexts and the fundamental effects of rising temperatures and carbon dioxide on native and managed ecosystems.

In this research program, Professor Leishman is responsible for:

- overall research and program leadership and management
- supervision of researchers, postdoctoral fellows and students
- establishing rigorous processes to ensure high-quality research
- review of publications, reports and project outputs
- leadership of stakeholder communication, engagement and feedback processes

Professor David Ellsworth is the Chief Investigator for the research program at Western Sydney University's Hawkesbury Institute for the Environment.

Professor Ellsworth brings an incredible wealth of expertise on the impacts from elevated carbon dioxide in plants, and is currently the Lead Scientist at the EucFACE experiment.

Under the Which Plant Where? project, Professor Ellsworth brings leadership and management capabilities to drive the direction of the research and trials at WSU. He will be primarily responsible for:

- Management and leadership of the overall research program
- supervision of researchers, postdoctoral fellows and students
- review and editorial of publications, reports and guidelines
- facilitation of research meetings and committees
- stakeholder engagement, feedback and communication

RESEARCHER PROFILES

Dr Linda Beaumont is a Chief Investigator on the research program's module 'Species attributes and climatic tolerance'.

Linda has an extensive track record of research, teaching and public outreach at Macquarie University, bringing to this project a wealth of expertise on understanding and reducing uncertainty in species distribution modelling and biological responses to climate change.

Under the Which Plant Where? research program, Linda's primary responsibilities include:

- coordination of Module 1 Species Attributes and Climatic Tolerance
- integration of the results from Module 1, in particular results from the research on species traits and modelling
- supervision of researchers, postdoctoral fellows and students
- project management, communications and outreach efforts.

Dr Rachael Gallagher is a Principle Advisor of the Which Plant Where? program based at Macquarie University. Rachael is an ecologist specialising in the functional biogeography of the Australian flora. She combines location data from digitised herbarium specimens (which describe the spatial occurrence of Australia's ~20,000 native plant species) with information on their functional traits to map and analyse patterns of plant function in the Australian landscape.

As part of the Which Plant Where? research project, Rachael's responsibilities include:

- Advising on the development of the trait database
- editorial and review of the research reports, publication and outputs
- industry and research engagement
- co-supervision of students and coordination of researchers

RESEARCHER PROFILES

Professor Lesley Hughes is a Chief Investigator on the Which Plant Where? research program based at Macquarie University.

Lesley has extensive experience and expertise in the impacts that a changing climate places on plants and ecosystems, and brings to the project well-established industry, research and governmental links that will strengthen the engagement of the project.

Lesley's responsibilities include:

- supervision and coordination of researchers, postdoctoral fellows and students
- writing and editorial of reports, publications and other outputs
- Expertise on experimental and research design protocols
- Contribution to communications and outreach efforts

Dr Muhammad Masood is a Technical Officer based at Macquarie University, responsible for the operation of glasshouse and growth room facilities.

Muhammad's major responsibilities under the Which Plant Where? program include:

- management of Macquarie University's plant growth facilities
- support for researchers and experiments
- researcher training for use of facilities
- maintenance and installation of equipment used by the researchers at the growth facilities

RESEARCHER PROFILES

Associate Professor Sally Power is a Chief Investigator for the Which Plant Where? research program based at the Hawkesbury Institute for the Environment at Western Sydney University and explores drought sensitivity assessments of the target species.

Sally's research explores how human activities affect processes at the leaf, plant and community level, and how these effects influence ecosystem function and sustainability.

In the Which Plant Where? project, Sally's primary responsibilities include:

- drought sensitivity assessments of the target species
- evaluation of the field research on impacts of climate and soils on planting successes
- contribution to the design, implementation and operations of experiments and their analysis and publication
- co-supervision of students
- community, industry and research engagement and outreach

Dr Paul Rymer is a Chief Investigator for the Which Plant Where? research program based at the Hawkesbury Institute for the Environment at Western Sydney University with specialist expertise in the ability of plants to adapt to changing environmental conditions by exploiting their genetic and phenotypic traits.

