

TIME'S UP

*making green
infrastructure count*



Acknowledgement

Prepared under the supervision of Dr Hazel Easthope as part of Master of Urban Policy and Strategy (MUPS) at the University of New South Wales (UNSW) in Sydney, Australia.

Disclaimer

This report has been prepared by the authors as students of UNSW. This report does not represent the views of the authors' employers, the project client, or UNSW.

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Front cover image: Kate Freney

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Acronym List

ACT	Australian Capital Territory
ALGG	All London Green Grid
BASIX	<i>State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004</i>
BID	Business Improvement District
CBA	Cost Benefit Analysis
CPRE	Campaign to Protect Rural England
CSP	Council Strategic Plan
DA	Development Assessment
DCP	Development Control Plan
DPE	Department of Planning and Environment
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPI	Environmental Planning Instrument
EPA	Environmental Protection Agency
ESD	Ecologically Sustainable Development
EU	European Union
EUA	Environmental Upgrade Agreement
FSR	Floor Space Ratio
GLA	Greater London Authority
GRGW	Green Roofs Green Walls
GSC	Greater Sydney Commission
IPART	Independent Pricing and Regulatory Tribunal
KPI	Key Performance Indicators
LAI	Leaf Area Index
LCA	Life Cycle Assessment
LEP	Local Environmental Plan
LGA	Local Government Area
LSPS	Local Strategic Planning Statement
MCA	Multi-Criteria Analysis
NPPF	National Planning Policy Framework
NSW	New South Wales
PPP	Public Private Partnership
ROC	Regional Organisation of Councils
SEPP	State Environmental Planning Policy
SIC	Special Infrastructure Contribution
TEV	Total Economic Value
TIF	Tax Increment Financing
TDR	Transferrable Development Rights
WSUP	Water Sensitive Urban Design

Table of contents

Executive summary	7
1. Introduction	9
2. Research framework	15
3. Benefits of green infrastructure	19
4. Valuing green infrastructure	27
5. Financing and funding green infrastructure	39
6. Governance	55
7. Leadership	75
8. Recommendations	89
9. Sydenham-Bankstown case study	95
10 Conclusion	105
References.....	107
Appendix	119



Executive summary

Globally, the infrastructure renewal spend required by 2030 is estimated at \$40 trillion. As we move closer towards peak urbanisation, the infrastructure decisions we make today will be locked in for at least 100 years. With Sydney's population set to jump 80 per cent over the next three decades, it is more urgent than ever that this is matched by appropriate green infrastructure so that our city stays healthy, liveable, and close to nature.

The NSW Government Architect (GANSW) has asked a team of researchers from the UNSW Masters of Urban Policy and Strategy to consider the regulatory and funding barriers to green infrastructure delivery in Sydney, and devise options that address these barriers. This research uses GANSW's comprehensive definition of green infrastructure included in the draft *Greener Places* policy:

Green Infrastructure is the network of green spaces, natural systems and semi-natural systems including parks, rivers, bushland and private gardens that are planned, designed and managed to support a good quality of life in an urban environment.

Green infrastructure directly and indirectly benefits economies, communities, and the environment. This suite of benefits operates at local and regional through to national and international scales, and accrues to governments, businesses and individuals. However, too often green infrastructure has come off second best, seen as a cost rather than an opportunity to improve our cities. Sydney is running out of time and can no longer afford this approach.

The value of green infrastructure extends far beyond environmental benefits. Environmental assets are also valuable for their economic and social benefits. Therefore, accurately valuing green infrastructure requires capacity to measure different types of benefits. Instrumental, institutional and intrinsic valuation achieve this.

In NSW, green infrastructure is funded by Commonwealth and State Government general revenue, grant programs of all levels of government, council property rates, user charges on water bills, and impact fees in the form of development contributions and voluntary planning agreements. Recent advances in the evidence base on the indirect financial benefits of green infrastructure have helped identify the true beneficiaries of green infrastructure. This is driving the emergence of new finance and funding mechanisms, some of which are already in use in NSW.

Identifying green infrastructure as a priority objective for government could leverage central agency support for a coordinated and forensic review of policy and regulation that would identify whole-of-government barriers to green infrastructure delivery and minimise these. Leadership will be crucial to successful delivery. Not just leadership that lasts an electoral cycle, or the tenure of one committed executive, but enduringly.

Recommendations

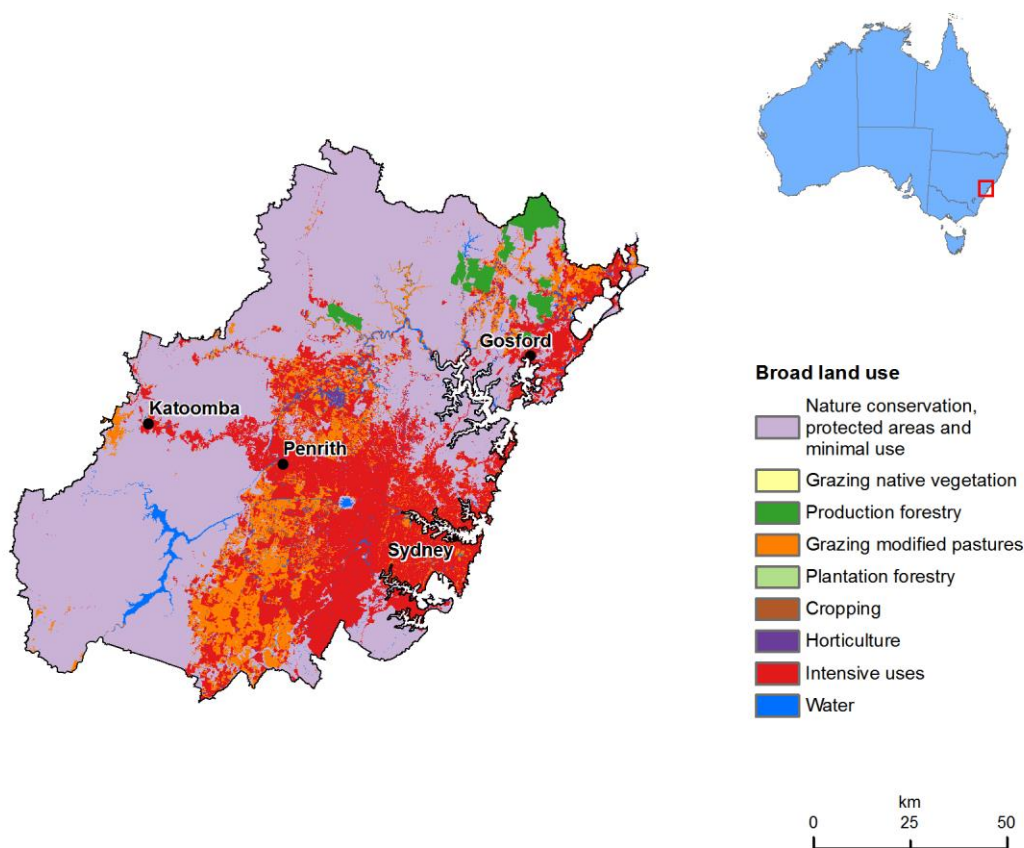
Based on our research, there are steps the NSW Government could take to enhance green infrastructure delivery in Sydney. They are based on a review of international research and practice and interviews with local stakeholders. Strong leadership, underpinned by substantial institutional value, are central to the successful implementation of these recommendations. Without these elements in place, it will be exceedingly difficult to enhance green infrastructure delivery in Sydney.

1. Make green infrastructure a NSW Premier's Priority.
2. Develop funding bids to the NSW Environmental Trust Environmental Research Grants and Climate Change Fund to develop an evidence base of the benefits of green infrastructure to the NSW Government and economy.
3. Use the evidence base to unlock new finance and funding mechanisms such as Green Bonds, Special Infrastructure Contributions, or securitised tax increment financing.
4. In collaboration with NSW Treasury, update the UK's Green Infrastructure Valuation Toolkit and establish it as the standard approach to valuing green infrastructure for capital investment business cases in NSW.
5. Develop a central repository of information to drive greater awareness of the range of green infrastructure benefits, how to effectively value these, and delivery strategies.
6. Use the evidence base to demonstrate to IPART that green infrastructure serves dual purposes and is a more cost-effective use of developer contributions.
7. Seek general revenue funding for green infrastructure from agencies such as NSW Health, Transport for NSW, NSW Roads and Maritime Services and Sydney Water that is proportionate to the avoided costs and indirect financial benefit they receive from green infrastructure.
8. Use the evidence-base to advocate to the CEFC to include natural green infrastructure solutions within its investment strategy. The evidence-base should also be used to work with private financiers to develop a financial model that incorporates natural solutions within EUAs.
9. Undertake a forensic review of central and line agency policies to identify direct and indirect goals and regulations that contradict or circumvent green infrastructure delivery.
10. The NSW Department of Planning and Environment should issue directions for green infrastructure to be considered by councils when developing, monitoring and reporting on LSPS.
11. Encourage councils to use cross-boundary VPAs to maximise the benefits and leverage economies of scale from delivering green infrastructure at sub-regional and regional scales.
12. Demonstrate leadership by including large-scale green infrastructure pilot projects in NSW Government-led urban renewal precincts.

1. Introduction

Ever since Captain Arthur Phillip arrived with his First Fleet in 1788, land use across Greater Sydney has constantly changed. Native bush was cleared to make way for the early urban centres of Port Jackson and Parramatta, and farms created on the fertile grasslands radiating out from Parramatta. Over time, much of that farming land was absorbed by Sydney's spreading suburbs with parks, sports fields and other green spaces overwriting the native landscape. Now, only remnant patches of Sydney's natural vegetation remain (Figure 1) (City of Sydney, 2013).

Figure 1 Land use cover for Greater Sydney



Source: Catchment scale land use of Australia ABARES 2016

As the pace of Sydney's population growth has accelerated, urban land has become more valuable. Pressure has intensified on existing green infrastructure forcing governments to grapple with the competing challenges of preserving green space while housing more people. Too often, green infrastructure has come off second best, seen as a cost rather than an opportunity to improve liveability. (Swinbourne & Rosenwax 2017).

With the city's population set to jump 80 per cent by 2054, there is growing concern green infrastructure delivery is not keeping pace with densification and climate change. This is despite widespread recognition green infrastructure is key to Sydney's liveability (Schaffer, 2017).

The global infrastructure renewal required by 2030 is estimated at \$40 trillion. As we move closer towards peak urbanisation, the infrastructure decisions we make today will be locked in for at least 100 years. With Sydney's population set to jump 80 per cent over the next three decades, it is more urgent than ever that this is matched by appropriate green infrastructure so that our city stays healthy, liveable, and close to nature.

The current rules surrounding green infrastructure delivery are haphazard, inconsistent and often ineffective. There is no single overarching policy or line of responsibility governing its delivery. Parks, tree plantings and open space are often treated as discretionary, or an afterthought to be shoehorned in once all other infrastructure is in place. In this way, the vital amenity provided by green infrastructure for people living in increasingly dense cities is under-valued.

Sydney can no longer afford this approach. From the outset, green infrastructure must be reclassified as 'essential infrastructure', as essential as the transport, power, water and telecommunication networks that make our city work. The economy, productivity, environment, and health and well-being of Sydney depend on it.

This research examines:

- the complex reasons why green infrastructure delivery in Sydney is lagging urban development, particularly in areas of major renewal, such as the Sydney Harbour to Bankstown Corridor
- the range of benefits and costs of green infrastructure
- methods for valuing these, and how other jurisdictions are approaching this
- the role governance and leadership play in delivering green infrastructure
- alternative models that could help regulate and fund green infrastructure delivery.

1.1. Background and history of the project – GANSW

Greater Sydney is expected to absorb an additional three million people over the next 35 years. As the number of infill developments increase in response, the challenge will be to shape Sydney's built and natural environs to ensure they remain liveable.

Green infrastructure is a hallmark of liveability. It includes the network of designed and natural vegetation and waterways found in cities and towns including public parks, recreation areas, sports fields, remnant vegetation, residential gardens, street trees, wetlands, community gardens and emerging urban greening technologies such as green roofs and green walls.

Well-planned green infrastructure helps absorb floodwater, cools the urban environment, cleans the air, enables local food production, ensures the survival of Sydney's fauna and flora, provides space for recreation, sport and leisure, improves community health and wellbeing, and creates jobs and economic growth.

There is recognition across government and the public that green infrastructure offers important economic, social and environmental benefits (Ely & Pitman, 2014; Commonwealth of Australia, 2017). Despite this, a recent report by international engineering firm AECOM noted:

Australian regulations and business models... focus on concerns about litigation, operating costs and engineering problems, without fully appreciating the value green infrastructure provides to our cities.

AECOM, 2017

GANSW is concerned green infrastructure delivery in Greater Sydney is not keeping pace with population growth, urban densification and climate change. Regulatory and funding mechanisms have been identified as major barriers to green infrastructure delivery (Young et al, 2014).

GANSW has engaged a team of UNSW Masters of Urban Policy and Strategy students to “...explore alternative delivery mechanisms beyond developer contributions to deliver Green Infrastructure” (Schaffer, 2017).

1.2. Definition of green infrastructure

Since humans invented language, writers, poets and philosophers have sought to define the therapeutic benefits to humans of being in proximity to nature and green space. Jane Austen’s character Fannie, for example, wrote in 1814 in *Mansfield Park*, “To sit in the shade on a fine day and look upon verdure is the perfect refreshment” (Austen, 1999).

In the 20th century, architects such as Frank Lloyd Wright believed the built environment should not be separated from nature. Indeed, Wright incorporated nature into his works whenever he could, with a most dramatic example in *Fallingwater*, a private home he designed in the 1930s which sits across a waterfall in Pennsylvania. “Study nature, love nature, stay close to nature. It will never fail you,” Wright is said to have instructed his students (Guggenheim Museum web-site, 2017).

The term ‘green infrastructure’ has been defined in many ways. Many definitions are simply lists of what green infrastructure includes.

Parks and reserves, backyards and gardens, waterways and wetlands, greenery on streets and transport corridors, pathways and greenways, squares and plazas, roof gardens and living walls, sports fields, and cemeteries

Jones, R. N., Symons, J. & Young, C. K., 2015

Or green infrastructure is described for its utilitarian value: “... a cost-effective, resilient approach to managing wet weather impacts ... that reduces and treats stormwater at its source while delivering environmental, social, and economic benefits” (United States Environmental Protection Agency web-site). Again: “Green infrastructure offers attractive solutions to environmental, social and economic issues, and as such needs to be fully integrated across different policy domains” (European Environment Agency web-site).

The American environment advocacy organisation, American Rivers, defines green infrastructure not only for what it does, but also for whom it benefits:

Green infrastructure incorporates both the natural environment and engineered systems to provide clean water, conserve ecosystem values and functions, and provide a wide array of benefits to people and wildlife.

American Rivers website

Here in Australia, the Institute of Landscape Architects defines green infrastructure as:

... the network of natural landscape assets which underpin the economic, socio-cultural and environmental functionality of our cities and towns—i.e. the green spaces and water systems which intersperse, connect and provide vital life support for humans and other species within our urban environments.

For the purposes of this research, we are using the comprehensive definition included in the *Working Draft of Greener Places*, by GANSW:

Green Infrastructure is the network of green spaces, natural systems and semi-natural systems including parks, rivers, bushland and private gardens that are planned, designed and managed to support a good quality of life in an urban environment.
GANSW, 2017

1.3. Aims and research questions

The aim of this research is to advise GANSW on alternative regulatory and funding mechanisms for green infrastructure delivery in Sydney. It explores three main questions:

1. How is green infrastructure delivered in urban infill developments?
2. What are the major barriers to delivery?
3. What alternative regulatory and funding mechanisms could enhance delivery?

For the purposes of this research, urban infill development is defined as new mixed-use residential and commercial properties in existing urban areas, often at higher building densities.

1.4. Objectives of this research

GANSW is currently consulting on a draft green infrastructure policy called *Greener Places*. This is “a State policy which is measurable and assessed against agreed criteria, enabling better opportunities for industry to embed the benefits of a greener approach to projects” (GANSW, 2017). This research supports *Greener Places* by:

- providing an understanding of regulatory and funding mechanisms for green infrastructure delivery in urban infill developments, including land-use regulations and development controls, voluntary planning agreements (VPAs) and contributions under the *Environmental Planning and Assessment Act 1979* (EP&A Act), as well as user charges
- identifying the barriers to green infrastructure delivery in urban infill developments, with a particular focus on regulation and funding
- developing a suite of options that respond to the barriers and enhance green infrastructure delivery in urban infill developments
- applying the options to a case study in Greater Sydney, the Canterbury Precinct of the Sydenham to Bankstown Corridor.

1.5. Target audience

As well as GA NSW, our research is relevant to state and local government planning departments, developers, architects, landscape architects, financiers and environmental consultants.

1.6. Our Approach/Method

Our project methodology is set out in greater detail at Appendix 1.

Stage 1

International desk-top audit to define green infrastructure and its value. A summary of benefits.

Stage 2

International and inter-jurisdictional desk-top audit of current best practice in green infrastructure delivery.

Stage 3

Desk-top audit of current policy and practice in delivery of green infrastructure across Greater Sydney.

Stage 4

Interviews with ten professionals involved in the delivery of green infrastructure.

These included architects, landscape architects, developers, environmental consultants, local and state planners and financiers. The interviews covered current practice, barriers and ideas for alternative regulatory and funding mechanisms for green infrastructure.

Stage 5

Drawing from the outcomes of Stages 1-4, we provide options for regulatory and funding mechanisms.

Stage 6

Finally, a demonstration of how the options could be applied to the Sydenham-Bankstown Urban Renewal Corridor.



2. Research framework

This Chapter sets out the theoretical framework for the research. It contains the component pieces, identified through research and analysis, to enhance green infrastructure delivery in Sydney.

2.1. Physical limitation to green infrastructure

We recognise there are physical limitations to green infrastructure delivery. These range from soil type or quality, to site location, to the size of the area available. For example, Rhodes and Rozelle, have highly contaminated soil and water after years of heavy industry; this places significant cost restraints on the type and scale of green infrastructure delivered.

In other jurisdictions, climate is already a prohibiting factor. For example, major cities such as Phoenix, Arizona, are unable to include green roofs due to its low rainfall and soaring summer temperatures. Climatic factors will likely affect green infrastructure in Sydney. Above and beyond these, there are other barriers to green infrastructure delivery in Sydney, and NSW as a whole. Our focus has been on these because government often has greatest control over them.

2.2. Literature review

The first stage of the team's work involved an extensive literature review, which led to the earlier definition of green infrastructure, and the development of a theoretical framework. This also highlighted various successful delivery models around the world, and a wealth of options that can underpin more effective delivery in Sydney.

Despite its benefits, green infrastructure delivery in Sydney is lacking. Our research has highlighted three parts to this problem:

- green infrastructure is not valued in a way that grants it any more than intrinsic value;
- the governance mechanisms for green infrastructure delivery are inadequate; and
- there is a lack of leadership across sectors and scales in valuing green infrastructure.

Without a solution to each of these, there is a risk the status quo will be maintained, or diminished. Increasing pressure for urban land-use will confine green infrastructure to a distant priority, and delivery will not increase in the volumes required to support growth.

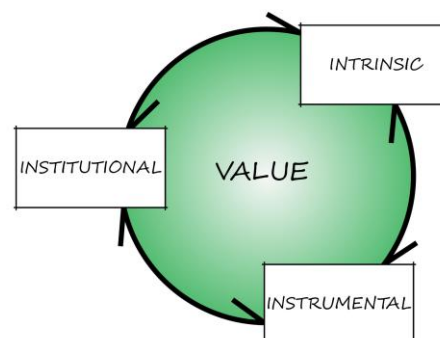
In response, our theoretical framework has three pillars – value, governance and leadership. In order to have effective and reliable delivery, green infrastructure must be valued correctly, there must be effective governance structures in place to encourage or require its delivery, and leadership will be the driving force for this.

2.3. Our theoretical framework

Each pillar of the framework can be further broken down into component pieces.

Value

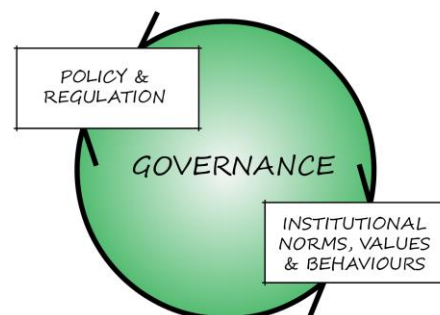
There is widespread recognition of the value of green spaces for their comfort, as social gathering spaces, and as environmental stepping stones for a city. There are a wide range of known benefits of green infrastructure, including economic, health and environmental. These benefits are explored in more detail in the following chapters, which deal with different reasons for, and methods of, valuing green infrastructure.