Through the Which Plant Where? program, Paul is responsible for delivery of the Successes and Failures Module. Paul's responsibilities include:

- planning and implementation of the module and its research design
- engagement with stakeholders from industry and research to build on their data and experiences as to what has succeeded and what has failed
- research that links plant growth and survival to environmental factors such as soil and climate
- 'picking the winners' from stress-testing research on plants to highlight the factors that make plants resilient

RESEARCHER PROFILES

Professor Ian Anderson is a Chief Investigator on the Which Plant Where? program and Director of the Hawkesbury Institute for the Environment at Western Sydney University. Ian specialises in the relationships between soil microbes and plants that acts as a major contributor to planting success in many Australian soils.

In the Which Plant Where? program, Ian's role is for overall strategic direction and management of the research team at Western Sydney University, and co-supervision of students.

Professor Mark Tjoelker is a Chief Investigator for the Which Plant Where? research program based at the Hawkesbury Institute for the Environment at Western Sydney University.

In the Which Plant Where? program, Mark is responsible for advisory and research design on soils and pot size factors, co-supervision of students and industry engagement particularly in connection with other Horticulture Innovation Australia projects.

RESEARCHER PROFILES

Leigh Staas is the Project Manager for the Which Plant Where? program, handling overall project management, coordination of meetings and workshops, budgets, planning and engagement.

Leigh has an extensive background in project management for research and manages other environmental and scientific research programs underway at Macquarie University.

Within this project, Leigh's major responsibilities include:

- project management including planning, implementation and tracking of the program to meet milestones and stay within budget
- organisation of the stakeholder and steering committee meetings and workshops
- reporting to committees and Horticulture Innovation Australia
- development and implementation of communications plans including internal and public outreach, stakeholder engagement and to committees.

Dr Nisha Rakhesh is the Research Development Advisor for projects in association with Horticulture Innovation Australia, including the Which Plant Where? project.

Based at Hawkesbury Institute for the Environment at Western Sydney University, Nisha excels at forging connections through research with partners across industry and academia.

RESEARCHER PROFILES

David Thompson is a research engagement and communications specialist based at the Hawkesbury Institute for the Environment at Western Sydney University.

Under the Which Plant Where? research program, David contributed to the initial communications design process and supports the team in delivering public, academic and industry communication and outreach.

ADVISORY GROUP

Hamish Mitchell
Managing Director
Speciality Trees (VIC)

Hamish Mitchell is the owner and Managing Director of Speciality Trees.

With a passion for trees in urban environments & a career that spans nearly 30 years in amenity horticulture, plant management & development, production and plant marketing, he is a knowledgable resource in all areas of tree selection and consultation.

Tim Carroll
Councils & Key Account Manager
Andreasens Green Wholesale Nurseries (NSW)

Recognised as the company's advanced tree specialist, Tim oversees supply of trees to most of the major developers in Sydney as well as councils for their street tree planting programs.

Tim conducts the training of all nursery staff in AS2303, quality control and also lead groups of landscape architects, councils and tree planters in similar training.

Tim also attends workshops of organisations such as AILA and the Local Government Landscape Design Forum.

Leanne Fleming
Research and Innovation Manager
Fleming's Nurseries (VIC)

Leanne holds a science degree and postgraduate horticulture qualifications, and has more than 23 years experience in the industry and has a range of experience in:

- propagation
- bare root
- containerised tree production
- street tree installation and maintenance
- event and project management
- management of quarantine processes (domestic and international)
- broad overview of the nursery industry on state, national and international levels

ADVISORY GROUP

Dr Lyndal Plant
Lyndal Plant Urban Forester Pty Ltd (QLD)

Lyndal's 25 years of local government urban forest management experience, research and engagement skills has helped align organisational goals with contemporary evidence gathering techniques to suit projects, policy development/review and cutting edge initiatives.

Lyndal sees the forest, not just the trees – helps plan and monitor for outcomes, not just the outputs – focuses on trees for people ("human habitat" values) - and engages customers and partners.