There are three ways to value the range of green infrastructure benefits: intrinsic or inherent value, institutional or governmental value, and instrumental or economic value. The intrinsic value of green infrastructure is widely recognised in Sydney. However, there are few methods in use for valuing it institutionally or instrumentally and this causes disparities between need and dollar value, leading to bias in our delivery system. Fortunately, new approaches to instrumental and institutional valuation around the world show great promise. These have successfully enhanced delivery in places such as Manchester in the UK and Bruges in Belgium, as discussed at Chapter 4.

Governance

There are two key barriers to good governance of green infrastructure: delivery-enabling policy and regulation, and ingrained behaviours that privilege conventional over green infrastructure. These are a result of the established policy and regulatory environment for green infrastructure delivery, and established practices, norms, and values that frame our inclination to support green infrastructure.

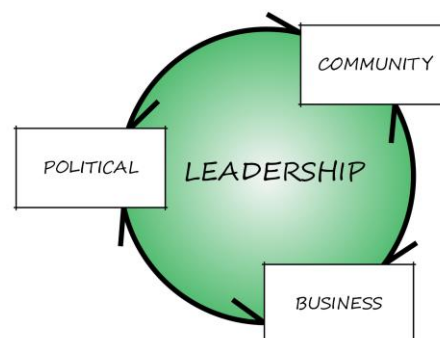


Options to overcome these policy and path dependency issues are set out in Chapter 7: Governance, which identifies the symptoms of institutionalised behaviours, and offers solutions.

Leadership

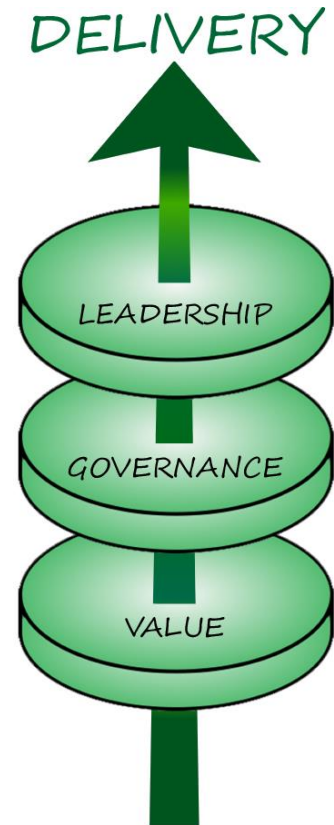
There are three key spheres of leadership influence: community, politics, and business. Each has a role to play in green infrastructure delivery, and can independently be a catalyst and drive projects. But their interaction is critical to the more effective and consistent delivery of green infrastructure.

Whether that leadership comes from community, politicians and government structures, or businesses and the development industry, leadership is critical to the successful delivery of green infrastructure. Where two or more come together to support delivery, there is greater uptake. This has been shown in international jurisdictions, such as England's north west where the status of green infrastructure has been elevated through support from regional economic decision makers and "... those more traditionally involved in green space policy such as conservationists, environmentalists, parks managers and community focused organisations" (Horwood, 2011). Further solutions to overcoming leadership hurdles are discussed in Chapter Eight: Leadership.



2.4. Framework as a whole

Green infrastructure can, of course, be delivered without all three parts of the framework in action. For example, Blacktown Council runs regular community tree planting events in their council area, with the aim of restoring local bushland, enhancing amenity, increasing local biodiversity and encouraging the return of native birds into the Bells Creek Corridor (Blacktown Council, 2017). There is no statutory requirement for these events; the council recognises the intrinsic value of trees and their role in reducing summer heat loads and regenerating local environment. In this way, just two of the pieces – leadership and value – are present in the delivery process. However, whilst green infrastructure can be realised when only one or two pieces are in play, the strongest action will come when all three pieces are activated.





3. Benefits of green infrastructure

Green infrastructure directly and indirectly benefits economies, communities, and the environment. This suite of benefits operates at local and regional through to national and international scales, and accrues to governments, businesses and individuals (Ecotec, 2008a).

Importantly, these benefit types, scales and beneficiaries are inter-linked, which means green infrastructure spans property, legal, policy and sectorial boundaries (Horwood, 2011). Yet lack of private sector involvement in planning, investing and managing green infrastructure, alongside limited integration within government machinery, indicates current delivery approaches are institutionally ineffective (Young & McPherson, 2013).

This is largely because most are unaware of the diverse benefits of green infrastructure or mistakenly believe it is more costly or difficult to implement than grey infrastructure (Flynn & Traver, 2013). Effective delivery requires integrated planning, investment and management that highlight the diverse benefits and range of beneficiaries of green infrastructure (Environmental Consulting Technologies, 2016). In all, this makes it an ideal candidate for new governance arrangements that adequately value its benefits.

When I talk about green infrastructure, I refer to the variety of benefits: healthy living; improved air and water quality; active transport; and improved urban amenity.
Barbara Schaffer, GANSW

3.1. Environmental benefits

Green infrastructure has substantial environmental benefits for governments, businesses and communities. These include improved air quality, reduced emissions, protection and enhancement of biodiversity values and ecosystem services, a cooler urban environment, and greater capacity for water filtration, absorption and retention. For example:

		
Street trees are 20 per cent more cost-effective at shading bus stops than metal shelters	Open space is three times more cost-effective at lowering sulphur dioxide emissions from power plants	Vertical green walls lower interior temperatures by 2 degrees
		
Constructing green infrastructure is less carbon intensive than conventional infrastructure	Planting 12 trees can offset a person's entire annual carbon dioxide emissions	A 10 per cent increase in green space reduces stormwater runoff by 5 per cent

(Cameron *et al.*, 2012; DeSanto *et al.*, 1976 cited in McPherson, 1992; De Sousa *et al.*, 2012; Ecotec, 2008c; Netusil *et al.*, 2011)

These also translate to indirect economic and social benefits for governments, businesses and communities. For example:

- By reducing the need for organisations such as Sydney Water, Sydney Harbour Foreshore Authority and NSW Environmental Trust to spend money on complex engineered solutions for stormwater quality improvement, and waterway health programs
- By reducing the likelihood ageing populations will succumb to heat stress and avoiding costs on public hospitals and the health system more broadly
- By lowering NSW household and business energy bills and insurance premiums, freeing up this economic activity for deployment in more productive parts of the economy
- By helping governments meet Paris Climate Agreement commitments and providing individuals an easy way to exercise environmental stewardship commitments and providing individuals an easy way to exercise environmental stewardship

We have a good idea of how much green cover you need to reduce temperatures by one degree in NSW.

NSW Government Employee

3.2. Social benefits

Green infrastructure has a range of social benefits. These include picturesque environs that reduce stress and improve mental health, assist with medical recovery, encourage exercise and social interaction, and improve quality of life (Mell, 2010; Glover *et al.*, 2005 *cited in* Cameron, *et al.*, 2012).

These also translate to indirect economic benefits for governments, businesses and individuals. For example, the mental health benefits of green infrastructure lower absenteeism and improve workforce productivity (Ecotec, 2008a), and a 2004 UK Department of Health study found a 10 per cent increase in adult exercise through greater access to green space could save 6,000 lives and reduce health system costs by £8.2 billion annually (Mell, 2010).

We need to measure what the benefit is going to be for non-communicable diseases and public health such as diabetes and obesity.

Roger Swinbourne and James Rosenwax, AECOM

3.3. Economic benefits

Green infrastructure has direct economic benefits for governments, businesses and individuals. For example, green stormwater infrastructure is more resilient and reduces flooding, which avoids damage to public and private assets, lowers insurance claims, and reduces disaster recovery costs (Mogge, 2014; Ecotec, 2008a; Green *et al.*, 2016). There is also convincing evidence that a range of green infrastructure types from street trees to parks and green roofs generate significant property value increases (Cabanek & Newman, 2016).

Figure 2 Value uplift by tree type

Price increase	Condition
2%	Mature yard trees (greater than 9-inch diameter at breast height)
3-5%	Trees in frontyard landscaping
6-9%	Good tree cover in a neighbourhoods
10-15%	Mature trees in high-income neighbourhoods

Source: Wolf, 2007 cited in Davies et al 2017a

The community see trees as a risk that will blow over and hurt their family rather than something that will improve property value. There is a real communication issue because the benefits are complex, diverse and not well understood. We are building mechanisms to manage risk but not for benefit management. We did some research that showed a heavily tree-lined area fared better during cyclones because trees protected houses from wind speeds. But the actuaries mistakenly perceive otherwise.

Roger Swinbourne and James Rosenwax, AECOM

For example, New York's High Line increased surrounding property values by \$100million, accessible green roofs increase property values by 11 per cent and surrounding properties by 2 per cent, proximity to parks in Philadelphia has increased values by 20 per cent, whilst a \$380 million naturalisation of a freeway into a river has increased values by 50 per cent and attracted more than \$2billion in capital investment to Seoul (Cabanek & Newman, 2016).

New woodland on the former Bold Colliery site in the UK has increased property values by £15 million (Ecotec, 2008b). Interconnected parks that improve the accessibility and amenity of an area increase house and land values on average 8 per cent and by as much as 36 per cent.

(Jones et al, 2015; Foster et al, 2011; Ecotec, 2008a)

Like any infrastructure, jobs are also created during the design, construction, operation and maintenance of green infrastructure and this translates into economic activity (Ecotec, 2008a). For example, interconnected parks can serve as urban farms that produce local food and create jobs in both the agriculture and tourism sectors (Ecotec, 2008b).

Work in the UK's Northwest to rebuild Osprey nests has attracted 100,000 additional tourists, created 34 jobs during breeding season, and generated £2million in economic activity (Ecotec, 2008b).

These economic benefits have served as strong foundations for leaders to drive green infrastructure interventions other jurisdictions. For example: green infrastructure has long underpinned Singapore's economic development plan; Vancouver is in the process of installing a large urban farm in the middle of the city; the UK Government's 2011 Natural Environment White Paper established a nation-wide policy based on the economic benefits of green infrastructure; and London is currently assessing the economic benefits of its parks and green space as the basis for a natural capital account. These are further discussed at Chapter Seven: Leadership.

Case Study: Establishing the economic benefits of green infrastructure Ecotec (2008a)

Action 113 of the UK's Northwest Regional Economic Strategy (NWRES) sought to optimize the environment's contribution to the economy. However, one of the downsides was that evidence of the economic benefits of green infrastructure was spread across numerous studies.

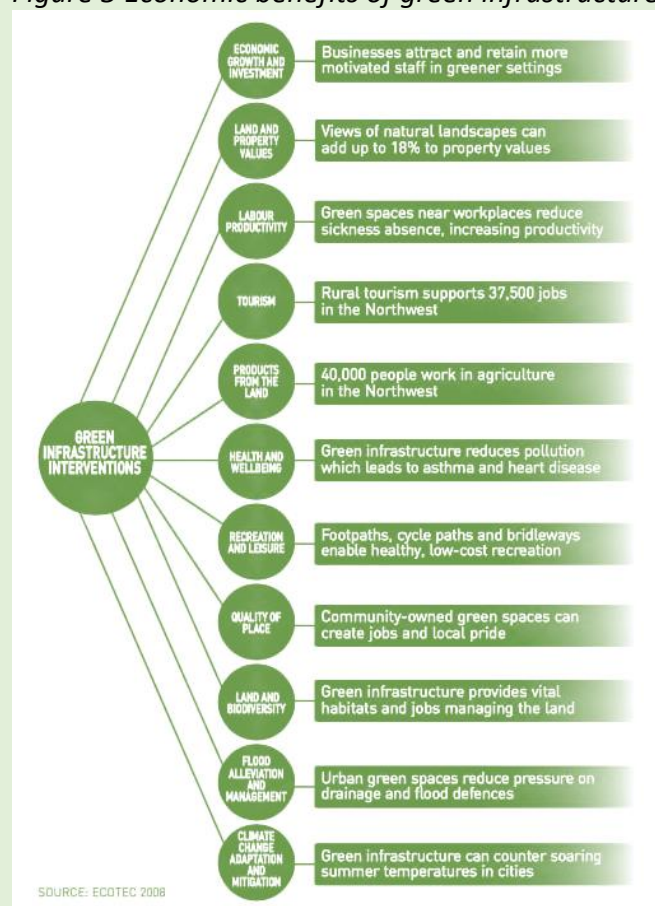
A partnership between Natural Economy Northwest, the Northwest Regional Development Agency (NWRDA), Government Office North West, and Natural England synthesized the evidence and identified 11 distinct economic benefits (Figure 2).

These benefits are summarized as (Ecotec, 2008a):

- Direct economic activity
- Indirect economic activity
- Public and private sector cost reduction
- Risk management

This comprehensive understanding of green infrastructure's economic benefits has enabled the development of tools to identify its true value and beneficiaries, and successfully institutionalised green infrastructure in public and private sector decision-making (Horwood K. , 2011).

Figure 3 Economic benefits of green infrastructure



Source: Ecotech (2008a)

3.4. Financial benefits

Green infrastructure tends to have fewer direct financial benefits when compared to other infrastructure such as toll roads. For example, the financial benefit of lower energy bills from street trees cooling interiors accrue to homeowners and businesses rather than nature. This is because nature is not paid for the ecosystem services it provides, which are worth more than \$72trillion globally and account for more than a third of any country's overall wealth (Mogge, 2014).

Blacktown City Council has informed residents in one street that adjusting the number and type of trees could save \$249 every year on average household energy bills (AECOM, 2017).

At the start of the Blacktown process, residents only wanted small trees in front of their house but by the end of it they were wanted big trees because of the energy savings.

Barbara Schaffer, GANSW

The cost to manage tree trimming across Sydney is about 10 cents per square metre but the value returned is about \$300 per lot.

Roger Swinbourne and James Rosenwax, AECOM

3.5. Green infrastructure costs

Green infrastructure has benefits *and* costs. Importantly, policy-makers tend to misunderstand the costs. Cost types include environmental, economic and financial and the quantum of these varies by the type and scale of green infrastructure. For example, costs per hectare are lower for large green infrastructure projects in rural areas and higher for isolated projects in urban areas (Ecologic, 2011). One way to minimize these is large-scale adoption at sub-regional or regional scales, which has been found to produce economies of scale and lower costs by up to 95 per cent (Environmental Consulting Technologies, 2016).

Minimising environmental costs requires engineering solutions to issues such as pollen production, hydrocarbon emissions, green waste disposal, water consumption, and displacement of native species by exotics (McPherson, 1992). The main economic cost is from foregone development through land use restrictions, although this is often overlooked when valuing projects (Ecologic, 2011). This is particularly important for urban infill areas where population growth has increased land values and there is a need to assemble land parcels in fragmented ownership to deliver sub-regional scale projects that achieve economies of scale.

The financial costs of green infrastructure delivery tend to be largest (Ecologic, 2011). They include one-off design and construction costs and ongoing operation and maintenance. One off costs are highest for research and development to establish an adequate evidence base to value green infrastructure (Ecologic, 2011). Ongoing operation and maintenance are typically about 6 per cent of the one-off design and construction costs (Ecologic, 2011). Within these, maintenance is typically largest, at around 70 per cent, followed by project management at around 25 per cent.

Whilst there is a perception green infrastructure costs more than conventional infrastructure (Choi & McIlraith, 2017), studies show this is wrong. For example, 17 cases examined by the United States Environmental Protection Agency (USEPA) (2007) showed natural drainage projects required fewer construction materials and were cheaper to construct by up to 80 per cent.

3.6. Summary

This section outlined the range and scale of direct and indirect economic, social and environmental benefits of green infrastructure to government, business and individuals. It also showed green infrastructure offers significant avoided costs and lower delivery costs when compared to conventional infrastructure.

Importantly, paying close attention to the type and scale of green infrastructure helps maximise its benefits whilst minimizing costs (Ecotec, 2008b). For example, different park sizes and tree types lead to larger property value increases (Figure 3) whilst projects delivered at sub-regional and regional scales achieve substantial cost savings through economies of scale (Cameron *et al.*, 2012).

Trees and cost is an easy discussion, benefits not so much. This is where we need the evidence to come into play. The property value argument is the one that works for people. If you had the conversation that a tree-lined street increases values by \$50,000, people wouldn't cut down trees because they understand the implications.

Roger Swinbourne and James Rosenwax, AECOM

Figure 4 Value uplift by green space and dwelling type

	DETACHED	FLAT	NON-DETACHED
CITY PARK	19.97%	7.54%	2.93%
LOCAL PARK	9.62%	7.92%	9.44%
OPEN SPACE	2.71%	4.70%	0.44%

Source: Dunse, 2007

However, the subjective nature of valuing and proving the economic worth of green infrastructure has been a stumbling block (Ecotec, 2008a). For example, research shows a problem in Australia is the failure to comprehensively value green infrastructure benefits in project business cases (Davies *et al.*, 2017a). When this is done properly, there is convincing evidence green infrastructure has a higher return on investment compared to conventional infrastructure (McNeill & Rayment, 2015). Indeed, green infrastructure benefits are often several times higher than costs, sometimes by as much as 10:1 (Merk *et al.*, 2012).

Government's select infrastructure with higher benefit-cost ratios through business cases and, in this way, have an important role in influencing green infrastructure delivery (Merk *et al.*, 2012). By better understanding the quantum of benefits and costs, green infrastructure can be compared to conventional infrastructure and policy-makers can make more informed decisions about which to deliver. Given the weight of evidence on the greater benefits and lower costs of green infrastructure, this will undoubtedly enhance delivery.

Another problem has been that, unlike other infrastructure such as toll roads, green infrastructure tends to have few direct financial benefits in the form of revenue streams. This is important because cash strapped governments use these streams to finance and fund infrastructure delivery (Horwood, 2011). Work in the UK and Portland, Oregon have provided solutions to this by collating and synthesizing evidence on the economic benefits of green infrastructure and reconceptualising its financial beneficiaries (Ecotec, 2008a; Davies *et al.*, 2017a). Work in Portland, Oregon has also

focused on quantifying the economic benefits of green infrastructure. Whilst evidence to properly value the benefits of green infrastructure is a high cost project item, this is well worth it as it is a critical element to unlock new finance and funding arrangements (see Chapter 5).

The big issue is that it is easy to see the cost and revenue equation for a toll road where this is clear money coming in and travel time savings. Something like a park it is difficult to quantify the benefits because it goes to an anecdotal perspective of the benefits yet the costs are clear.

Julian Szafraniec, SGS Economics and Planning



4. Valuing green infrastructure

As has been shown, the benefits of green infrastructure extend far beyond its environmental qualities. Environmental assets are also beneficial for their economic and social qualities (Jones, Symons, & Young, 2015). Therefore, accurately valuing green infrastructure requires capacity to measure its different benefit types (Gallet, 2011). Instrumental, institutional and intrinsic valuation approaches achieve this.

Value type	Green infrastructure benefit examples
Instrumental Functional and market benefits of an asset (Horwood, 2011)	• property prices • tourism • products from the land • economic activity from design, construction, operation and maintenance • reducing energy bills, insurance premiums and disaster costs
Intrinsic Merit of an asset because it exists now and in the future (Vandermeulen <i>et al.</i> , 2011)	• public good in leaving an environmental legacy for future generations • community pride in a clean environment • volunteering opportunities that build social capital • greater community resilience
Institutional Contribution to related policy goals (Young <i>et al.</i> , 2014)	• economic growth • reducing health system costs • meeting water quality regulations • meeting Paris Climate Agreement goals

4.1. Methods of valuing green infrastructure

Correct, understandable and repeatable methods for valuing green infrastructure benefits are crucial to identifying and building support for investment amongst its beneficiaries. However, because green infrastructure has multiple benefits, one problem is too much choice in valuation methods (Jones, Symons, & Young, 2015). Australian research shows policy makers need guidance on identifying benefits and appropriate methods for valuing these (Jones, Symons, & Young, 2015).

In Australia, it is an emerging field, overseas it is a different matter.
Barbara Schaffer, GANSW

People working in green infrastructure muddle up the benefits and that doesn't do projects any good. Evidence isn't being applied to projects and policy-makers need help on how to bring general evidence to a specific project.
Julian Szafraniec, SGS Economics and Planning

A small number of Australian initiatives, such as 2020 Vision and Greener Places, are making tentative steps into this space by providing guidance on delivering green infrastructure projects.

However, the UK is particularly well advanced in this space. For example, a partnership led by the UK's Northwest Regional Development Agency has synthesized the evidence on green infrastructure benefits and agreed on the quantum and methods for valuing these (Ecotec, 2008a).

The UK's green infrastructure Valuation Toolbox assists policy makers identify evidence of green infrastructure benefits and determine appropriate methods to value them (Horwood K. , 2011).

The Green Infrastructure Valuation Toolbox features a menu of methods depending on the type of benefit being valued. Some include:

- tracking property value increases through the Valuer-General
- tracking reduction in disaster recovery costs through insurance premium data
- public sector tests of meeting regulatory service standards such as water quality
- private sector tests of avoiding costs such as reduced workforce absenteeism
- logic chains that link green infrastructure benefits to policy goals in health and energy.

The Toolbox is designed to be flexible and adapted to different projects. It includes a values library that quantifies green infrastructure benefits by type and per unit (Figure 4). New benefit amounts can be plugged into the library as local evidence becomes available. This is important given the quantum of benefits changes depending on the type and scale of green infrastructure, and the evidence base for interventions in Sydney is limited. A better local evidence base can help reduce existing uncertainties and variation when valuing green infrastructure.

The Centre for Independent Economics' (2017) draft business case for Sydney's Green Grid used secondary evidence. However, it lacked evidence specific to the Sydney context and an agreed quantum of benefits that could be realised. This meant benefit estimates varied widely by as much as \$8 billion.

Key decision-makers really want to see that local evidence base.
NSW Government Employee

Figure 5 Green Infrastructure Valuation Toolbox Values Library

Values library						
5. LAND AND PROPERTY VALUES	Value			Units	Date	Source
	Low	Mid/average	High			
City park, property value premium, detached house <450m		0.200		%		Neil Dunse, RICS (2007)
City park, property value premium, flat <450m		0.075				Neil Dunse, RICS (2007)
City park, property value premium, non-detached < 450m		0.030				Neil Dunse, RICS (2007)
Local park, property value premium, detached house <450m		0.096				Neil Dunse, RICS (2007)
Local park, property value premium, flat <450m		0.079				Neil Dunse, RICS (2007)
Local park, property value premium, non-detached < 450m		0.094		%		Neil Dunse, RICS (2007)
Open space, property value premium, detached house <450m		0.027				Neil Dunse, RICS (2007)
Open space, property value premium, flat <450m		0.047				Neil Dunse, RICS (2007)
Open space, property value premium, non-detached < 450m		0.004				Neil Dunse, RICS (2007)
Average property value increase following city park enhancement	0.050	0.060	0.070			CABE (2005); yellow figures are extrapolated for enhancement of local parks and open space, in proportion to Dunse's findings
Average property value increase following local park enhancement	0.024	0.029	0.034			CABE (2005); yellow figures are extrapolated for enhancement of local parks and open space, in proportion to Dunse's findings
Average property value increase following green space enhancement	0.012	0.014	0.016			CABE (2005); yellow figures are extrapolated for enhancement of local parks and open space, in proportion to Dunse's findings
Average property value increase following city park creation		0.120				From Dunse and CABE work, creation of a new asset has a value approx 2x enhancement. NB applies estimate across mix of house types.
Average property value increase following local park creation		0.058				From Dunse and CABE work, creation of a new asset has a value approx 2x enhancement. NB applies estimate across mix of house types.
Average property value increase following green space creation		0.028				From Dunse and CABE work, creation of a new asset has a value approx 2x enhancement. NB applies estimate across mix of house types.

4.2. Instrumental approaches

Since 2011, green infrastructure valuation in the UK has shifted rapidly from ecologically to economically driven to better reflect how ecosystems underpin economic growth (Ecotec, 2008a). Articulating green infrastructure in terms of its economic benefits has provided environmental policy-makers with a strong foundation to work with economic policy-makers when valuing green infrastructure (Horwood, 2011). Integrating economics into project development has provided an opportunity to realise the wider benefits of green infrastructure without compromising intrinsic and environmental values, such as biodiversity protection (Mogge, 2014).

Sometimes economic and environmental policy-makers don't see eye to eye because environmental policy makers are coming from a different perspective of passion for the environment.

Julian Szafraniec, SGS Economics and Planning

This approach has also resonated strongly with economic policy-makers because it engages with the quantifiable benefits of green infrastructure (Horwood, 2011). By comprehensively demonstrating the economic value of green infrastructure, environmental and economic policy-makers have found a new way of working with each other to effectively deliver green infrastructure (Horwood, 2011). This has offered a solution to the wicked problem of shifting established practice away from grey infrastructure and towards green infrastructure. It is now being followed in other jurisdictions, including the All London Green Grid and Bruges in Belgium, as further discussed in this Section and at Section 7.

Treasury are supportive but they cannot make the decision without the numbers. If the Government's primary priority is economic benefit then that is what we need to give them.

NSW Government Employee

The UK experience shows economic valuation is a critical element for effective green infrastructure delivery (Horwood, 2011). Economic valuation is measured by (Ecotec, 2008a):

1. Direct benefits (e.g. jobs created, tourism spend)
2. Indirect benefits (e.g. economic activity in green infrastructure supply chain industries)
3. Cost reduction (e.g. lower disaster recovery and health system costs)
4. Risk management (e.g. reduced insurance premiums for homes and business)

4.2.1 Cost-benefit analysis

Economic valuation assesses the benefits and costs of infrastructure (Vandermeulen *et al.*, 2011). Cost-benefit analysis (CBA) is the dominant method because it is an objective and evidence based way of comparing similar projects (Jones, Symons, & Young, 2015). However, even though green infrastructure offers many of the same functionalities of conventional infrastructure, these projects are rarely compared because green infrastructure is seen as having solely environmental purposes (Foster *et al.* 2011, p.4).

CBA tends to focus on up-front capital costs and is imperfect at valuing indirect benefits, particularly economic, over long time periods and multiple spatial scales (Mogge, 2014; McPherson, 1992;

Vandermeulen *et al.*, 2011). This is important because green infrastructure is far superior to conventional infrastructure at delivering such benefits, which means CBA biases against green infrastructure (Mogge, 2014; Ecotec, 2008a). CBA is also imperfect in that it fails to acknowledge land use change surrounding new infrastructure (Infrastructure Australia, 2016). Again, this is important because green infrastructure has been shown to change land use by attracting new businesses to an area.

Despite all of this, there remains a need to assess the economic return on investment in green infrastructure to compare to conventional infrastructure (Jones, Symons, & Young, 2015).

Economic valuation assesses the benefits and costs of infrastructure (Vandermeulen *et al.*, 2011). Cost-benefit analysis (CBA) is the dominant method because it is an objective and evidence based way of comparing similar projects (Jones, Symons, & Young, 2015). However, even though green infrastructure offers many of the same functionalities, it is rarely compared to conventional solutions because it is seen as useful for solely environmental purposes (Foster *et al.* 2011). CBA tends to focus on up-front capital costs and is imperfect at valuing indirect benefits, particularly economic, over long time periods and multiple spatial scales (Mogge, 2014; McPherson, 1992; Vandermeulen *et al.*, 2011). This is important because green infrastructure is far superior at delivering these types of benefits, which means CBA biases against it (Mogge, 2014; Ecotec, 2008a).

CBA is also imperfect by failing to acknowledge land use change that happens when new infrastructure is installed (Infrastructure Australia, 2016). Again, this is important because green infrastructure has been shown to change land use by attracting new businesses to an area.

In the UK, green infrastructure has increased commercial occupancy by 40 per cent, attracted high profile knowledge-economy jobs, and increased private investment (Ecotec, 2008a).

Despite all of this, there remains a need to assess the economic return on investment in green infrastructure to compare to conventional infrastructure (Jones, Symons, & Young, 2015).

4.3. Other economic valuation methods

New economic valuation methods are being used to more fully account for the range of green infrastructure benefits (Jones, Symons, & Young, 2015). These include travel cost, willingness to pay, hedonic pricing, tree valuation, life-cycle assessment (LCA), multi-criteria analysis (MCA), and total economic value (TEV) (Vandermeulen *et al.*, 2011; Jones, Symons, & Young, 2015). A selected overview of these methods is provided below. These have been selected because they have been applied to real cases of green infrastructure delivery, including in Sydney.

There is a value calculator that looks at how big a tree is and what type it is to provide a value proposition based on its annual return.

Roger Swinbourne, AECOM

Method	Description
Hedonic pricing	Observing differences in the values of property between locations, and isolating the effect of green infrastructure on those values. Used to measure the impact of green infrastructure on property prices.
Shadow pricing	A price set by government that determines the monetary value of a non-marketable good, for example, a price on carbon.
Travel cost method	The cost of green infrastructure and the benefit people get from it is inferred from the time and cost they incur travelling to it. Mainly used for public parks.
Effect on production	Impact on the environment and customer output, cost or profitability of producers. For example, reservoirs creating new fisheries, or bee keepers benefiting from gardens.
Benefits transfer	Adapts information from valuation studies undertaken elsewhere and applies them in a similar socio-economic context or location.
Return on investment	How much profit or cost saving is realised. Used by the private sector to develop business cases, for example a business park incorporating green infrastructure results in higher rental returns.
Multi-criteria analysis	Where possible, monetises all benefit types and then ranks these from most to least certain.
Life-cycle assessment	Compares the benefits provided by green infrastructure to the costs of providing hard engineering solutions, for example protection from flood risk or replacement cost.
Total economic value	Accounts for the direct and indirect economic benefits of infrastructure investment using a mix of methods including conventional CBA, hedonic and shadow pricing, benefits transfer and LCA.

4.4. Multi-criteria analysis

MCA ranks green infrastructure benefits from most to least certain (Jones, Symons, & Young, 2015):

1. Direct-use benefits with market values such as property value uplift
2. Direct-use benefits with shadow pricing or preference methods such as travel cost
3. Acquired values convertible into dollars such as willingness to pay studies
4. Indirect benefits that sustain social and environmental values. These may be converted into dollar-equivalent measures
5. Option benefits that relate to potential future uses such as land use change
6. Existence and other ethically framed values such as meeting related policy goals

Sydney's Greenway, a suite of projects along the corridor of land adjacent the Inner-West Light Rail route, has been valued using MCA. The Greenway includes cycle ways, parks, playgrounds, foreshore paths, and green links to tram stops, art galleries and cafes. The MCA assessed the benefits of each project and the cumulative benefit realised by all projects. It ranked benefits from most certain, such as travel savings, to least such as land use change along the route. It also assessed the Greenway's contribution to fully realizing the benefits of light rail investment through property value uplift.

Case Study: TEV of Bruges' Green Cycle Belt (Vandermeulen *et al.*, 2011)

Bruges in Belgium is home to more than 120,000 residents and 70,000 jobs. The Flemish Land Agency commissioned a 15km bike path connecting the inner city to surrounding areas. The path is integrated into the landscape and accommodates places to picnic, recreation facilities, access to historical monuments and new natural sites.

Data showed about 8,500 workers and 8,000 students commute to the city centre by bike every day, and 56,000 bike tours travel along the route annually. Based on stakeholder engagement, the new path was assumed to induce a 5 per cent increase in bike tourists.

The TEV considered:

1. capital investment in path construction, landscape gardening and improving access to adjacent heritage sites. This was then multiplied by regional input/output figures
2. excess burden costs of increased regional taxes to pay for the capital investment
3. project maintenance costs using data on annual district expenditure for maintaining bike paths and standard labour unit costs
4. design, construction and maintenance workers spending wages locally and across the region. This was then multiplied by regional input/output figures
5. regional land use change from farmers giving up their land, lost income from these farms, and paying a small number of landowners that sold their properties to the project
6. avoided car and congestion costs from travel behaviour change for 16,500 daily users
7. daily expenditure data for the assumed 5 per cent increase in bike tourists
8. reduced health care costs from a 40 per cent lower chance of daily cyclists dying at a young age, 1.5 per cent lower lifetime health costs for young cyclists, and a 1 per cent decrease in sick leave attributable to commuting cyclists
9. air quality improvements and lower emissions from increased tree canopy cover and modal shift between cars and bikes, based on an annual cost to society per ton of CO₂
10. improved traffic safety and avoided costs per injury and death due to better cycling conditions

Direct costs and benefits were projected over the asset's 20-year effective life showing a total net cost of €1.7 million. When combined with TEV analysis of indirect benefits, the project had a net benefit of more than €5million and payback period of 14 years. In accordance with guidance on best practice CBA, TEV assumptions were then tested for sensitivity. This showed the 5 per cent increase in bike tourists could halve before the project became unprofitable

MCA is useful because it helps layer the assessment with first round benefits, the next layer of not very stretched benefits, then the next of more far-fetched benefits. With the Greenway it was hard to justify one project in isolation. Getting a path over a road is one thing, if the rest isn't added it doesn't have a huge health benefit. Doing the whole precinct is what provides this. For the Greenway, the big benefit was unlocking the activation potential for the light rail, which already had huge sunk costs because it had been built but the entire business case had been justified on the activation.

Julian Szafraniec, SGS Economics and Planning

4.5. Life cycle assessment

LCA is well suited to valuing infrastructure with multiple benefits, including avoided costs. Common LCA measures for green infrastructure projects include carbon footprint, acidification potential, human health cancer impact, human health non-cancer impact, respiratory effects, eutrophication potential, ozone depletion potential, eco-toxicity, smog formation potential, labour impacts, and financial costs of design, construction, operation and maintenance (Flynn & Traver, 2013).

LCA shows natural stormwater solutions offer significant avoided costs when compared to conventional approaches particularly for pollutant treatment and reducing sewer damage during flood events (Flynn & Traver, 2013).

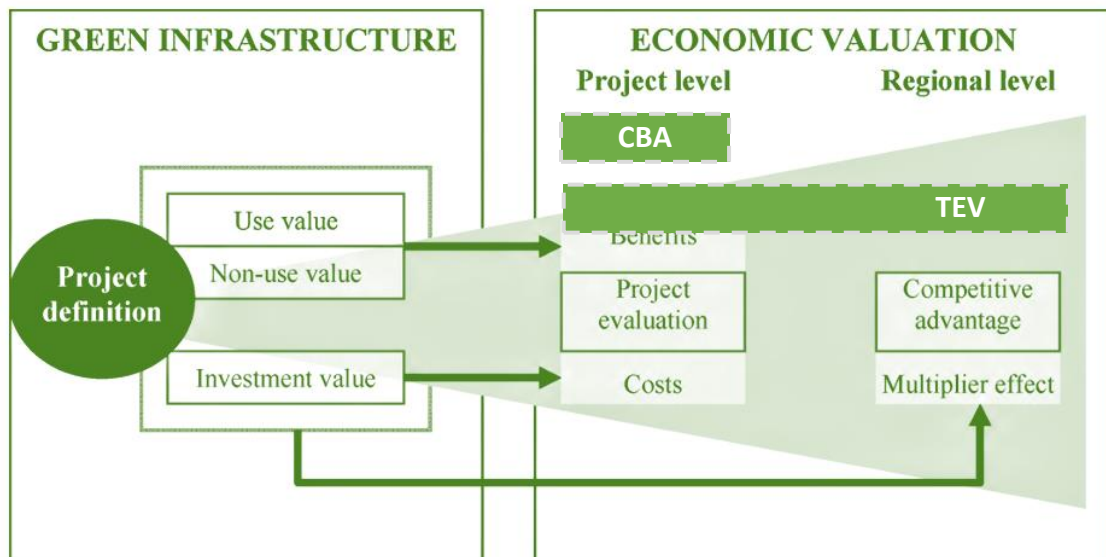
4.6. Total Economic Value

Total Economic Value (TEV) accounts for direct and indirect economic benefits (Figure 5) (Jones, Symons, & Young, 2015). It is a sophisticated approach that combines CBA and other methods such as hedonic pricing, willingness to pay, travel cost method, return on investment, and tree valuation (Vandermeulen et al., 2011; Ecotec, 2008a).

TEV's main indicator is gross value added (GVA). GVA accounts for the Wider Economic Benefits (WEBs) of attracting and retaining high value industries, improved labour productivity, increased property values and tourism, lower energy costs, and so on (Ecotec, 2008b).

The environment supports over 100,000 jobs and generates a GVA of £2.6 billion for the UK's Northwest region (Ecotec, 2008b).

Figure 6 Comparing CBA and TEV for Green Infrastructure



Source: Vandermeulen et al., 2011

Practical application of GVA to valuing green infrastructure means policy makers must prioritise projects with greater regional economic benefits (Vandermeulen *et al.*, 2011). This is particularly well suited to green infrastructure given its benefits are maximised and delivery costs minimised at sub-regional and regional scales. An example application of this approach to a sub-regional cycleway in Bruges is provided in the case study on page 36.

TEV's more expansive consideration of green infrastructure benefits mirrors recent developments in transport infrastructure where CBA has not typically captured wider benefits. For example, a version of TEV is used to value and select transport projects for investment under the UK City Deals (KPMG, 2014). This is being used because policy-makers recognise the substantial land use changes that occur around new infrastructure. WEBs have been a persistent issue when valuing infrastructure in Australia, and domestic governments are currently developing a consistent approach and data that avoids the key issue of estimating and double counting (Transport and Infrastructure Council, 2016; Infrastructure Australia, 2016; Transport for NSW, 2013).

The business case approach that exists around other infrastructure has not been established for green infrastructure in Australia... WEBs have become a lot more resolved in transport and there is a standard approach to measuring them. You could draw on those guidelines to develop an accepted approach for green infrastructure that is clear on double counting of benefits... There isn't clear direction. If there is a big funding pool for green infrastructure and you can bid for it, there needs to be guidance that this is the economic approach to use when valuing the project.

Julian Szafraniec, SGS Economics and Planning

4.7. Intrinsic approaches

To date, intrinsic valuation has been most common for green infrastructure projects. However, problems with current delivery indicate it is ineffective on its own. This is contrasted with the UK experience where leading with instrumental valuation has been successful in recent years (Horwood K. , 2011).

A review of 127 projects in the EU Green Infrastructure database found 61 per cent gave qualitative evidence of intrinsic and institutional benefits, just 15 per cent gave quantitative evidence of instrumental benefits, and 24 per cent gave both (Ecologic, 2011).

Despite this, intrinsic valuation remains important to ensure the full range of green infrastructure benefits are captured, valued and realised. Intrinsic valuation is a component of some of the more sophisticated instrumental valuation methods, such as MCA. There are a number of ways to value these benefit types.

There had been numerous studies and research done around the Greenway. It was more anecdotal and environmental perspectives and how good it is for the environment.

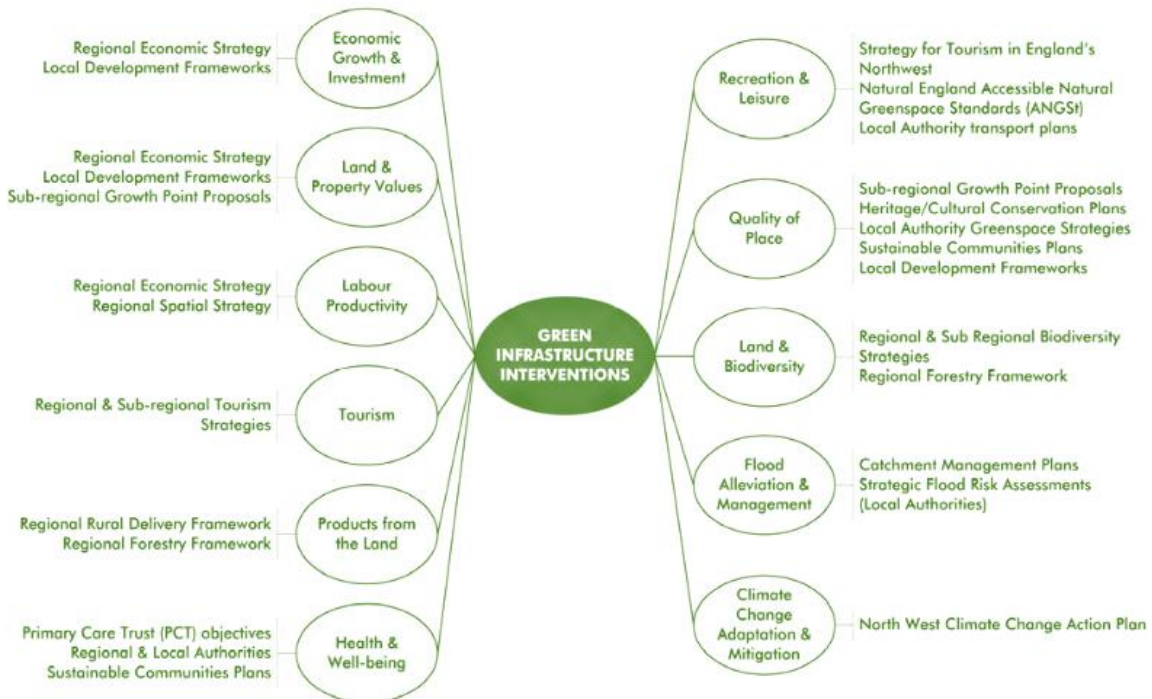
Julian Szafraniec, SGS Economics and Planning

Method	Description
Willingness to pay	How much someone is willing to pay for access to green infrastructure? Travel costs are sometimes used as a proxy
Willingness to accept	How much compensation a person is willing to accept to forgo access to green infrastructure
Contingent valuation	Trading off WTP and WTA to capture true preferences for changes in service and infrastructure levels. The average cost or benefit becomes the value a person assigns to the service or infrastructure
Ranking surveys	Simple ranking of project options as a measure of preferred value (Jones, Symons, & Young, 2015)

4.8. Institutional approaches

Institutional valuation is increasingly common, particularly for comparing and contrasting green infrastructure with conventional projects (Jones, Symons, & Young, 2015). It reflects the way green infrastructure benefits link to other policy goals and is crucial to expanding the view of it beyond environmental purposes (Figure 6).