Some of Lyndal's urban greening achievements include:

- Brisbane Neighbourhood Shadeway program, including av. 10,000 shade tree plantings per year for cooling shade-hungry pathways, playgrounds and carparks.
- Project reporting for Brisbane's 2 million tree project
- Development and monitoring of native street tree species trials.
- Brisbane's Subtropical Boulevard Vision and delivery strategy.
- Member of expert panel for review of Canberra's Urban Forest Renewal Strategy

Most recently Lyndal has published on evidence gathering methodologies for urban greening target evaluation and property value/tax based business case for investment in leafier streetscapes.

Carole Fudge
Sales and Marketing Manager
Benara Nurseries (WA)

Carole has been involved in the nursery industry for 40 years, 30 years of this at Benara Nurseries in sales and marketing.

Carole has been involved in the scheduling and research of plant varieties, of which they grow over 1500 different species.

During this time Carole has worked with Landscape Architects, landscape contractors, local government and retailers working out which plants would work best in their particular projects.

Carole has extensive experience in what works in the landscape in Western Australia, both native and exotic, and also works with breeders trialing new plant material for both landscape and retail markets.

ADVISORY GROUP

Hugo Struss
General Manager and Director
Tinamba Turf (QLD)

Hugo has been working on the family business since finishing primary school. Between boarding school and work at home on the main property, Tinamba Turf (the family business) has continued to grow into what is now the largest family owned turf production business in Australia. After finishing school Hugo worked on the property while studying commerce (majoring in marketing) and then to construction management. At this time he also competed heavily at an elite level in national and international rowing.

In 2010, Hugo joined the business full time in a sales role, and worked his way up to general manager. He oversees the sales, operations on and off farm, staff, business development and production of three farm sites. Tinamba Turf has nearly 1000 acres under irrigation.

Lara Solyma
Senior Environmental Planner
City of Gold Coast (QLD)

After completing an environmental science and management degree, Lara worked for 10 years as a practitioner of horticulture, landscape design, plant design, landscape construction, landscape maintenance and ecological restoration within southeast Queensland; developed her plant knowledge and a passion for the plants and vegetation communities of south-east Queensland, and started and successfully operated her own horticultural business. Lara started working in local government in 2006 and over eleven years has worked in a variety of roles across the organisation, further developing skills and expanding knowledge and abilities into new areas, including:

- Public open space design and assessment, including streetscaping
- Public landscape works approvals. How to facilitate improved, extensive street tree plantings
- Species selection and issues of biodiversity, soils, urban constraints, provenance, nursery availability, lack of plant knowledge, specification of plant species and palette diversity
- Project management, including the Gold Coast Regional Botanic Gardens which included design and plant selection for a proposed Children's Garden and extensive wetland / stormwater treatment system
- Vegetation asset management, vegetation cover and use of i-Tree Canopy
- Environmental planning, policy development and policy implementation, community consultation, significant tree registers.

ADVISORY GROUP

Simon Adermann
Business Manager
Lawn Solutions Australia (QLD)

Simon has been involved in the turf industry for 37 years, commencing with an apprenticeship in Turf & Greenkeeping in 1981 and 13 years as a Greenkeeper in the lawn bowling industry. From there, Simon commenced employment with Nuturf, a specialist product supply company to the turf industry as the QLD manager and in 2007 took the position of National Sales Manager managing the responsibility of the Australian and overseas business. After 18 years with Nuturf he was made National Business Manager for Lawn Solutions Australia in 2013. Simon now manages 43 turf production farm accounts nationally.

Carl Heyne
General Manager
Heyne Nurseries (SA)

Tim Sansom
General Manager
Australian Ecosystems (VIC)

Tim has extensive horticultural and business skills, working his way through several roles over the last 13 years with The Diggers Club. During this time he worked as a Garden and Site Manager at the prestigious Garden of St Erth in Central Victoria curating an internationally acclaimed public garden and through various horticultural business management roles (including 10 years' intimate involvement with nursery operations).

Tim has recently taken a role as General Manager - Nursery, with Australian Ecosystems, a company that specialises in seed collection, propagation and sourcing of local provenance plants for all Victorian regions. In this role, he is involved with the production and marketing of plants for clients including Commercial and Residential developers, Civil Contractors, Landscape Architects, Local Councils and State and Federal Government Departments.