Figure 7 Example logic chain for green infrastructure interventions in Northwest UK



Source: Ecotec, 2008a

Methods for assessing institutional value include logic chains that help policy-makers identify green infrastructure benefits and link these to related policy goals (Jones, Symons, & Young, 2015). Importantly, this can help identify the true beneficiaries of green infrastructure and potential new funders. Importantly, this requires a deep understanding of the range of government policy goals green infrastructure intersects with.

The UK's green infrastructure Valuation Toolbox includes guidance for policy-makers on mapping related policy priorities for green infrastructure, such as health, energy and economic development. It also includes an evidence base that quantifies and attributes the benefits of green infrastructure to these policy domains.

Health Departments tend not to have the evidence that a tree represents a dollar-saving to the system. They really struggle to keep up with these newer areas.

Julian Szafraniec, SGS Economics and Planning

You need someone who is working across agencies to help articulate the benefits.

Barbara Schaffer, GANSW

There is evidence there are benefits to be had by incorporating green infrastructure but to calculate that against immensely complex health budgets and service delivery is not anyone's responsibility. The NSW Public Health Institute is doing some mapping to understand and link the benefits and potential costs and avoided costs over the long term but these are complex and difficult questions.

NSW Government Employee

Cost effectiveness can be used to value the institutional benefits of green infrastructure. It is typically used when benefits are difficult to quantify in monetary terms or self-evident, such as street trees cooling the urban environment (Jones, Symons, & Young, 2015).

Treasury has come a long way in understanding there is a need to incorporate these benefits and Treasury Business Case Guidelines discuss cost effectiveness analysis.

Julian Szafraniec, SGS Economics and Planning

Ratepayers want councils to reduce costs by reducing risk, liability and insurance premiums so trees come out to reduce premiums. But then you are just looking at costs incurred, not avoided by trees.

Roger Swinbourne and James Rosenwax, AECOM

Cost-effectiveness assessment also involves LCA and ensures the relative total costs of green infrastructure and conventional infrastructure projects are compared from research and development through implementation and costs over a project's effective life. In this way, LCA addresses a key challenge in demonstrating the financial viability of green infrastructure by reflecting avoided costs over long time scales (Mukheibir & Currie, 2016).

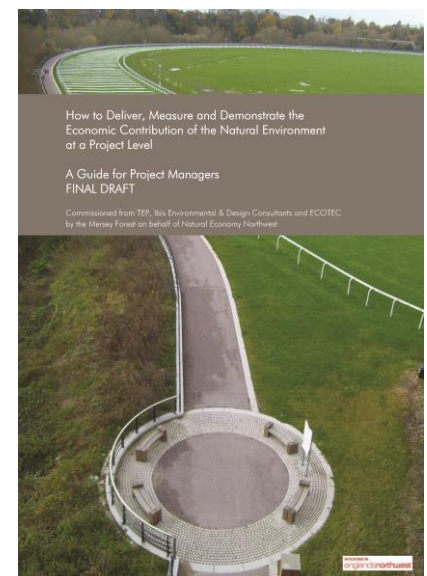
Local governments in New York appropriate the value of a large green infrastructure investment portfolio through cost-effectiveness assessment green infrastructure has been found more cost-effective by avoiding \$3.5 billion in conventional infrastructure expenditure to meet State and Federal water quality regulations (Young *et al.*, 2014).

4.9. Summary

This section outlined instrumental, intrinsic and institutional methods for valuing green infrastructure. It highlighted the problem of misalignment in valuation frames for economic and environmental policy-makers, and the need for guidance for policy-makers to appropriately identify benefits and measure value beyond the dominant environmental and intrinsic approaches. In the UK, shifting to an economic-led approach and developing tools (Figure 7) that enable policy-makers to demonstrate economic benefits and value has provided solutions.

Main problems for economic valuation include limited evidence bases and the use of CBA and consideration of wider benefits such as land use change from green infrastructure interventions. The UK and Belgium have solved this by agreeing to use TEV and its component metric, GVA, to value green infrastructure. In combination with a more comprehensive evidence base on the economic benefits of green infrastructure, this more sophisticated valuation approach is crucial to identifying the true beneficiaries and unlocking new finance and funding mechanisms for delivery.

Figure 8 Guidance on demonstrating the economic benefits of green infrastructure



Source: Ecotec, 2008a

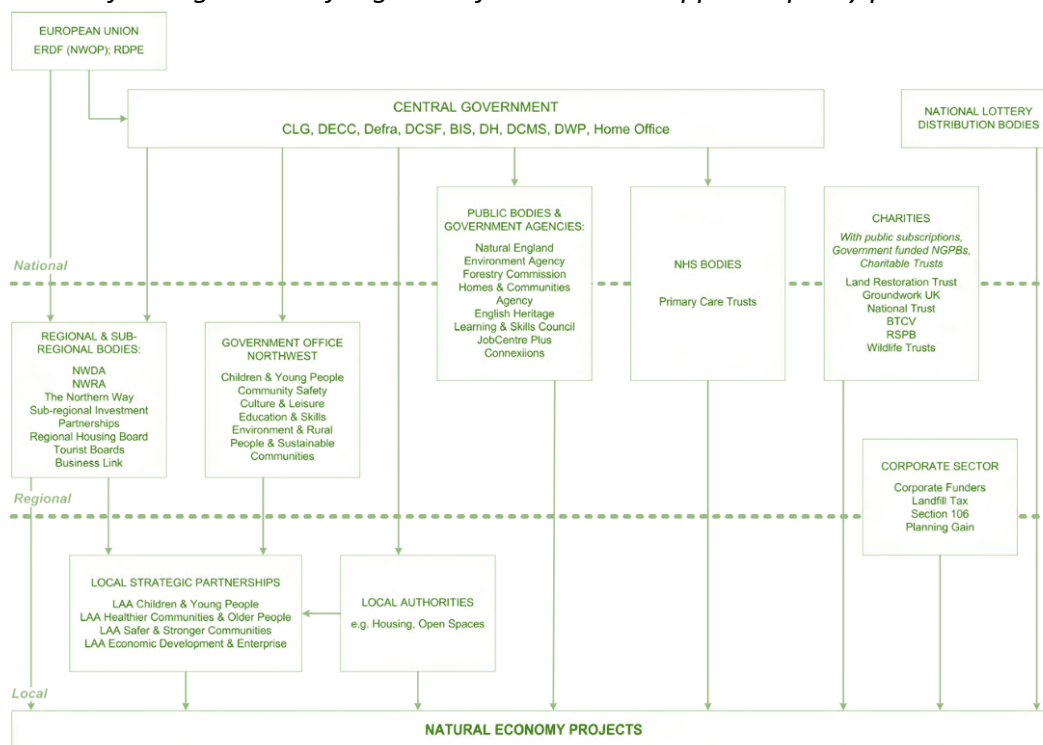
The Commonwealth Government has agreed in principle to the recommendations of a 2015 Senate Inquiry to develop, in consultation with States and Territories, a National Stormwater Initiative (Australian Government, 2016). The Initiative will consider LCA and other economic valuation methods to assess and prioritize projects, as well as new funding and finance models. Similar to the work of Infrastructure Australia on the wider benefits of transport infrastructure, the Initiative may provide a vehicle to address the issue in valuing stormwater green infrastructure (Choi & McIlraith, 2017).

5. Financing and funding green infrastructure

Infrastructure finance and funding are interrelated. Finance covers capital costs for design, construction, operation and maintenance whereas funding is the revenue source that secures or provides this capital. There are a wide range of public and private sector finance mechanisms. In most countries, green infrastructure is funded from government general revenue such as property taxes, grant programs, direct user charges and impact fees (USEPA, 2008). These are documented in this section.

Global infrastructure funding is challenged by fiscal constraints and all governments must do more with less (OECD, 2015). This is a particular challenge for green infrastructure because nature is not paid for ecosystem services and so it does not have direct financial revenues to fund its delivery. Because green infrastructure serves multiple purposes beyond the environment, there an array of financial sources that could potentially fund its delivery (Figure 8). However, this variety means managing finance and providing funding for delivery is complex (Ecologic, 2011).

Figure 9 Potential funding streams for green infrastructure mapped to policy priorities



Source: Ecotec, 2008a

Government decisions about the use of financial revenues to fund infrastructure is variable and depends on organisational judgments of core and non-core purposes (Davies *et al.*, 2017a). Because green infrastructure is multi-purpose, the result is that it often falls through the revenue cracks because government revenue sources tend to be single purpose (USEPA, 2008).

In NSW, green infrastructure is funded by Commonwealth and State Government general revenue, grant programs of all levels of government, council property rates, user charges on water bills, and impact fees in the form of development contributions and voluntary planning agreements. Recent advances in the evidence on the economic benefits of green infrastructure have helped identify

indirect financial beneficiaries and new finance and funding mechanisms, some of which are already used in NSW.

We are going to need to look at different funding mechanisms for green infrastructure.
Barbara Schaffer, GANSW

It really is about prioritising the funding that already exists.
NSW Government Employee

For example, market mechanisms shift the cost of implementing green infrastructure in positive directions and increase the feasibility of implementation (Flynn & Traver, 2013). Reduced storm-water charges or lowering insurance premiums by providing on-site detention are examples of market signals that make positive behaviours cheaper (Flynn & Traver, 2013).

5.1. Development contributions

Whilst this research project is concerned with funding options for green infrastructure beyond development contributions, these contributions remain important delivery mechanisms. Indeed, our research shows the understanding and valuing of green infrastructure within the NSW contributions regime can be enhanced.

Section 94 of the *Environmental Planning and Assessment Act* allows councils to levy charges on new development to fund infrastructure. These development contributions are a form of impact fee and levied for infrastructure councils are reasonably expected to provide to facilitate new development, such as connection to water supply (Department of Infrastructure, Planning and Natural Resources, 2005). Some development types are exempted from contributions for public good reasons.

Contributions are levied for 'essential works' including open space, stormwater management, and pedestrian and cyclist facilities. They cannot be levied solely for environmental works, such as bush regeneration, but can where environmental works serve a dual purpose with essential works. For open space, contributions cover a basic standard of embellishment that makes it suitable for recreation activity such as site grading, utility servicing, drainage and irrigation, and basic landscaping and equipment.

We need to redefine green infrastructure so it is essential work and when IPART is making recommendations there is a change of thinking.
Barbara Schaffer, GANSW

Developers will provide contributions for green infrastructure because they know it increases property values. But the link is weak because the contribution just goes into a general bucket. If they can see the benefit they will do it, but they are rightly skeptical they will see the benefit near their project.
Julian Szafraniec, SGS Economics and Planning

Developers are starting to see the value and targeting certain markets that see the benefits of green infrastructure.
NSW Government Employee

There are two types of contributions. The first apply in greenfield areas and are based on the relationship between new development and infrastructure demand. Amounts are capped per residential lot or dwelling, and uncapped for non-residential development. The second applies in low growth areas where new infrastructure costs are low, spread over time, or it is difficult to establish a relationship between new development and infrastructure demand, such as urban infill areas. In practice, this means greenfield contributions tend to work on full cost recovery because there is no existing population, whereas this is not the case for urban infill.

Contributions can be made in the form of financial payment, land transfer or works-in-kind from a developer, a developer providing a material public benefit, or a combination of these. They can only cover capital costs for infrastructure land and construction, not ongoing operation or maintenance, and they can be levied across multiple council areas or applied to specific areas within a council. The NSW Independent Pricing and Regulatory Tribunal (IPART) approve council contribution plans. Special infrastructure contributions work in a similar way to development contributions but are collected by the State Government for regional infrastructure such as roads, land for schools, hospitals and emergency services, and offsetting biodiversity impacts.

IPART and Development Contributions

Stormwater management and open space infrastructure can be funded by contributions. IPART interprets that it can disallow contributions where they are for infrastructure that serves a solely environmental purpose (IPART, 2016). Despite encouraging councils to leverage the dual use of stormwater management and open space infrastructure to minimize essential work costs (IPART, 2017), it has disallowed contributions plans that seek to do this.

One recent example was an application by The Hills Shire Council for contributions to fund raingardens (IPART, 2016). IPART ruled raingardens were for the sole environmental purpose of water treatment and disallowed the contributions. However, it allowed contributions to cover conventional gross pollutant traps because they help mitigate flooding and treat water.

In contrast to jurisdictions such as Queensland where contributions and scope for green infrastructure are limited to trunk infrastructure like roads and water supply (Choi & McIlraith, 2017), NSW is fortunate in that contributions cover a broader range of infrastructure through which the dual purposes and benefits of green infrastructure are realised. However, IPART's decision on the core activity of raingardens, which ignored flood mitigation potential, reflects an institutional value of green infrastructure for solely environmental purposes (Choi & McIlraith, 2017).

Integrating blue and green infrastructure is where we see the greatest bang for buck.
NSW Government Employee

5.2. Voluntary Planning Agreements

Voluntary Planning Agreements (VPAs) are similar to contributions. They are used to re-distribute costs and benefits and allow the community to realise public benefits from new development (Department of Infrastructure, Planning and Natural Resources, 2005). VPAs are an undertaking by developers to make contributions toward a public purpose beyond the demand development creates for new infrastructure.

General principles for VPAs include compensating for loss of natural resources from development by replacing, substituting, repairing or regenerating these resources. As with contributions, developers can enter into VPAs that cross council boundaries. VPAs can be applied more widely than contributions because they do not need to demonstrate a direct relationship between development and new infrastructure demand. They also differ from contributions in that they provide funding for maintenance and operations costs and can be used for environmental purposes.

5.3. Bio-banking

Land is a base production input for infrastructure, and land costs are often higher in urban infill areas. Because the opportunity cost of restrictions on land use is overlooked in economic valuation of green infrastructure, and given the higher value of land in urban infill areas, it is especially important to consider delivery mechanisms that address this issue.

The NSW Biodiversity Banking and Offset Scheme enables landowners to commit to enhancing and protecting biodiversity values on their land in perpetuity (Office of Environment and Heritage [OEH], 2017).

The Scheme operates on a like for like basis. The practical effect is that biodiversity values lost in infill areas should be credited in infill areas. In this way, the Scheme continues to facilitate the economic development of urban infill areas whilst balancing the opportunity cost of land use restrictions when delivering green infrastructure.

Landowners that enter into a Biobank Agreement are assigned credits to sell to other parties looking to avert biodiversity loss from developing their land. Upon sale of the credits, the seller can use these funds to undertake management actions that improve biodiversity values over 20 years. Councils can apply to create credits as public landowners, which can revenue for ongoing operation and maintenance of green infrastructure in the form of annual payments from the NSW Biodiversity Conservation Trust.

Landsdowne Park in the Canterbury-Bankstown Council area is subject to a Biobank Agreement (Southern Sydney Regional Organisation of Councils Incorporated [SSROC], 2016).

5.4. Transferrable Development Rights

A particular challenge for delivering green infrastructure in high land value urban infill areas is the opportunity cost of foregone economic development. One solution to this issue is transferrable development rights, which work by transferring the economic development potential of one parcel to another. In this way, they are used as compensation when land is deemed unfit for development because its use has high intrinsic value.

For example, a version of transferrable development rights is applied in the Sydney CBD for sites with high value heritage items. In order to incentivise conservation of the sites, owners can sell the floor space above for a developer to use on another parcel in the CBD (City of Sydney, 2016). The seller then uses the proceeds to offset conservation costs. In this way, transferrable development rights avoid the economic loss of foregone development.

5.5. Voluntary Conservation Agreements

Similar to the Biobanking Scheme, voluntary conservation agreements enable landholders to protect and conserve private land in urban areas. Voluntary conservation agreements bind landowners, Crown land lessees, and councils to ensuring their land remains a wildlife refuge or conserving the ecological value of the land in perpetuity (Davies *et al.*, 2017a).

Land subject to voluntary conservation agreements is also eligible for council rate rebates and income tax offsets. Importantly, voluntary conservation agreements may increase the economic cost of delivering green infrastructure in high land value urban areas. As previously mentioned, these opportunity costs are often overlooked when valuing green infrastructure and should be accounted for when considering voluntary conservation agreements as delivery mechanisms.

5.6. Stormwater funding

There is no single line of responsibility for funding stormwater infrastructure delivery in Sydney. Instead, it is split between the State Government and councils. Generally, the State-Owned Sydney Water provides large trunk drains in stormwater designated areas east of Parramatta (Sydney Water, 2015). It also provides some local stormwater infrastructure in parts of inner Sydney. Sydney Water's infrastructure is funded through a stormwater user charge on the water bills of households and businesses located in stormwater designated areas.

IPART regulates Sydney Water's user charges. Residential customers pay a flat amount based on dwelling type, and businesses pay based on property area. IPART decides the amount based on whether Sydney Water meets organisational efficiency standards and expected capital costs for infrastructure renewal (IPART, 2016). Sydney Water's capital costs have overrun significantly in recent years and are forecast to grow substantially to 2024 as much of its stormwater network was constructed before 1910 and is nearing the end of its effective life (Sydney Water, 2015).

IPART is a necessity. They define so much in this space.
Roger Swinbourne and James Rosenwax, AECOM

Sydney Water has sought funding for Water Sensitive Urban Design (WSUD) projects through its IPART pricing proposals (Sydney Water, 2015). However, IPART has ruled against this on the basis that impervious and pervious surfaces produce 100 per cent runoff during storms. IPART reasons that because stormwater infrastructure is primarily to mitigate flooding, capital costs are driven by the maximum amount of runoff the system needs to handle during storms (2016).

Notwithstanding, IPART concedes properties that install on-site detention can capture a large amount of rain during storms (IPART, 2016). Because of this, it has created the incentive of a lower stormwater charge for non-residential properties that demonstrate they make a small contribution to the need for infrastructure (Figure 9). In 2016, IPART extended this to residential properties.

Figure 10 Stormwater charge incentive models

Goal of Discount	Mechanism for Fee Reduction	Process for Implementation
Reduce Imperviousness	• Percent fee reduction • Per-square-foot credit	• Percent reduction in imperviousness • Square feet of pervious surfaces
On-site Management	• Percent fee reduction • Quantity/Quality credits (performance-based)	• List of practices with various credits • Total area (square feet) managed
Volume Reduction	• Percent fee reduction • Performance-based quantity reduction	• Percent reduction in imperviousness • Performance-based • Total area (square feet) managed • Practices based on pre-assigned performance values
Use of Specific Practices	• Percent fee reduction • One time credit	List of practices with various credits

Source: USEPA, 2008

In 2015, Sydney Water engaged the community on beneficiary pays charging (Sydney Water, 2015). This approach would recoup stormwater infrastructure costs from households and businesses outside stormwater designated areas to reflect the wider benefits such as cleaner waterways and continued access to inner city areas during flooding. However, IPART does not support it and instead prefers an impactor pays approach based on property area because it is considered a reliable indicator of contribution to stormwater system load and capital requirements. Impactor pays is also used in other jurisdictions, such as the United States, however this is generally on top of separate charges for capital costs (USEPA, 2008).

Rouse Hill, in The Hills Shire Council, is an unusual case of stormwater funding in Sydney. It has an integrated system that manages both stormwater *and* wastewater (IPART, 2016). There are two charges in Rouse Hill. A stormwater charge recovers system operating and maintenance costs and funds bush regeneration, weed and ground management activities. A land charge then covers capital costs. The NSW Government decides the amount of the land charge. Unlike other areas, capital costs for Rouse Hill are recovered from Sydney Water's entire customer base because it performs the dual purpose of stormwater management for Rouse Hill and wastewater management that links to the broader Sydney network.

5.7. Council Rates, Stormwater Charges, and Sustainability Levies

Councils provide local stormwater infrastructure such as kerbs, gutters, drainage pits and gross pollutant traps. Councils west of Parramatta also provide the large trunk drainage system. This infrastructure is funded through council general revenues from property rates (Office of Local Government [OLG] N-D). However, general revenue increases are capped by IPART at between 1 per cent and 2 per cent annually. The cap applies to a council's total income, not individual properties, so councils can charge different rating categories an amount higher or lower than the cap as long as overall revenue increases remain below the cap (IPART, N-D).

Councils can increase revenue above the cap by applying to IPART for a special rate variation. Special rate variations can fund environmental works, town improvements, redevelopment of community and civic facilities, address maintenance backlogs, and maintain or improve existing service provision, including stormwater infrastructure. A number of Sydney councils have SRVs in place to fund green infrastructure.

Lane Cove Council has a 6 per cent special rate variation. This collects around \$1 million annually and is hypothecated to sustainability projects (Lane Cove Council, 2016). Projects funded include developing new landscaped open space and picnic areas, and water quality and monitoring for creeks and waterways. Blue Mountains and Wingecarribee councils have similar SRVs in place.

Some councils also levy an additional \$25 stormwater management charge. The option to levy the charge was introduced in 2005 in recognition of the need for a more sustainable revenue stream for councils to fund stormwater management because of increasing impervious surfaces that lead to waterway pollution and flooding (OEH, N-D). For the purposes of this charge, stormwater management is defined as both the quantity and quality of stormwater flowing from privately owned developed land (OLG, N-D).