ADVISORY GROUP

David Callow
Team Leader
Urban Forest & Ecology Urban Sustainability
City of Melbourne (VIC)

David has two decades of experience in Landscape Horticulture. He has qualifications within the fields of Horticulture, Arboriculture and Natural Resource Management.

David is passionate about creating healthy and diverse urban forests through community participation, strategic thinking and continuous improvement.

In his role at the City of Melbourne, he is responsible for implementing the Urban Forest Strategy, through the annual tree planting program.

Prior to joining the City of Melbourne, he was self-employed as an Arboricultural and Landscape Consultant.

Brigid Adams
Manager IWM Program Governance and Capacity Building
Department of Environment, Land, Water & Planning

Brigid is a highly personable multi-skilled Environmental Engineer with 16 years' experience in water management and climate change mitigation.

She possesses well-developed strategic planning and project management skills, with proven technical expertise.

Brigid is experienced in all aspects of the project delivery life cycle, from strategy development to program implementation, monitoring and evaluation.

Her influential interpersonal skills allow for effective communication with team members and key stakeholders to achieve organisational goals in an effective manner.

ADVISORY GROUP

Mathew Plummer
Managing Director
EvergreenConnect (QLD)

Mathew is a horticulturalist with 30 years' experience in the nursery industry, having worked in a range of wholesale nurseries growing everything from plugs to ex-ground production stock.

As operations manager of Newton Container Trees in Brisbane in the 1990's, Mathew took a leading role in Queensland to critically look at and bring new production methods into the industry regarding tree root development.

As well as a number of horticultural qualifications, Mathew has undertaken business studies including a Diploma of Business Management and a Masters of Business Administration which has allowed him to successfully manage nursery businesses and create his own business from scratch, EvergreenConnect. EvergreenConnect is being positioned to be a vital communication and data link for all facets of the horticultural industry.

Suzanne Dunford
Principal Project Officer
Impacts and Adaptation
Office of Environment and Heritage (NSW)

Suzanne Dunford is the Principal Project Officer in the Impacts and Adaptation Team at the NSW Office of Environment and Heritage. Her role focuses on supporting local government with tools, information and capacity to minimise the impacts of climate change in their local communities, through the establishment of projects including: the $1 million Building Resilience to Climate Change grants program, the NSW Urban Green Cover program, and leading an Integrated Regional Vulnerability Assessment of as part of the Towards a Resilient Sydney project.

This four year project engaged with over 270 different local and state government decision makers, and leading researchers to identify the impacts of climate change on social, economic and biophysical systems in Metropolitan Sydney and opportunities to respond. It was delivered in partnership with the Department of Planning and Environment, the Sydney Coastal Councils Group and the Western Sydney Regional Organisation of Councils.

Suzanne has have been working in the climate change field in a range of communications, program and policy roles since 1998. She has a Bachelor's degree in Organisational Communication from Charles Sturt University and a Masters of Public Administration from the University of Sydney.

ADVISORY GROUP

Noel Corkery
Managing Director
Corkery Consulting (NSW)

Noel is a Registered Landscape Architect with more than 30 years of landscape and urban design consulting experience throughout Australia and Asia. Noel has managed multi-disciplinary consultant teams for projects involving 'green infrastructure' such as public open space, urban development, landfills, forestry, highways, windfarms and mines. Noel has developed a strong understanding of sustainable development principles and their application to integrated planning and design.

Noel's qualifications:

- Bachelor of Science (Forestry), 1968, Australian National University.
- Master of Landscape Architecture, 1978, Cornell University.
- Master of Business Administration, 1989, Australian Graduate School of Management (UNSW).
- Master of Cross-Disciplinary Art & Design, 2011, COFA, UNSW.

Noel was awarded the AILA 2013 NSW Presidents Award in recognition of outstanding contribution to the profession of landscape architecture.

Jason Hick
Director, Principal Consultant
Emerge Associates (WA)

Jason is an environmental consultant and now part-owner of a combined environmental consultancy and landscape architectural practice, the largest of its kind in Western Australia.

Emerge Associates works across many projects for property developers, local government and state government, and integrate the provision of a range of technical environmental advisory areas with landscape architectural design and delivery.

WHICH PLANT WHERE?

For more information:

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www.whichplantwhere.com.au

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