Works covered by the stormwater management charge include pollution prevention, flood mitigation, rainwater and stormwater harvesting, and stormwater drainage system planning, construction, operation and maintenance. As with developer contributions, the charge cannot be used solely for environmental purposes such as riparian vegetation or parks and gardens except where they are a component of stormwater management. The charge also cannot be used to fund work on public land or land without impervious surfaces. In most circumstances, councils levying the charge cannot apply for a special rate variation that also covers stormwater management.

Following introduction of the charge, 77 councils have raised over \$40 million, enabling a 90 per cent average increase in spending on stormwater management (OEH, 2011). In 2009, it was estimated Sydney councils each raised \$1 million annually, or enough to construct three wetlands or stormwater harvesting schemes. (OEH, 2011) Generally, this additional revenue has gone towards capital works and maintenance of existing infrastructure that has improved the health of urban waterways, reduced the impact of local flooding on communities, and promoted alternate water sources to reduce demand on potable supplies.

Despite introduction of the charge, the local stormwater infrastructure backlog has ballooned (NSW Treasury Corporation, 2013). NSW Treasury Corporation has introduced a low interest loan scheme to assist councils borrow to address the backlog.

5.8. General Government Revenue and Grants

A wide range of financial and in-kind grant programs also fund green infrastructure delivery. All levels of government as well as not for profit and philanthropic organisations provide these. Because green infrastructure serves many purposes, potential use of these programs to fund delivery is immense. It is beyond the scope of this report to document all potential programs but a selected overview is provided below.

Councils provide a range of programs including free native plants, community tree planting events, financial grants for creating habitat on public and private land, and competitions with prize money for backyard gardens (SSROC, 2016). Councils also offer rate rebates, such as for land subject to voluntary conservation agreements, although this is not common. Importantly, there is no statutory requirement for such programs and where councils run them it is a good indicator of high intrinsic and institutional value at the local level.

Sutherland Shire Council offers 10 grants of \$2,000 each year for works including weed removal, bush regeneration, habitat creation and slope stabilisation within its Greenweb corridor (SSROC, 2016).

The Greater Sydney Commission (GSC) administers the Metropolitan Greenspace Program, which aims to improve regional open space by co-funding projects with councils on a dollar for dollar basis (GSC, N-D). Over \$40 million has been awarded to 620 projects through the Program since inception. Program funding guidelines have been aligned to Sydney's Green Grid, including an objective to support inter-connection between bushland parks, centres and waterways. Despite limitations on council revenue and capacity to increase dollar for dollar contributions, a record high value of applications was received for 2015/16, and a number of awarded projects contributed to Sydney's Green Grid. This is a further indicator of high institutional value of green infrastructure at the local level.

The current grant programs such as the Metropolitan Greenspace Program are aligning their objectives and funding streams to priority Green Grid projects.

Barbara Schaffer GANSW

The NSW Environment Trust grants around \$100million of funding collected through the NSW Waste Levy (Local Government NSW, 2016). Grants are awarded to a wide range of projects including on-ground work as well as research and community education. Current programs include \$1million annually for councils to build resilience to climate change in partnership with regional and private sector organisations (OEH, 2017). This program aims to, amongst others, minimize climate change impacts by enhancing consideration of impacts in decision-making. Another program is the Environmental Research Grants that provide \$1 million annually to assist with developing knowledge and advanced techniques to solve environmental problems.

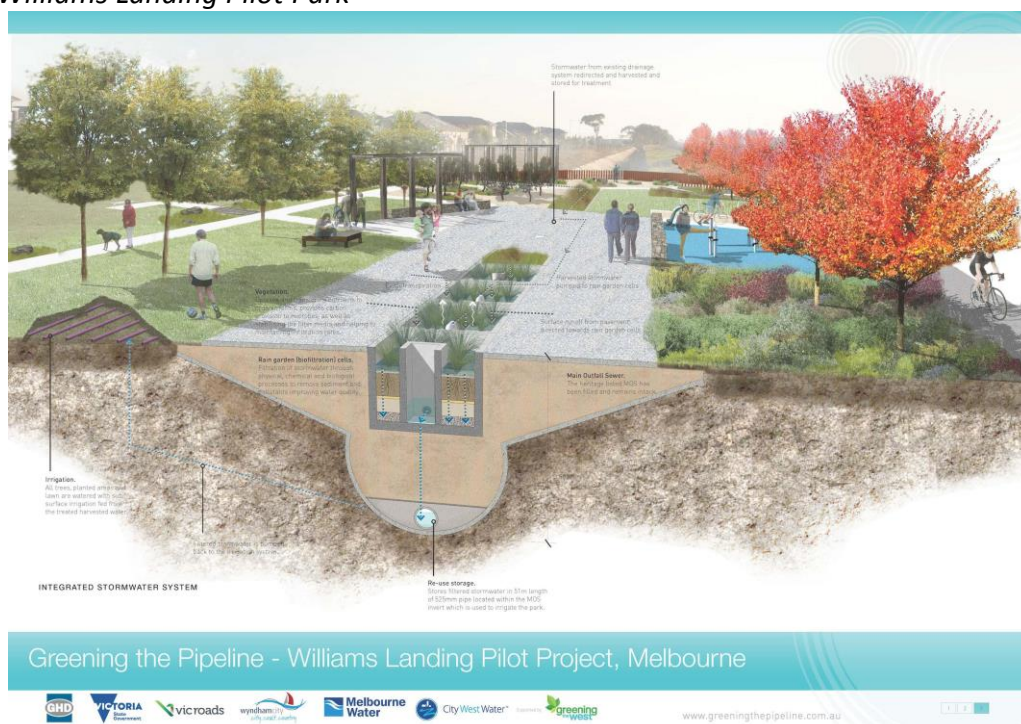
Fleshing out what the benefit metrics are for green infrastructure and the best way to quantify them is where research can help.

Julian Szafraniec, SGS Economics and Planning

The NSW Climate Change Fund has offered \$500 million worth of funding for energy efficiency, government resource efficiency and regional clean energy projects (OEH, N-D). The Fund is being refreshed with another \$500 million for 2017 and 2022. New funding priorities include \$200 million to accelerate advanced energy solutions, \$200 million to enable NSW to play a national leadership role in energy efficiency, and \$100 million to prepare NSW for climate change. For example, one of the Fund's draft priorities is to implement a program of information, tools and funds for demonstration projects to improve green cover in cities and regions (OEH, 2017). The Fund's Draft Strategic Plan to guide the new funding allocation is under consultation.

At the Commonwealth level, the 20 Million Trees Program has provided grants for individuals and organisations including community groups, schools and landholders to undertake vegetation works on urban land. So far, the Program has awarded around \$40 million to plant 13.5 million trees across 166 projects and is on track to contract and deliver the remaining 6.6 million trees by 2020 (National Landcare Program, 2015). The Greening the West Initiative in Melbourne's outer northwest, a partnership between the State Government, water utilities, local councils, and a carbon-offset trader, was awarded \$5 million through the Program (Furlong, Dodson & Phelan, 2017). The Initiative is transforming a 1.2 kilometre section of Upper Stony Creek from a concrete channel into a green waterway, a kilometre linear park and bike track along Melbourne's main outfall sewer, and a 100 metre pilot park at Williams Landing (Figure 10). A separate component of the Program was the 2015 Cumberland Conservation Corridor Grant Round, which prioritised Western Sydney projects.

Figure 11 Williams Landing Pilot Park



Source: Greening the West, n-d

5.9. Environmental Upgrade Agreements

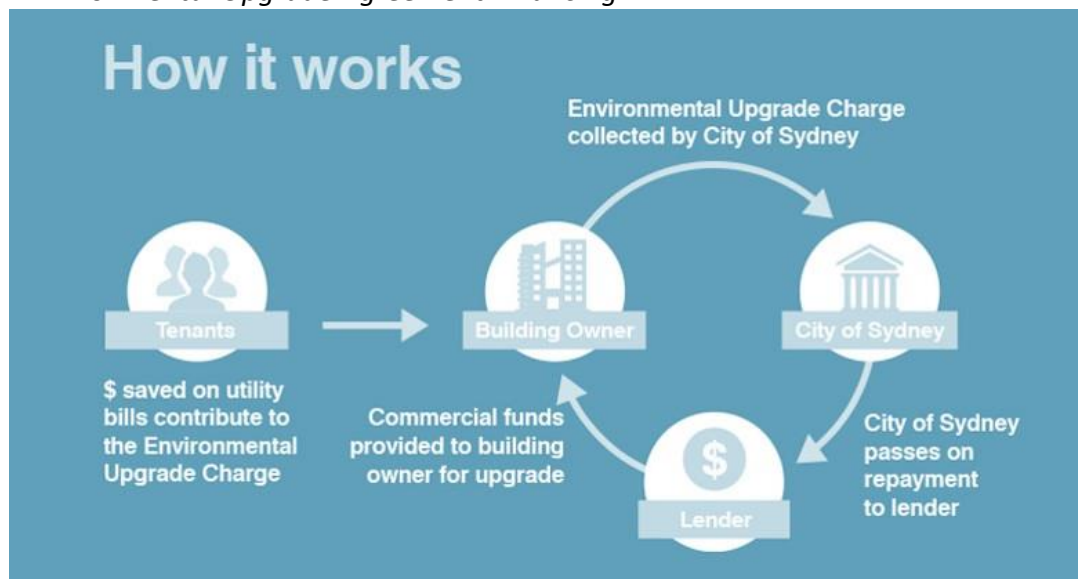
Environmental Upgrade Agreements (EUAs) are low cost, long-term finance agreements to retrofit non-residential and multi-residential buildings with over 20 dwellings (OEH, 2011). They are three way agreements between a building owner, council and financier. The financier provides up-front capital for building works and the council levies an environmental upgrade charge on the land for up to 15 years and then passes this revenue on to the financier to repay the capital (Figure 10).

EUAs finance and extend repayment periods for capital works that improve building sustainability. These include activities that increase energy or water efficiency or decrease consumption, prevent or reduce pollution, eliminate or reduce waste and materials, enable recovery and recycling of materials, monitor environmental quality, reduce greenhouse gas emissions, or encourage alternative transportation such as walking and cycling. Building owners can require tenants and unit

owners to pay a contribution to help cover the charge. Contribution amounts are pegged to the average energy and water bill savings realised by tenants and owners from the upgrade.

EUAs have been used in Sydney for rainwater harvesting technology at Central Park (Fraser's Property, 2013). However, they do not extend to non-building work that realises the same environmental outcomes, such as street trees that lower indoor temperatures and reduce energy consumption. In contrast, a similar scheme in the United States, the Clean Water State Revolving Fund, covers capital costs of a more expansive range of activities, including non-building works (USEPA, 2008). Only a handful of Sydney councils participate in EUAs including City of Sydney, Blacktown, Parramatta and North Sydney (Eureka Environmental Upgrade Finance, N-D).

Figure 12 Environmental Upgrade Agreement Financing



Source: City of Sydney, 2016

5.10. Clean Energy Finance Corporation

The Commonwealth's Clean Energy Finance Corporation (CEFC) was established in 2012 to invest in clean energy (CEFC, N-D). Each year, it is credited with \$2billion in low interest, long-term loans of between \$10million and \$20million for Australian renewable energy, energy efficiency and low emission technology projects, including those undertaken by local councils. To date, most CEFC investments have been in the built environment, including as financier for a EUA for a government-owned building in Parramatta.

As a financial institution, the CEFC considers proposals on the basis of commercial viability. However, as a public entity, it also places value on the positive externalities of projects such as realizing carbon reductions over long time frames. In this way, the CEFC mirrors national development banks in Europe that are actively investing in green infrastructure, such as the Dutch Greentech Fund, Nordic Environment Fund and UK Green Investment Bank (Ecologic, 2011).

The CEFC meets the unique characteristics of green infrastructure that require innovative finance mechanisms (Merk *et al.*, 2012). These include the generation of positive externalities that are justified through collective social benefit, the production of benefits over long time frames that

make it hard to advance conventional CBA economics, and uncertainty in the regulatory and economic environment.

5.11. Public Private Partnerships

Green infrastructure benefits are shared between governments, businesses and communities over time. This means there is a strong case for public-private partnerships (PPP) where risk and returns are also spread over time (Ecologic, 2011). PPPs are typically pursued for infrastructure projects with a financial revenue source, such as toll roads.

However, PPPs are increasingly being used for green infrastructure even though it has fewer direct revenue sources (Mogge, 2014). One example is community based PPPs, which finance the design, construction, operation and maintenance of urban stormwater projects in the United States. Community based PPPs respond to the localised scale of these projects that makes the investment market small and fragmented, and which increases transaction costs for private finance (Environmental Consulting Technologies, 2016). Community based PPPs aggregate thousands of individual projects, which lower transaction costs, reduce risk and generates substantial savings. For example, in Maryland, CPB3s have generated cost savings of 30 per cent in project construction through economies of scale (USEPA, 2007).

Community based PPPs are secured by dedicated revenue from stormwater user charges and operate on a performance-based risk transfer model. Because payment is only made when the provider satisfies performance standards, such as water quality targets, community based PPPs reduce risk for government investing in stormwater projects to meet regulatory requirements. The ways community based PPPs operate means it is crucial that environmental outcomes are weighted appropriately when awarding contracts (Merk *et al.*, 2012). The benefit of community based PPPs is that the legal contractual basis generates significant data that can be used to assess the effectiveness of new types of green infrastructure as well as economic benefits.

5.12. Green Bonds

Green bonds are an emerging finance mechanism for green infrastructure, and increasingly popular with institutional investors. For example, they make up 25 per cent of the World Bank's green investment portfolio and it is estimated there are over 30 funds with more than \$475 billion ready to invest in the United States (Mogge, 2014). The CEFC recently participated in Australia's first green bond issuance, which focused on building technology (Clean Energy Finance Corporation, 2017).

Green bonds offer government revenue as security for repaying private capital used to fund new infrastructure (Climate Bonds Initiative, 2017). Bond funds are hypothecated to green projects, and the projects funded must provide a return to government. This return is used to repay the private capital. If projects do not generate a return, the investor retains the government security. Some green bonds are ring-fenced, which means investors do not have recourse to government revenue if the project does not make a return. Key problems for green bonds include whether projects generate revenue, placing a dollar value on projects so that investors can adequately value natural asset portfolios, and quantifying government return on investment (Mogge, 2014).

We need a total value of street trees in Sydney. This is why IPART needs to financially value green infrastructure so that councils can borrow against it and create green bonds.
Roger Swinbourne and James Rosenwax, AECOM

It would be useful to see green infrastructure as an infrastructure asset class so that it has financial status and can be borrowed against.

NSW Government Employee

5.13. Tax Increment Financing, Value Capture and Business Improvement Districts

Tax Increment Financing (TIF) is used to attract private capital to finance new infrastructure (Merk *et al.*, 2012). TIFs rely on future tax revenues from up-lift in property values or business activity from new infrastructure. These future revenues are then used to repay private capital used to build the infrastructure. TIFs are well suited to green infrastructure given it is proven to increase property values and attract new tourism and commercial businesses, for example, Chicago's Green Roof Improvement Fund is a TIF for green roofs that help manage stormwater (Georgetown Climate Centre, N-D).

Chicago has an incredible urban forest strategy that is well funded.

Barbara Schaffer, GANSW

Value capture operates in a similar way to TIFs (Merk *et al.*, 2012). It also uses future tax revenues from up-lift in property values around new infrastructure. However, rather than using private capital, public capital is used and governments levy an additional charge on land that increases in value to recoup this capital. In this way, value capture can better align green infrastructure funding to the indirect financial beneficiaries of It also allows government greater control over selecting projects to fund by financing them from government revenue. Value capture is gaining traction in Sydney. For example, a Special Infrastructure Contribution will enable the NSW Government to fund new schools and other infrastructure by capturing the value uplift of Parramatta Light Rail for residential dwellings in the Greater Parramatta to Olympic Park Peninsula Priority Growth Area (Transport for NSW, 2016).

If council is going to unlock the value of a site through rezoning or increased height there is a portion of that value which the local community should capture for green infrastructure.

Julian Szafraniec, SGS Economics and Planning

Business Improvement Districts (BIDs) are place-based business cooperatives that elect to make a contribution to the maintenance, development and promotion of commercial business in an area (In The City Canberra, N-D). Through BIDs, businesses invest collectively to improve their economic environment and attract more customers and other businesses to an area. For example, in 2008 the ACT Government enacted new legislation to enable the establishment of a BID in Canberra to promote the city centre and drive other initiatives such as arts and culture festivals (In The City Canberra, N-D).

A BID in the London district of Victoria, the home of Westminster and Buckingham Palace, is funding green roofs, natural stormwater solutions for flood mitigation, tree canopy initiatives, and research for post-implementation improvements in business activity (Land Use Consultants and Green Roof Consultancy, 2010). The BID applied for a share of an initial £500,000 from the Greater

London Authority and subsequently leveraged this into more than £4.3 million in private sector investment (Cross River Partnership, 2016).

5.14. Alternate Approaches

There are a wide range of alternatives to finance and fund green infrastructure delivery. In Malmo, developers are exempted from development contributions for open space. Instead, they pay councils to design and install open space in new developments where there is a strategic fit with the regional green space plan (Davies *et al.*, 2017).

Philadelphia has a system where all properties are charged for stormwater infrastructure capital cost based on percentage of impervious surface. In contrast to IPART, Philadelphia recognizes impervious surface, rather than land area, is the primary indicator of actual contribution to runoff (USEPA, 2008). The amount charged is based on an 80/20 impervious/gross area formula so that on-going operation and maintenance costs are still recovered through a minimal user charge.

Philadelphia is doing fantastic work demonstrating the financial benefits of integrated green infrastructure solutions for water management and quality control. They have saved billions of dollars over the traditional piped approach.

Barbara Schaffer, GANSW

If water is used for watering trees instead of car washing then it should be charged at a lower rate.

NSW Government Employee

Portland uses a similar system but breaks stormwater charges into on and off-site (USEPA, 2008). About 35 per cent of the charge relates to on-site infrastructure and landowners can fully discount this by installing green infrastructure such as on-site detention, whilst the remaining 65 per cent funds large-scale off-site infrastructure. This could be well suited to Sydney where most councils include on-site drainage in development control plans and the cost of installed infrastructure is estimated at just \$50 million (Bewsher & Still, n.d). New York has used a similar approach by offering a 35 per cent property tax reduction for installing green roofs (Flynn & Traver, 2013).

Other cities in the United States offer property owners the option of forgoing on-site detention in exchange for payment into a fund that then finances large-scale priority green infrastructure (USEPA, 2008). As with TIF, this allows greater government control over deciding which projects are delivered by financing from general revenues.

The upcoming District Plans will identify Sydney's Green Grid priority projects.

Barbara Schaffer, GANSW

Off-site approaches are also used for other types of green infrastructure across Sydney. For example, Sutherland Council estimates continued loss of around 3,500 trees annually would reduce the urban canopy by 165 Ha over the next decade (Sutherland Shire Council, n.d). In 2012, Council recognised its 1:1 replacement rate was insufficient and increased the ratio to 4:1. At the same time, it allowed property owners to enter into a Deed of Agreement to pay Council to replant trees lost on public land.

This type of approach increases government control over where green infrastructure is delivered and can better meet strategic priorities. For example, Sutherland has committed to replanting in areas of greatest ecological benefit or visual amenity, both of which have economic benefits. The City of Sydney also places bonds on developers and event organisers to ensure street trees are protected and retained (City of Sydney, 2013). If trees are destroyed, Council retains the bond to fund replacement trees.

Pulling out trees might save on the insurance premium side but it just pushes the cost onto households that then require air conditioning or back to government because of detrimental health impacts.

NSW Government Employee

We need to create the same kind of barriers to the removal of trees as there are for removing traffic signs and signals.

Roger Swinbourne and James Rosenwax, AECOM

Canada's Green Infrastructure Fund was established as a response to the 2008/09 Global Financial Crisis (Infrastructure Canada, 2016). Run by the Canadian equivalent of Infrastructure Australia, it directed \$725 million towards green infrastructure that supported the Government's environmental and economic priorities.

Over six years the Fund received 198 applications for wastewater, green energy generation and transmission, carbon transmission and storage, and solid waste management. The Fund boosted green infrastructure as a proportion of all infrastructure spending from 14 per cent to 20 per cent. Remarkably, it also leveraged a further \$2.3 billion in co-contributions from councils and State Governments as well as some private sector organisations. South Korea and the United States also included green infrastructure in fiscal stimulus packages (OECD, 2015).

Perth's Metropolitan Region Improvement Tax was introduced in 1960 to provide a dedicated revenue source for long term planning (Western Australian Planning Commission [WAPC], 2007). The Tax is levied in addition to stamp duty and only on properties in Metropolitan Perth. It has been used to buy back land along the Swan River foreshore and to protect the Darling Escarpment

Over the years, the Tax has enabled the purchase of \$1.2billion of land for regional open space and transport corridors. For example, land parcels required to protect Perth's future drinking water supplies were purchased between 1984 and 2006 using \$25million of funding from the Tax. WAPC calculated that purchasing the same parcels today would cost more than \$120million (2007).

Rather than a new tax, the WAPC refers to the MRIT as the 'planning dividend' whereby long-term planning coordinated with funding is an early investment with high rates of return because it avoids later costs (2007, p.5). In this way, it is similar to the financing principles underpinning the CEFC. The Mayor of New York has used similar thinking to envision and fund a \$3.5billion green infrastructure investment portfolio (Young *et al.*, 2014).

5.15. Summary

This section has demonstrated a wide range of mechanisms to finance and fund green infrastructure delivery, some of which are already in use across NSW. Some, such as VPAs and

developer contributions, can be applied across multiple areas and are uniquely suited to the sub-regional and regional economies of scale that maximize benefits and minimise costs of green infrastructure. Indeed, this research shows that where two or more leaders partner in supporting green infrastructure, such as the Victoria BID or Melbourne's Greening the West Initiative, there is often greater uptake and delivery. This is further discussed at Section 7.

The biggest issue with green infrastructure is the benefits and value returned sit with the wider community while the costs and impacts sit with government. Conversely, the community has limited capacity to influence whereas government has the greatest capacity.

Roger Swinbourne and James Rosenwax, AECOM

However, a particular problem for Sydney is that some mechanisms to finance and fund green infrastructure delivery are artificially and unhelpfully restricted. For example, these include IPART determinations on the application of development contributions and stormwater user charges, as well as the NSW Government's cap on council rates and stormwater management charges. This indicates institutional valuation of green infrastructure is low at the State Government level. The UK has developed tools to help policy-makers bridge this institutional gap by demonstrating the multiple purposes and cost effectiveness of green infrastructure in meeting aligned policy goals. This has also helped identify new revenue sources to fund delivery, such as the National Health Service, by clearly demonstrating a broader range of beneficiaries (Merk *et al.*, 2012).

Where artificial restrictions have been lifted in NSW, this has not gone far enough. For example, whilst the stormwater management charge was introduced to provide councils with a more sustainable funding source the local stormwater infrastructure backlog has only grown (Division of Local Government, 2013). Another barrier is contradiction in how these restrictions are applied. For example, IPART has introduced a concession for stormwater user charges where properties have on-site detention in recognition that this type of green infrastructure can help mitigate flooding. Yet, when considering development contributions, it has decided green solutions capable of on-site detention are for solely environmental purposes and not flood mitigation.

Yet still other mechanisms that seek to better align funding sources with green infrastructure beneficiaries are underutilized. For example, EUAs better align funding with the indirect financial beneficiaries such as tenants and owners that reap the reward of lower building operating and energy costs. This type of alignment is a best practice approach to funding green infrastructure delivery (Merk *et al.*, 2012). However, a barrier with EUAs is that they extend only to building works rather than natural solutions that achieve the same economic outcomes. The United States has responded to this by ensuring natural solutions can be funded by similar mechanisms.

Similar barriers exist with other finance mechanisms. For example, the CEFC's investment philosophy is uniquely suited to green infrastructure but its investment strategy focuses on the built environment despite natural solutions being capable of achieving the same outcomes. For more traditional mechanisms that have been 'greened', such as Green Bonds, the problem remains one of adequate economic valuation of green infrastructure assets. This valuation is crucial to unlocking new finance and funding mechanisms, such as CBP3s, which require a strong economic evidence base to develop performance-based contracts.

In all, this underscores the criticality of developing an economic evidence base for green infrastructure that is accepted by both environmental and economic policy-makers, as has occurred in the UK and is being used to fund green infrastructure delivery through the UK City Deals. Priorities for the Environmental Research Grants and Climate Change Fund could help establish this evidence base in NSW and meet the problem of developing adequate businesses cases for green infrastructure.

A particular opportunity in this space is stormwater infrastructure. As Sydney's network nears the end of its effective life it is crucial green infrastructure solutions are part of the renewal. It is well known the current wave of urbanization is final and there are only another 80 years before 'peak urbanisation' is reached and significant opportunities for large-scale conversion dissipate (OECD, 2015).

As with the previous wave of urbanisation, the decisions we make now will be locked in for at least 100 years. But peak urbanisation means that missing this wave will likely have much longer consequences. At the same time, the cost effectiveness of green infrastructure means it is an ideal solution to help fiscally constrained governments meet the estimated \$40 trillion worth of global infrastructure renewal required by 2030 (Environmental Consulting Technologies, 2016).



6. Governance

Barriers to green infrastructure delivery fall into different, inter-linked categories. As already identified, these include identification of the range of benefits and robust valuation methods for these, and appropriately matched finance and funding mechanisms.

This chapter is concerned with governance barriers. Some of these are more tangible in the form of existing policies and regulations, and others less tangible that relate to path dependencies in our established institutional behaviours, practices, norms and values. These are inter-linked and provide the value frame for green infrastructure delivery.

Barrier type	Example
Policy and regulatory	Misaligned policy objectives Lack of policy integration Insufficient land use controls
Institutional	Cross-scale coordination and collaboration Competing priorities Lack of capacity and awareness

6.1. Policy and regulatory barriers

Reviews of the NSW policy framework for climate change adaption, sustainable development, urban ecology, and water sensitive urban design (WSUD) identify a number of policy and regulatory barriers to green infrastructure delivery (Matthews *et al.*, 2015; Davies *et al.*, 2017a; Mukheibir *et al.*, 2013). These include misaligned policy objectives, lack of vertical and horizontal policy integration, and insufficient incentives in land-use regulation.

6.1.1 Misaligned policy objectives

Misalignment of policy occurs when those that exist for one purpose inadvertently limit the ability of other policies to achieve their purpose. For example, in housing, the policy goal to increase the number of owner occupiers is countered by tax incentives that favour investors. The policy and literature review and stakeholder interviews revealed a number of policy and regulatory settings that directly and indirectly contradict and hinder more widespread delivery of green infrastructure.

Both State and local governments have policies and regulations to preserve and enhance green infrastructure. These include, but are not limited to, urban canopy and WSUD at the local level, and State policies to protect urban bushland on public and private land. However, other policy objectives bypass these.

One example is the regulatory approach to bushfire protection in NSW. A regulation was introduced in 2014 in response to the destruction of over 200 homes due to devastating bushfires the year before. The regulation allows the removal of trees within 10 metres, and vegetation within 50 metres of property on bushfire prone land without the need for a permit, thereby precluding checks and balances on urban canopy removal.

The rule was to be reviewed in 2015, but the NSW Rural Fire Service (RFS) brought this forward due to widespread concerns the '10/50 rule' was being misused to clear trees blocking views. The review attracted over 3500 submissions, which largely focused on lack of alignment with other

policies aimed at protecting vegetation, including critically endangered species habitat and land protected as part of the bio-certification of the Sydney growth centres (RFS, 2015).

A catchment planner from a council in the Central District of Sydney interviewed for this research highlighted another example. The *Water Management Act 2000* allows new development to occur in closer proximity to stormwater drains. They indicated this could preclude future green infrastructure delivery on these sites due to the higher cost of inner urban land acquisition once given away to development.

A study undertaken in Brisbane by Daniel *et al* (2016) also found misalignment between planning policy for urban consolidation and tree protection regulations. The result was a loss of tree cover on private property as lot sizes decrease and house sizes increase. In NSW, fast track assessment permits the removal of unprotected trees up to a height of 8m within 3m of a building. However, to avoid the same outcomes as Brisbane, and better recognise the urban heat island effect, the NSW Department of Planning and Environment (DPE) amended development controls for fast track assessment in greenfield areas. The new controls require a tree to be planted in the front and rear setback of a lot, and DPE is supporting this by running a program providing free trees.

This is just one example of corrective action being taken, but there are opportunities to further adjust controls to support green infrastructure delivery. For example, by increasing landscape requirements and rear setbacks in State planning controls to encourage more vegetation or requiring driveways to be constructed with permeable paving to minimise runoff. Similar planning controls are considered by the City of Unley in South Australia as part of its green infrastructure strategy (City of Unley Council, 2015). Given the dual purposes of green infrastructure, these types of controls could help further cool the urban landscape and reduce stormwater runoff whilst also increasing property values (Refer to Chapter 3).

A forensic review of State and local policies and regulations is beyond the scope of this research. However, it would likely identify further barriers than those outlined above. While policy objectives for reduced bushfire risk and a fast and efficient assessment system are worthy pursuits, better alignment is needed to ensure they do not compromise the long-term ability to enhance green infrastructure delivery.

Care should be taken to holistically consider policy interventions. For example, an institutional analysis that considered Victoria's policies for addressing urban heat island effect found a WSUD approach as a key enabler of green infrastructure delivery (Bosomworth *et al*, 2013). However, the study also warned water conservation campaigns may have the unintended consequence of reducing soft landscaping in favour of hard surfaces that require less water. Institutional valuation, as discussed in Chapter 4, can be a useful process for identifying such consequences.

For example, a 'multi-objective approach' that is broader than water conservation considerations could result in a more integrated solution, such as by encouraging drought-resistant native planting schemes in WSUD. This would reduce reliance on potable water to maintain green infrastructure while also utilising vegetation to improve filtration and reduce the impacts of flooding (Bosomworth *et al*, 2013).

6.1.2 Vertical and horizontal policy integration

Planning systems are key delivery vehicles for green infrastructure. However, responsibility for planning is divided asymmetrically between levels of government, and across departments. Mainstreaming green infrastructure through the planning system, therefore, requires both vertical and horizontal integration (Schleyer, *et al.*, 2015). Indeed, a review of the NSW planning system has identified the “lack of a strong vertical and horizontal framework” as a major challenge (Davies *et al.*, 2017a). Therefore, identifying mechanisms for vertical and horizontal integration are crucial to effective green infrastructure delivery.

The Commonwealth’s role in planning is Constitutionally limited (Dodson, 2013; Davies *et al.*, 2017a). Despite this, it still influences planning through infrastructure investment, funding programs such as *20 Million Trees*, and research programs such as its urban greening agenda (The Hon. Greg Hunt MP, 2016). Another way the Commonwealth is involved is through its decision-making responsibilities under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Act requires the Commonwealth to decide on development applications involving ‘matters of national environmental significance’, such as nationally significant threatened species and heritage items (Davies *et al.*, 2017a).

Over the last year, the Commonwealth has shown increasing interest in cities through the Smart Cities Plan, which advocates for green sustainable cities including greater tree coverage, green spaces and high quality urban design. A key pillar of the Plan is City Deals. They provide a vehicle for greater vertical and horizontal integration between Commonwealth, State and local priorities, and, an opportunity to re-direct funding to green infrastructure. As discussed in Section 4.1, the UK’s City Deals have been used to fund substantial green infrastructure projects. In this way, they can help meet the challenges of intergovernmental coordination, and support a more integrated delivery approach.

However, at the State level there is no overarching policy designating green infrastructure as a whole-of-government priority. For example, the State Plan is the apex of the NSW Government’s policy agenda and consists of 12 Premier’s Priorities and 18 State Priorities (Davies *et al.*, 2017a; NSW Government, n.d.). These establish key performance indicators (KPIs) that drive reforms and policy development across departments. The political imperative associated with the Priorities drives greater funding from Treasury and increased coordination and oversight by the Department of Premier and Cabinet (Bunker, 2015; NSW Government, 2017). Considering the State Plan, Davies *et al* (2017a) note:

The present plan lacks specificity on biodiversity management and the protection of natural environmental assets; state-wide government decision-making, therefore, is informed by no apex policy with consideration of the natural environment. This limits inter- and intra-government strategic planning, assessment processes and operational policies and procedures for addressing the natural environment beyond statutory obligations and creating a governance gap in ecologically based decision-making and practice.

(Davies *et al.*, 2017a)

6.1.3 Green infrastructure and climate change

Green infrastructure is a prominent strategy to help cities adapt and respond to climate change. However, evidence suggests adaptation planning has yet to be fully embedded in NSW (Mukheibir *et al.*, 2013). In contrast, the UK government's National Planning Policy Framework (NPPF) sets a clear direction for the role of green infrastructure in climate change adaptation.

114. Local planning authorities should: set out a strategic approach in their Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure...
(Department for Communities and Local Government, 2012)

While the UK is to be commended for this approach, Scott *et al.*, (2017) point out the operative word in the Framework is 'should'. This means it is not a statutory requirement for local authorities to consider green infrastructure in strategic planning. However, where councils identify it as a key component of an adopted local plan, it constitutes a 'material planning consideration' in controlling development and applications must be assessed against it.

Local authorities in the UK also have the option of adopting green infrastructure policies as 'supplementary planning guidance', which has the effect of making it a key consideration in development control. However, so far, the Greater London Authority (GLA) council is the only one to do so (Scott *et al.*, 2017). This is significant given parallels between London and Sydney as global cities, and lends support to the idea of affording Sydney's Green Grid with legislative status to ensure the city does not fall behind global competitors. Including the Green Grid in Sydney's District Plans, which local plans are required to give effect to, will assist with this and should be a key consideration for the Greater Sydney Commission in its capacity as local plan reviewer.

The EP&A Act supports this through regulatory objectives emphasising the importance of ecologically sustainable development (ESD) and 'proper management, development and conservation of natural and artificial resources'. However, despite this, Davies *et al* (2017a) suggest the effectiveness of development control plans (DCPs) in supporting regulatory objectives such as ESD are not well understood. Indeed, widespread loss of tree cover and green space in favour of larger built-area-to-land-ratios, suggests development controls could be better aligned to ensure they support the ESD objective (Amati *et al.*, 2017).

Green infrastructure has also been identified as a crucial part of resilient city strategies (Jones & Somper, 2014). However, whilst potential climate change impacts are being acknowledged in strategic planning across NSW through initiatives such as AdaptNSW, less progress is being made in 'operationalising' this through local plans and DCPs (Measham *et al.*, 2011).

For example, our research identifies a fragmented policy landscape for WSUD, and stakeholders suggested lack of an overarching State policy is the main factor in the wide variability between councils in their approach to and knowledge of WSUD (Choi & McIlraith, 2017). However, state governments around the world are starting to act in this space: for example, Ontario in Canada recently enacted legislative changes requiring all councils to develop policies that protect and enhance tree canopy.

These changes will bolster the good work of many Ontario municipalities, some of whom are already global leaders in this area, and will provide impetus to other municipalities to begin developing plans.

(Green Infrastructure Ontario Coalition, 2016)

Whilst the absence of a State policy results in varying council responses, some, such as Parramatta, City of Sydney and Sutherland, are farther ahead because of greater resources, levels of awareness, and recognition of green infrastructure as an asset rather than a liability. In this regard, State intervention should be careful to ensure local autonomy remains for councils who are already further ahead.

Whilst recognising local plans have the potential to deviate from overarching goals identified in regional plans, Davies *et al* (2017a) are cautiously optimistic about the prospect of greater vertical and horizontal integration flowing from recent amendments to the NSW planning system. These include recent introduction of a statutory requirement for local plans to give effect to Sydney's regional and district plans. This is significant given these plans include actions to support delivery of the Green Grid and this will need to be translated by councils into local plans (NSW Department of Planning and Environment, 2017).

Further amendments are proposed to require review of local plans every five years. The introduction of Local Strategic Planning Statements (LSPS) aims to complete the 'line of sight' between regional, district and local plans. They will support greater horizontal integration by linking local plans with Community Strategic Plans (CSP) as the overarching document that sets community goals. This is significant given most CSP's highlight natural assets as goals.

A standard format for LSPSs is proposed and the draft legislation allows the Secretary of the NSW Department of Planning and Environment to monitor and report on LSPS implementation (NSW Department of Planning and Environment, 2017). This provides another point through which the monitoring of green infrastructure delivery can be institutionalised in the planning system. For example, the monitoring and reporting framework could include a green infrastructure component, such as canopy targets, changes in the level of public and private open space provision, or other indicators, which councils therefore must address in preparing LSPSs.

6.1.4 Land use controls and incentives

Green infrastructure policy can be either strategic or statutory. Strategic policy includes green infrastructure strategies, sustainability strategies, masterplans and structure plans. Statutory policies control development at the lot scale, such as green space ratios, and must be considered in development assessment.

Davies and Laforteza (2017) found green infrastructure is generally well established in strategic policy and this should continue to progress. Notwithstanding, some of the policy concepts and themes which green infrastructure can address were considered underrepresented. These include consideration of green infrastructures to engender greater social cohesion, drive green economy growth, deliver ecosystem services, and support adaptation to climate change. This is significant given a green economy has underpinned much of the UK's recent success in green infrastructure, as has been discussed at Chapters 3 and 4.

Case Study: City of Sydney

The City of Sydney is arguably farthest ahead in terms of effective green infrastructure policy and regulatory intervention. Its strategic policy is vertically and horizontally integrated with council's overall community strategic plan (Davies *et al.*, 2017).

One component of Council's approach to green infrastructure is its green walls and green roofs (GWGR) policy. It seeks to lead, promote, and encourage the installation of GWGRs, remove barriers to delivery and support capacity building and knowledge sharing initiatives. A key implementation mechanism is the use of DCP controls.

Additional delivery mechanisms within the GWGR policy include financial disincentives, such as the Tree Bond discussed at Chapter 4, and demonstration projects on council assets. Both financial mechanisms and demonstration projects were recognised by Carter and Fowler (2008) as effective strategies to overcome upfront cost barriers and build local capacity.

A recent study into the impact of policy interventions for GWGRs in Australia highlights the success of the City of Sydney's policy, identifying a total of 123 green roof installations in the City of Sydney with a 23 per cent increase in total GRGW coverage since introduction of its GWGR policy in 2014 (Irga *et al.*, 2017). Irga *et al* (2017) identified a clear correlation between the number of developments with GWGR and the presence of a GWGR policy within the local government area across Australia.

As green infrastructure is not yet part of a broader policy narrative in NSW, current strategic policies across Sydney are likely to vary in terms of whether they adequately reflect the definition of green infrastructure in *Greener Places*. However, the anticipated release of *Greener Places* is timely given it coincides closely with the shift in focus toward a strategic planning framework which is both vertically and horizontally integrated with State directives, and community strategic planning of councils.

While the misalignment of strategic policy has been considered, the effectiveness of statutory policies for green infrastructure delivery is equally important. A comparison with international best practice suggests Sydney's statutory policy is not sufficiently developed to support 'mainstreaming' (Black *et al.*, 2016). Although the importance of green infrastructure is recognised in strategic policy, statutory policies are generally limited to 'protect and conserve' rather than the creation of new green infrastructure (Davies *et al.*, 2017a).

In response, a 'Blueprint for Living Cities' identified a number of possible statutory policies that go beyond protect and conserve to restore, enhance and create (Davies *et al.*, 2017b). These include re-wording landscape requirements in LEPs to proactively promote urban greening; developing a new approach to calculating green-space requirements which better reflects needs; and developing a transparent, robust multi-criteria analysis that places equal weight on environmental, economic and social outcomes. Indeed, the Greater Sydney Commission's draft regional plan now includes a direction to enhance green space across Sydney, principally through Sydney's Green Grid.

A protect and conserve approach is consistent with current practice in Europe. Research to better understand the extent to which strategic planning in Europe is consistent with the principles of green infrastructure concluded "conservation is the strongest task taken up by current strategic urban greenspace planning. However, in pursuit of [urban green infrastructure] compliance it will be necessary for restoration and creation urban greenspace to feature more strongly" (Davies & Laforteza, 2017).

Green development standards are typically contained in DCPs. However, these are subject to variation during development assessment, and are often inconsistent because controls are 'legally unenforceable' through the EP&A Act, and are required to be applied flexibly (Davies *et al.*, 2017a). Because controls are voluntary, rather than mandatory, this means green infrastructure is not always supported by regulatory incentives.

Research suggests mainstreaming of green infrastructure requires a multi-faceted approach (Carter & Fowler, 2008; Lindholm, 2017), and the use of 'carrot-and-stick' regulatory incentives. Without this, only green infrastructure that directly benefits developers, such as property value increases from green roofs, will be delivered (Ngan, 2004). This goes some way toward explaining why green infrastructure has been primarily delivered as part of higher end developments, those undertaken by public authorities such as Landcom's 'The Ponds' greenfield development, or those undertaken on council assets such as the City of Sydney's approach. Regulation that incentivises green infrastructure is therefore considered a necessary pre-requisite to wider implementation.

Direct regulations are those that target specific green infrastructure interventions. They go beyond traditional protect and conserve approaches, such as minimum landscaped area requirements, to

include green roof regulations in planning or building controls. Other global cities such as Berlin, Copenhagen, Toronto, and more recently San Francisco have made these mandatory.

Indirect regulations include performance based standards such as Biotope Area Factors, and Green Plot Ratios. These performance-based tools set ecological targets, and promote the use of green walls and roofs by incentivising development that meets the targets or includes green walls and roofs.

Green Plot Ratio

Green plot ratio is a relatively new planning and design tool which can be used to regulate 'greenery on site without excluding a corresponding portion of the site from building development' (Ong, 2003).



Source: Ong, 2003

The tool is based on the familiar floor space ratio (FSR) tool and a biological parameter known as leaf area index (LAI). LAI is defined as the single-side leaf area per unit of land area and is used as a proxy for the value of greenery to the environment. Based on existing ecosystems, a score can be ascribed to different types of vegetation, with a higher score representing higher value vegetation.

For example:

- LAI 1 - grass
- LAI 3 – bushes
- LAI 6 – 10 – trees (dependent on density of tree canopy)

The LAI divided by the site area provides a green plot ratio, so an existing site wholly covered in grass would achieve a GnPR of 1:1, whereas a site covered in 50 per cent trees with an LAI of 6 and 50 per cent grass would achieve a green plot ratio of 3.5:1.

This GnPR can then be used as a regulatory tool to better ensure that the design of buildings or precincts to some extent can better accommodate the loss of ecological value. Through a flexible

combination of areas reserved for planting, installation of green roofs and green walls, and other greening methods the developer is able to demonstrate compliance with the green plot ratio.

The tool has been adopted as part of Singapore's GreenMark rating system and used in a number of design competitions and adopted in the planning requirements of various projects.

A recent project undertaken by the Singapore Urban Development Authority identified the optimum green plot ratio to inform landscape requirements for new residential development as being between 2.7 and 4.7 (Landscape + Urbanism, 2008; Urban Redevelopment Authority, 2016).

Incentives typically include faster planning approval, bonus densities or financial incentives such as rate rebates or grants paid to developers to fund green inclusions. Indeed, the inclusion of green infrastructure in performance-based tools has been recommended as an area for future investigation by Australia's Centre for Low Carbon Living (CRCLCL, 2017).

While incentives are an important catalyst for wider delivery of green infrastructure, Davies *et al* (2017a) point out that, in NSW, these must 'pass regulatory review processes such as those of IPART'. This may be problematic given the challenges associated with how green infrastructure is institutionally valued in NSW by bodies such as IPART, as previously discussed at Chapter 5.

Carter and Fowler (2008) suggest incentives need to be accompanied by well-defined standards, and institutional authority and resources to ensure that, once installed, green infrastructure is maintained and continues to fulfil policy objectives. For example, they suggest green roof 'overlay zones' can provide a mechanism to ensure incentives and regulations are targeted in the areas where the greatest environmental benefits can be realised. However, despite international precedents, Pianella *et al* (2016) suggest mandatory regulation for green roofs in Sydney would be premature because of deficiencies in the evidence base:

... given the early stage of green roof research and practice in Australia, mandating green roof installation through policy regulations would be premature, because there is not sufficient data to allow specification of minimum performance standards, and the construction industry (including green roof specialists) is not yet developed enough to support wide-scale installation and maintenance.
(Pianella *et al.*, 2016)

However, targeted green roof 'overlay zones' which provide incentives for green roof installation could be the basis for developing evidence to support broader application of minimum performance standards. Given the high land holding costs for urban infill in Sydney, a suitable incentive could be the use of faster assessment for developments featuring green infrastructure in these areas.

Overall, the NSW policy landscape provides little in the way of indirect regulations supporting broad scale green infrastructure delivery. However, the State Environmental Planning Policy (Building and Sustainability Index) 2004 (BASIX) requires dwelling houses and residential apartment buildings to meet minimum performance criteria for sustainability, including targets for water use, greenhouse gas emissions due to energy consumption and thermal comfort (NSW Government, n.d.).

The BASIX policy has been credited with effecting systemic change over and above similar sustainability measures elsewhere in Australia (Smit & Coombes, 2016).

A particular strength of BASIX is the need to obtain a performance certificate before lodging a development application. This ensures sustainability measures are considered from the outset of the design process, and not after the time and expense to prepare detailed development plans is incurred (Smit & Coombes, 2016). Despite its success, there have been calls to update BASIX to include additional considerations that could indirectly contribute to greater upfront consideration of green infrastructure in residential projects (Gilbert, 2013).

While BASIX targets have recently been increased, there is scope to include controls and incentives that require or encourage reduction of stormwater runoff (Choi & McIlraith, 2017). This could result in pervious surfaces and green roofs being advanced more frequently as part of initial designs to meet BASIX ratings. Davies *et al* (2017a) have also suggested greater consideration of natural solutions be included either as part of BASIX, or a similar tool.

One limitation of BASIX is that it applies only at the lot scale, rather than precinct scale. Given integrated, connected networks of green and blue infrastructure are required to maximise their benefits, similar performance based tools could be developed at the precinct scale to better meet these objectives. These tools already exist, such as Green Star Communities (Green Building Council Australia, 2017) and PRECINX® (Kinesis, 2017; Rauland & Newman, 2015), and there is opportunity to embed them more widely within planning regulation to drive similar systemic change as BASIX.

For example, Williams *et al* (2016) suggested more points could be awarded for green roofs through the Green Star rating schemes as an incentive for developers to more readily adopt them. Indeed, some councils are already encouraging compliance with rating schemes such as Green Star through DCPs. Pianella *et al* (2016) suggest one possible reason for green roofs not being part of the national Green Star rating system is the variation in thermal performance between different climatic zones. An interview respondent also recommended greater use of performance-based tools as regulatory requirements, including the Green Plot Ratio:

It's not only prescriptive mandatory regulations but also performance based regulations or requirements....[mandatory disclosure of NABERS ratings for commercial buildings], a regulatory requirement which is performance based has improved the energy efficiency of the commercial sector by a much longer way than market forces through Green Star buildings or something like that have been able to do....[so] there are examples in the energy sector which could be adapted for green infrastructure and preservation of greenspace and so on. They could be done in association with, and specify the performance of new development... for example a particular approach adopted in Singapore is the green plot ratio.

Interview respondent with an academic interest in green infrastructure

DPE's recent legislative proposals also foreshadow the introduction of new standard format DCPs to provide greater consistency across councils (NSW Department of Planning and Environment, 2017). Given the potential for positively effecting green infrastructure outcomes, consideration could be given to ensuring DCPs are performance, rather than merit-based. Performance-based standards could ensure more consistent, quantifiable and measurable results, while still allowing developers

opportunity for flexibility and innovation in achieving compliance. This could help address an issue previously outlined in that the effectiveness of controls is often not measured or reported, a problem compounded by the discretionary nature of controls' (Davies *et al.*, 2017a).

Davies *et al* (2017a) identified three common themes of best practice DCPs in NSW as they relate to urban ecology. These, along with the principles of green infrastructure articulated by GANSW, could be useful in underpinning consideration of green infrastructure in any forthcoming standard DCPs:

1. Provide explicit targets or minimum performance standards;
2. Recognise the importance of scale, significance, connectivity and multifunctionality;
3. Evidence based on sound ecological principles with supporting controls

Adapted from Davies *et al* (2017a)

6.2. Institutional barriers

The previous sections were focused on policy and regulatory barriers. This section explores some of the institutional barriers that must be overcome to enhance green infrastructure delivery, as well as solutions for shifting toward a system that is more comfortable with green infrastructure. These barriers include a lack of coordination and collaboration between and within various levels of government and the wider community, whilst solutions include the need for more integrated and holistic approaches to planning, and to build capacity to shift established practices.

The finance, funding, policy and regulatory barriers identified so far are symptoms of an underlying disorder. That is, they reflect our established institutions, social practices, norms and values that have evolved over time. As such, our existing approach more directly relates to how we have shaped the built environment in the past and 'the way we've always done it'. This bias is evident in both the literature and our interviews with experts.

... the functioning of modern industrial societies is depending on the permanent and steady availability of infrastructure services. Based on the dominant infrastructure technology, specific socio-cultural habits as well as cognitive and normative regulatory rules have been established. The implementation of innovative solutions and the transformation of infrastructure sectors is therefore not primarily an engineering challenge.

(Schafer and Sheele, 2014)

6.2.1 Cross scale challenges

By virtue of green infrastructure requiring a multi-scalar approach through lot, neighbourhood, district and regional scales, there is a need to ensure planning and implementation can be coordinated across organisational and spatial boundaries (Scott *et al.*, 2013). Kambites and Owen (2006) state "it is essential that green infrastructure planning should involve operational connections between different administrative organisations".

There is limited research on cross-scale challenges in relation to green infrastructure delivery in NSW. However, research on urban ecology and climate change adaptation, as well as examples from other jurisdictions, are useful reference points for better understanding these challenges. For instance, Mukheiber's (2015) consideration of climate change adaptation in Australia drew on workshops with councils from NSW and other states, and identified a lack of clarity in terms of roles and responsibilities, poor communication between tiers of government and uneven power as

critical challenges to overcome. The need for better alignment of government activities and more effective working relationships were also stressed.

Case Study: Punggol eco-town

Punggol eco-town, is a major urban renewal project in Singapore. The eco-town's development is being led by Singapore's Housing Development Board (HDB) in collaboration with other government agencies.

The eco-town is intended to serve as a 'living laboratory' or 'test bed' where emerging green technologies can be tested before being more widely rolled out, and skills and capacity to implement green infrastructure solutions can be enhanced (Centre for Liveable Cities, 2015).



Source: Erwin Soo, 2013

Treelodge@Punggol has received various awards for its sustainability credentials, including Singapore's BCA Green Mark Platinum Award. The development incorporates several green infrastructure elements including green roofs, vertical green walls, planter boxes on balconies and interconnected green walkways, community gardens and connectors (Ming *et al.*, 2010).

Punggol Waterway is another major green infrastructure project within the eco-town. The waterway connects the Sungei Serangoon and Sungei Punggol. A grey infrastructure pipe solution to connect the two rivers was proposed before a landscaped waterway was eventually constructed at the suggestion of the Ministry of National Development (Lee, 2011). The waterway utilises freshwater mangroves to cleanse the water and bio-retention swales to detain and treat up to 10% of runoff within the waterways catchment. The waterway also provides a recreational focal point for Punggol eco-town.

Similarly, Davies *et al* (2017a) state that:

Coordination, consistency and spatial alignment between and within government agencies is required to achieve long-term beneficial urban ecological outcomes... this must also overcome the inherent governance tensions between the roles of state and local governments and the sectoral (silo) policies and practices within and between levels of government.

(Davies *et al.*, 2017a)

The NSW planning system provides an example of uneven power between levels of government and this is significant given the importance of planning systems in delivering green infrastructure. In NSW, councils have a significant role to play in strategic planning for local areas and assessing development (Planning Institute Australia: NSW Division, 2012). However, the planning system creates a number of instances in which responsibilities overlap.

For example, the Minister for Planning determines large scale, State Significant development, where council DCPs are not applicable, which means councils are limited to an advisory role. Mukheiber and Currie (2016) suggested this dynamic has left the City of Sydney “in a difficult position with regard to ensuring new developments follow the intended aims of the Decentralised Water Master Plan”.

In all, this has the effect of limiting opportunities to deliver green infrastructure in major development unless all tiers of government share the same level of commitment. Councils in South Australia have also called for greater State Government involvement in green infrastructure projects, and the Victorian Government is perhaps leading the way through initiatives such as Greening the West (Sustainable Focus, 2013).

The NSW Government’s role in planning the priority precincts provides a significant opportunity to demonstrate leadership in delivering green infrastructure through government projects. Given notable concerns about the quality of development and lack of open space, there is an opportunity for State Government to reimagine its Sydenham to Bankstown Corridor, as a ‘green growth corridor’.

A similar government-led approach is taken by Singapore, which is well known for its commitment to green infrastructure. Singapore’s Housing Development Board has been able to utilise major renewal projects such as Treelodge@Punggol to good effect by creating ‘eco-cities’ which serve as ‘living labs’ showcasing green infrastructure solutions and elevating expectations of sustainable development. While there are different governance issues facing NSW, it is important NSW takes note of the leadership elements of Singapore’s model, as further discussed at Chapter 7.

Therefore, the State Government’s role in assessing major developments and planning for major urban renewal is significant, particularly given these large-scale developments offer greater scope for green infrastructure delivery that maximises benefits and minimises costs. Similarly, State Government decisions on local government funding, such as rate capping as discussed at Section 5, leave councils dependent on short-term grants that do not provide a sustainable funding basis for long term strategic planning, delivery or maintenance of green infrastructure.

Gero *et al* (2012) also identified challenges relating to effective communication between all levels of government and that the view of local government as a subservient tool of state governments results in a lack of co-design in relation to policy that is then expected to be implemented by local government.

The importance of communication between councils has also been recognised as a barrier. One such example is how differing levels of coordination in the planning of Copenhagen's green wedges led to varied outcomes. Where greater coordination was observed, the better the results in delivering multifunctional greenspaces (Primadah et al, 2009 cited in Scott *et al.*, 2013). A local government employee who was interviewed for this research also identified cross-boundary coordination between councils as an issue in delivering green infrastructure:

The history of why the councils haven't been able to somehow scrape together the strategic vision and the funding across four councils boundaries is exactly that because its across council boundaries...because that is the essential barrier in my view.

A local government employee

Despite the difficulties in coordination and a degree of overlap in terms of responsibilities inherent within multi-level governance systems, there are positive examples of how these barriers can be overcome, for example City Deals, the Greater Sydney Commission, Regional Organisations of Council's (ROC), and VPAs all provide spaces for cross boundary collaboration.

One example is the 'Turn down the heat' project led by the Western Sydney ROC in partnership with councils, State agencies and NGOs. The project 'aims to tackle urban heat in Western Sydney by building a cross disciplinary network, and multi-sector strategy that works towards 'a cooler, more liveable and resilient future'. Similarly, in Melbourne, the Greening the West initiative led by City West Water and councils is leveraging Commonwealth funding from the 20 Million Trees Program to improve access to open space and increase tree canopy. The Initiative's strategic plan notes shared ownership of its plan with the community is a key success factor.

A number of well-intentioned urban greening projects are currently being undertaken in isolation from each other. The outcomes of these and future initiatives can however be optimised only through cross-border collaboration between local governments and private-sector stakeholders. Building a collaborative culture is key to the successful implementation of Greening the West. The power of collaboration has already been showcased by the members of the Greening the West Steering Committee, and additional partners now need to be brought on board. Notably, this involves sharing ownership of Greening the West with all community residents.

(Greening the West, 2013)

Increasingly, networks and coalitions are being established to address major challenges facing our cities (Harkness & Katz, 2016). The 2020 Vision is a bottom-up initiative bringing together industry, business, government and academia in efforts to increase the tree canopy in Australia's major cities by 20 per cent by the year 2020. Starting in 2013, it facilitated widespread consultation, identified barriers to implementation and several projects to help deliver the vision. The project includes guidance documents as capacity building tools to help councils implement urban canopy

initiatives. The programme continues throughout Australia, advocating the importance of urban canopy, building capacity, awareness and facilitating collaborative efforts.

The success of bottom-up programmes is largely reliant on raising awareness, building capacity and motivating behavioural change at a local level. Here, there is a critical role for government to play in affecting the kind of systemic change required to shift social practices, norms and values to overcome barriers to green infrastructure delivery.

Governments shape institutional and infrastructure systems. They also play a critical role in supporting community-based organisations and practices, through systemic support structures, funding models, infrastructure projects and policy and regulatory mechanisms...It is important that governments acknowledge and support the important work of such groups without shifting responsibility away from the critical role that government needs to play in changing the institutional, regulatory and social contexts shaping social practices.

(Moloney *et al.*, 2010)

6.2.2 Competing priorities

One of the strengths of green infrastructure conceptually is its capacity to deliver multi-functional benefits. However, responsibility for its implementation requires the support of agencies and departments that are typically focused on achieving a narrower subset of goals more closely related to their portfolios core responsibilities (Keeley *et al.*, 2012; Matthews *et al.*, 2015). As discussed at Chapter 5, it is often judgments about these core responsibilities that drives funding allocations.

... [green infrastructure] butts up against the epistemological structuring of disciplines reflected in city agencies that is based on divergent and exclusive framings of each subject and distinctive methods of inquiry and problem solving: meeting stormwater runoff requirements, for example, is an entirely separate function from providing clean drinking water, though they could be united under a common agency that ensures that stormwater is not wasted and becomes integrated into water supply.

(Pincetl, 2010)

There are various levels of government and multiple organizations with differing agendas, perspectives, and goals related to green infrastructure. For example, Sustainable Focus' study in South Australia found green infrastructure is not always prioritised at the beginning of the planning process.

Plants come last. In terms of subdivisions, plantings were looked at last. Now that is changing. The green elements get tacked on the end once the designers and engineers have their parts put in.

(Sustainable Focus, 2013)

While green infrastructure can serve multiple purposes, and replace or augment the functioning of traditional grey solutions, council staff in South Australia 'expressed frustration it is not included within asset management plans and therefore not assigned a maintenance budget' (Sustainable Focus, 2013).

However, attitudes towards this particular issue are beginning to shift in NSW. For example, in 2006 Newcastle City Council identified street trees as assets, and transferred the City Arborist to the asset management department. This is identified as a significant step forward for green infrastructure as it ensures it is protected and maintained in the same way as other assets (Hewett, n.d.).

When public trees are managed as assets they gain stature, identification and a recorded work history. Assets get consideration notwithstanding the personal views of those who disagree with their existence. It does not matter whether the asset is a road, culvert, creek or tree. Arbitrary and expedient tree removal or injury is no longer acceptable since it degrades the asset base and imposes avoidable costs.
(Hewett, n.d.)

Since 2006 it is recognised that other councils have followed suit. For example, the City of Ryde Council's Tree Management Plan (2012) states:

The City of Ryde recognises that the urban forest is an integral part of the urban form and accordingly its management must be integrated with the management of the entire urban environment including built infrastructure.
(City of Ryde Council, 2016)

Similarly, a catchment planner at a council in the Central District of Sydney finds asset managers and strategic planners within council often advance different solutions to the same issues, with grey infrastructure preferred by asset managers, and green preferred by strategic planners. Despite this, they were positive things were starting to change with asset managers and engineers less reluctant to accept green infrastructure and more willing to recognise shared goals could be achieved. Often, this results in a green-grey 'hybrid' solution.

A reluctance to accept innovative ways of working has been identified as a potential limitation to wider green infrastructure delivery in the UK, Australia and Ireland (Matthews *et al.*, 2015). South In Australia, council planners also indicated that provision for other utilities is almost universally prioritised over green infrastructure, noting that 'much of our original infrastructure was not designed with plants in mind, so it is not surprising there are significant challenges to overcome' (Sustainable Focus, 2013).

Integrated, multidisciplinary planning teams and place-based planning approaches which bring together a variety of professionals, and leverage community input can eliminate these barriers. The GSC's collaboration process and GANSW's design-led planning processes are considered positive responses to the traditional planning approach, and should be encouraged to ensure green infrastructure is considered up front as part of strategic planning.

Aligning the different interests for instance already in the development of the long-term visions and the urban development plans, potential conflicts can be resolved and synergies can be taken advantage of. Although a more integrated form of cooperation may increase the time spent on meetings in the beginning of the process, with a clear objective, early agreements facilitate planning processes and perhaps even speed them

up and improve their quality. The extra effort in the beginning will result in time savings later on.

(Atelier Groen Blauw, n.d.)

Scott *et al* (2013) also considered the need for a change in the traditional approach to land planning, indicating that an ‘ecological turn in spatial planning’ was required to overcome some of the established planning practices characterised by the ‘protect and preserve’ approach, and professionals approaching the task of planning in functional silos. An ecological turn in planning envisages a more integrated, holistic and collaborative approach, “which includes not only protection but also enhancing, restoring, creating and designing new ecological networks characterised by multi-functionality and connectivity”. This sentiment was shared by interviewees:

Planners think in two dimensions because they’re taught to, zoning is still very key to the way, certainly statutory planning is done. There’s not really much understanding of infrastructure or engineering or architecture or horticulture, so I would argue that planning education itself needs reform in order to equip those at the cutting edge with the type of skills they need going forward into 21st century development in a world of climate change, constraints concern over health and wellbeing urban resilience etc. Which is very different from the modernist model of separating cess pits and tanneries from residences and shops.

An interview respondent with an academic interest in green infrastructure

Sustainable urban development has to be multifaceted it has to be holistic and it has to involve all the different parties: on the government side that’s local, state and preferably federal; on the property side, the residents who live in these or pass through them, the owners of commercial buildings if there are commercial areas; and also the agents of change, which is the developers because that is the one in 50 year opportunity to work across boundaries.

A local government employee

While sectoral priorities and institutional path dependencies influence willingness to deliver green infrastructure, political priorities do too. In recent times, there has been a political goal of economic growth, which manifests in a focus on faster development assessment and increase in the number of approvals (NSW Government, n.d.). However, this focuses departments on achieving narrow KPIs associated with this goal to the detriment of other worthwhile goals. Margin and Foley (2014), Buxton and Goodman (2014) and Scott *et al* (2013) suggest this has routinely been the case in Australian planning reform, where legislative amendments and policy initiatives have prioritised economic development and downgraded urban design and environmental protection.

Given the myriad benefits green infrastructure provides, a higher priority should be placed on its multi-layered benefits, including economic. In the UK, green infrastructure is increasingly seen as an enabler of economic growth, with clear policy helping to resolve “the challenge to growth posed through environmentalism by showing green approaches can fit environmental priorities rather than being set in opposition to one another” (Horwood, 2011). Identifying green infrastructure as a priority economic goal for government could leverage central agency support and minimise intra-governmental barriers.

Similarly, a shift in focus on measuring the success of planning in terms of the amount of approvals toward a broader range of KPIs could ensure the benefits of growth are not offset by worsening sustainability and liveability outcomes, which if allowed to deteriorate could impact future productivity gains. Indeed, there is potential for the GSC's productivity, liveability and sustainability metrics, the Commonwealth's National Cities Performance Framework, and the forthcoming LSPSs to keep check on this.

6.2.3 Capacity building, perception and awareness

Green infrastructure is a relatively new concept and needs to be more broadly socialised to overcome a lack of awareness amongst the community and those who need to be involved in delivery (Mell, 2010).

Despite the increasing amount of research on how urban green infrastructure can prevent climatic extremes in urban areas, our understanding remains fragmented and the level of 'take up' by urban planners is low.
(Norton *et al.*, 2015)

A tendency to subvert consideration of green infrastructure among planners was identified as an issue in Sweden with a key reason being a lack of knowledge. In considering where participants obtained their knowledge, Sandström *et al* (2006) found a significant source of information was planning and environmental legislation, and national policies. However, despite information being available, planners rarely used it effectively because they did not know how to apply it (Sandström *et al.*, 2006). In this regard, the introduction of 'Greener Places' and associated guidance material issued by the NSW state government can be valuable resources in improving professional capacity.

Similarly, lack of awareness and a need for education was a consistent theme raised in stakeholder workshops exploring barriers to urban ecology in NSW (Corkery, Pelleri, Joei, Van den berg, & Davies, 2017). The workshops provided numerous suggestions for improvement, one of which was targeted education programs for decision makers in the architecture and planning professions (Corkery *et al.*, 2017). Workshop participants proposed education could be undertaken as part of continuing professional development or adopted in tertiary education courses. Given, the tendency for 'business as usual' processes to endure within departments, continuing professional development is considered a particularly useful approach. Alongside green infrastructure toolkits similar to those developed in the UK, and discussed at Chapter 4, targeting practicing planners with green infrastructure education throughout the PIA Certified Practicing Planner program could be useful.

In the USA, the Environment Protection Agency website also provides a comprehensive resource of green infrastructure information. The website collates guides and information for multiple interested parties to support green infrastructure from design to delivery. The site includes modelling and decision support tools, technical information and funding solutions, and the information is delivered in a variety of formats including webcast.

Bosomworth *et al* (2013) have also suggested the Victorian Government provide an online 'clearing house' for all information related to the urban heat island effect. As per the Vision 2020 website, the NSW Government could consider a similar website to support the dissemination of green infrastructure information and showcase best practice. Information on the website could be sorted

into different 'personas' involved in green infrastructure delivery to more effectively communicate the benefits and help address particular barriers faced by these groups.

Corkery *et al* (2017) also suggest ways in which community education addressing misperceptions on green infrastructure costs and benefits could be undertaken. These include the perception that Sydney is already green enough, and that certain green infrastructure solutions are not aesthetically pleasing, or act as 'rubbish collectors'. Others which need to be overcome include the tendency for the public and government to be risk averse, which often results in the removal of trees to reduce liability and insurance premiums.

Davies *et al* (2017) consider a key requirement of effective education and awareness programs is to ensure they are relatable. One strategy identified was to communicate the benefits of improved ecosystems to individuals. As previously discussed, this approach has been followed in communicating energy bill savings from increased tree cover in Blacktown. The potential for communicating the benefits to individuals has been recognised by Vision 2020, in projects such as the 'Property Price Predictor' which aims to communicate the impact of urban trees on property prices and the 'Green to Gold Calculator' which is targeted at councils, communities and developers and predicts the impact of green infrastructure on social, economic and health indicators.

Corkery *et al.* (2017) also highlighted the potential impact of media campaigns in raising awareness. Indeed, the NSW Department of Planning and Environment has recently sought to raise awareness of projects such as the 'Missing Middle Design Competition', and complying development through short online videos, and social media marketing campaigns. Similar campaigns could be utilised to explain the concepts of green infrastructure and articulate its benefits.

As well as increasing general awareness of the importance of green infrastructure and its potential environmental, social and economic benefits, there is a need to increase specialist knowledge, skills and capacity for delivery. According to Norton *et al* (2014), there needs to be a greater understanding of the horticultural limitations of green infrastructure. While conceptually, green infrastructure provides a positive opportunity to address environmental concerns with growth, there is currently 'disconnect between some architectural and urban design 'visions' and what is biologically or physically possible' (Norton *et al.*, 2014). A lack of capacity among building professionals was also identified through the teams' interview with a catchment planner from the Central District of Sydney that provided an example of green infrastructure alongside the M5 that was found, on inspection, to have an incorrect level of substrate that limited its functionality.

Pianella *et al* (2016) recognise the importance of demonstration sites in overcoming these barriers. For example, Singapore has developed its capacity and expertise in green infrastructure through the use of 'living labs', while also investing significant amounts in terms of research and development and the establishment of training programs to create 20,000 green building specialists by 2020 (BCA, 2009).

As previously suggested the identification of the Sydenham to Bankstown Corridor as a 'green growth' corridor could provide a platform to build capacity to develop and evaluate technical solutions. It is noted the CSIRO has a national research agenda for green infrastructure and recently established its first urban living laboratory, in partnership with Celestino at Sydney Science Park. The laboratory is expected to research the impacts of urban greening on energy efficiency, with a

particular focus on the urban heat island effect. Its location in Western Sydney provides an opportunity for the NSW Government to collaborate with CSIRO and other researchers to overcome technical challenges posed by green infrastructure (Wright, 2017).

6.3. Summary

This Chapter identified the presence of tangible policy and regulatory barriers that, if left unaddressed, will hinder widespread green infrastructure delivery. These include a misalignment of policy objectives, and a lack of vertical and horizontal policy integration.

Current statutory policy settings are orientated toward a traditional 'protect and conserve' approach and are often subverted through discretionary decision-making that fails to fully account for the multiple benefits of green infrastructure. Despite these issues, recent and proposed amendments to the NSW planning system, and the introduction of *Greener Places* are the beginnings of a more integrated policy framework.

However, overcoming the less tangible barriers presents as a bigger problem. These require a more transformational shift in established norms value and behaviours, and require old problems usually solved in silos to be approached with new integrated solutions that arise from coordinating the efforts of multiple actors through vehicles such as the GSC, City Deals, or the ROCs. In combination, a concerted effort is required to educate, raise awareness of the benefits of green infrastructure, and build capacity among professionals and the community to support new approaches.



7. Leadership

This Chapter explores the role leadership plays in green infrastructure delivery. It provides several case studies that show best practice, how progress can happen when leaders change, how leaders need to agree change is warranted, and how even successful green infrastructure programs can stall if not supported by funding.

Leadership comes in many forms, and if leaders decide to champion green infrastructure, it tends to be delivered. For example, the mayors of the City of Sydney, Vancouver, Toronto, and Bruges have all shown how a powerful belief that green infrastructure is critical to urban liveability can bring about real change by harnessing community action. However, these leaders are not just found in the political sphere, they are also in business, academia, and community organisations.

In London, as political momentum for its Green Grid program stalled, the community Campaign to Protect Rural England, London and Neighbourhoods Green, took up the cause and placed pressure on the city's leadership to refocus efforts on greening the city. In Penrith, despite rising summer temperatures, identified urban heat islands, and some of the lowest percentages of green cover in Sydney, a comprehensive green infrastructure program is yet to be adopted by the council.

And in Blacktown, a highly successful neighbourhood tree planting program has demonstrated how residents could change their minds about the types of trees they want in their street and opt for bigger trees when presented with the right information. The project was led by a landscape architect using her PhD research, and used grass-roots community engagement and digital visualisations to show residents how a tree would look when fully grown, and the energy savings it would generate.

Case study: Academic leadership can cool the planet, one street at a time

In 2016, landscape architect Dr Libby Gallagher approached Blacktown Council with a novel initiative called *Cool Streets Blacktown*, which built on her PhD research into the role streetscape design could play in mitigating the effects of climate change. The pilot project involved holding street meetings over two Saturdays with residents in Glenwood, and, in an informal and relaxed atmosphere, presenting them with information about the effects that trees could have in reducing power bills, curbing pollution, and improving health and wellbeing. The residents were presented with digital mock-ups of different tree varieties in their street.

“Initially, residents opted for the smallest trees. When we dug deeper, we found they were concerned that bigger trees wouldn’t be as neat and, to a lesser extent, they’d drop more leaf litter. When we showed them options for streetscapes with bigger and different varieties of trees and presented them with our research showing the health benefits and power savings, they changed their preference. They went from the worst-case scenario to the best, based on the results of clear information and a nuanced conversation,” said Dr Gallagher.

The program concluded with a tree-planting party where residents received their own tree and a watering can. Dr Gallagher says *Cool Streets Blacktown* was an outstanding success in that it created a direct relationship between residents and ‘their’ tree. It was something they discussed with their neighbours, and had a great environmental outcome. There was genuine local buy-in. She’d like to see many more councils take up the program, and already had interest from councils in Victoria and South Australia, and from community groups, businesses and individuals around Australia wanting to replicate the project.

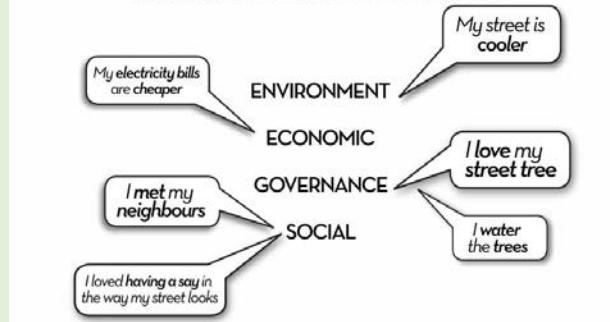
“What I learned is that researchers should not fear taking their work beyond universities. We saw an opportunity and approached Blacktown Council. Councils are generally kept busy with their core business and have limited capacity to undertake detailed research. We took our proposal to them and it allowed them to do something innovative to address the problems of increasing urban heat and the need for more trees to cool streets” she said.

Cool Streets Blacktown recently won the National Institute of Landscape Architects’ *2017 Award of Excellence* and the *Award of Excellence for Community Contribution*, as well as Local Government NSW *2016 Climate Change Action Award*.

Cool Streets Blacktown shows attitudes to street trees can change when residents are provided with appropriate information. It also shows that when the approach is truly collaborative, people are far more willing to engage and work to produce an outcome that benefits not just themselves, but the broader neighbourhood amenity and environment.

Despite the success of the program, council officers say efforts to secure funds to repeat it have proved unsuccessful. “We will continue to apply for grants [as] we are very keen to find a way to continue this work” (Interview, Blacktown Council).

What are the benefits of cool streets?



Benefits

772 tonnes CO_2 reduced and avoided over 40 year period

20
YR OLD
TREES

- 10 561 kWh
over one year for the street

BILL
\$84.00
average saving
per house over 1
year

40
YR OLD
TREES

- 17 700 kWh
over one year for the street

BILL
\$141.00
average saving
per house over
one year

7200 kWh
reductions NSW
average household
consumption

...the Mayor even helped!



Source: Dr L Gallagher

Case Study: Far from coastal breezes, Penrith is getting hotter

Two recent plans have recognised the region's growing problem with urban heat, and the need for further local green infrastructure. *2015 Penrith Progression – a Plan for Action* was a partnership between Penrith City Council and the Penrith Business Alliance to build the economy and create jobs in advance of an anticipated 25 per cent population growth over the next two decades. The report built on the results of community forums, workshops and focus groups seeking the views of residents, workers, employers and community groups on what they wanted for their city in the future (Penrith City Council, Penrith Business Alliance, 2015).

The report makes clear that growth and development must proceed hand-in-hand with improvements to local amenity and liveability.

“Connecting people with local jobs is a focus, but it’s not enough. It is crucial to grow in a way that is smart and sustainable...Green grids of movement, combined with green infrastructure, will better connect people and places, improve public domain and enhance the river precinct and other urban parks.”

Specifically, residents wanted a ‘green city’ with innovative buildings, rooftop gardens, renewable energy, shade and greenery, fewer cars and better cycling and pedestrian access and more public transport.

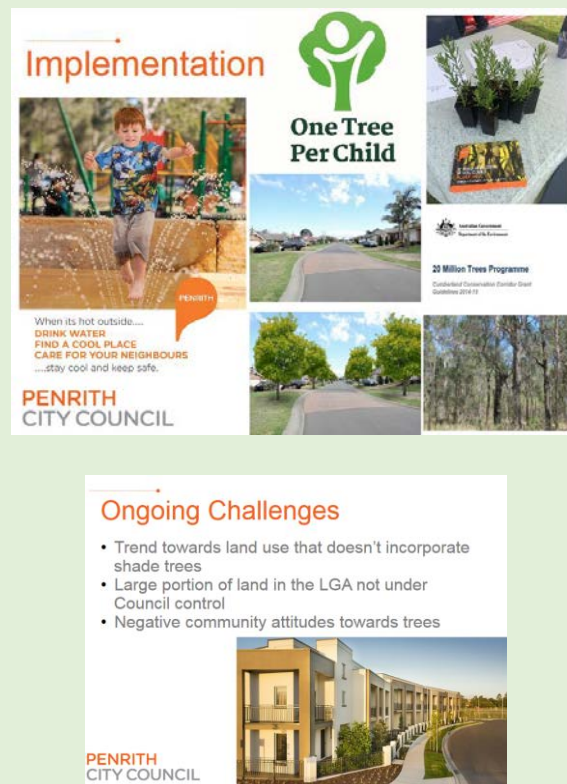
In 2015, the council also launched *Cooling the City* which identified a range of strategies to address urban heat. It drew on extensive work by the Institute of Sustainable Futures at the University of Technology Sydney, which examined 16 hotspots in five suburbs where tree cover was as low as 2.5 per cent (Dunne, 2015).

“The whole of the Penrith is already experiencing extremely high heat well in excess of 49°C land surface temperature during heat events, [therefore] investment in strategies to cool the city will be required into the future, with limited resources so the spatial location of cooling strategies such as green infrastructure needs to ensure the best return on investment.” (Guice & Delaney, 2015).

Lead researcher Candice Delaney said: ‘We found the presence of tree cover explains 55 per cent of the variation in surface temperature in 16 Penrith hotspots.’ (Dunn, 2015). Indeed, thermal imaging by the CSIRO across the entire LGA undertaken during a heatwave in 2011 confirmed that the cooling effect of vegetation could lead to temperature differences of up to 20 C compared to areas where there was no vegetation. (Penrith City Council, 2015).

Despite this, progress in adopting new green infrastructure strategies for Penrith has been slow. Council’s Sustainability Education Officer says changing public attitudes to green infrastructure can be difficult, particularly when parks and green spaces are included with new urban developments: “Feedback from ratepayers is they think we’re putting parks in for developers to sell houses.” There are some local greening and cooling strategies underway, such as a One Tree per Child program in early learning centres, where parents sign a pledge to maintain a tree with their child in exchange for a free tree. Around 1,500 trees have been distributed this way. The council also operates a community engagement program to coincide with new council street

plantings where letterbox drops and forums advise residents about the health benefits and power savings that result from green cover.



Source: Penrith Council

7.1. Political leadership - international

Singapore is the prime example of political leaders championing change and nurturing green infrastructure into reality. In the 1960s, with next-to-no natural assets, the island state's founding father Lee Kuan Yew began greening the roadways leading from the airport as a way of impressing business visitors and tourists.

Singapore's stable top-down political system has continued for close to 60 years and allowed its green infrastructure program time to flourish, providing a model for the rest of the world to follow. Now, over half a century later, the greening of Singapore has become key to its identity. Not only have Singapore's leaders seen the financial benefit in badging it *The City in a Garden*, they have also recognised the value of green infrastructure as a critical tool in addressing climate change, curbing urban heat and power costs, and improving liveability. (Skinner, 2017).

Case Study: No on-going funding mechanism and a change of leadership sees momentum slow with London's Green Grid

In the UK, leadership was critical in placing the protection, preservation and delivery of green infrastructure at the centre of policy. In June 2011, the UK Government produced a Natural Environment White Paper, called *The Natural Choice: securing the value of nature*, a nation-wide policy which set out to place a value on the economic, social and health benefits of green infrastructure. In it, Environment Secretary Caroline Spelman MP, said her Government wanted the citizens of England to “be the first generation to leave the natural environment of England in a better state than it inherited... It requires us all to put the value of nature at the heart of our decision-making – in Government, local communities and businesses” (HM Government, 2011).

Following the *White Paper*, the Greater London Authority in 2012, under the direction of then-Mayor Boris Johnson, launched the All London Green Grid (ALGG). The ALGG feeds into the *London Infrastructure Plan 2050* which calculates that “... the capital will need the equivalent of 13,000 football pitches of new green cover by the middle of the century” (Mayor of London, 2014).

No recurrent funding mechanism was put in place to ensure long-term delivery of the ALGG. However, Mayor Johnson sought early buy-in through widespread community and business consultation. Across London, Business Improvement Districts (BIDs) were established bringing landowners and businesspeople together to take responsibility for delivering new green infrastructure. BIDs could apply for a share of a pool of £500,000 to nurture projects through to fruition, and as of 2016, 117 projects had eventuated and leveraged more than £4.3 million in additional private sector investment (Cross River Partnerships, 2016).

One of the projects is a 450m², 10 tonne green wall across the Rubens at the Palace hotel, near Buckingham Palace. The wall is made up of 10,000 plants including pollinator-friendly species such as buttercups, strawberries, spring bulbs and winter geraniums. The wall was “... inspired by local businesses wanting more places to relax and enjoy their working environment” (Cross River Partnerships, 2016).

Ten tonne 'green' wall at Rubens at the Palace



. Source: Bonnie Alter

However, despite early enthusiasm and success, political interest in the ALGG has waned. Indeed, community organisations appear now to be its strongest cheerleaders. The Campaign to Protect Rural England (CPRE) London, and Neighbourhoods Green in 2014 jointly released an independent review of progress and found only half of London's boroughs had made a specific commitment to the ALGG or "showed a robust understanding of and commitment to the [grid] principles" (CPRE London & Neighbourhoods Green, 2014). No progress was evident in the remaining boroughs.

In the report, CPRE London and Neighbourhoods Green:

- called for the GLA to ensure far greater collaboration between boroughs and to ensure that they incorporated the ALGG into their policies, and
- urged further investment in areas where less progress had been made,
- monitor and audit progress
- build a robust dataset including key performance indicators.

(CPRE London & Neighbourhoods Green, 2014)

Further evidence that action on the ALGG was lagging came in July this year when the GLA's environment committee reportedly called on the current Mayor, Sadiq Khan, to appoint a Commissioner for Green Infrastructure "... so that more could be done at a city level to aid planners and developers...a champion, an advocate, somebody who really understands the social, economic, and environmental benefits of green infrastructure" (environmentanalyst, 2017).

In London, then-Mayor Johnson, launched the ALGG in 2012 to:

... promote a shift from grey to green infrastructure to secure environmental, social and economic benefits. The ALGG changes our understanding of London as a green city. It is a progression from perceiving London as a city punctuated by parks, green spaces and surrounded by countryside, to an appreciation of this network as part of the city's fundamental infrastructure.

(Greater London Authority, 2012)

Though not as encompassing as Vancouver's 'greenest city' program, the ALGG has involved wide consultation and community, stakeholder, business and resident buy-in. However, it still does not have a clear funding mechanism, and there is some evidence momentum has slowed. Advocacy agencies such as the Campaign to Protect Rural England, London and Neighbourhoods Green, have urged the current Mayor, Sadiq Khan, to give higher priority to green infrastructure (CPRE, London, Neighbourhoods Green, 2014). These were backed recently by the Mayor's own GLA environment committee which urged him to appoint a Commissioner for Green Infrastructure to better advocate and champion for more green infrastructure (environmentanalyst, 2017).

On a positive note, an economic assessment of all London's public parks and green spaces is due to be completed in a few months when '...it is hoped such a pan-London natural capital account will unlock funding for green spaces and help decide where local authorities and others spend their money' (environmentanalyst, 2017).

The story of London's Green Grid underscores the importance of consistent strong leadership if a long-term policy initiative is to be successful. This is particularly the case with a project like Sydney's Green Grid which, by its very nature, takes time to grow, flourish, and make a visible difference to the city. Such a project cannot depend on the political cycle. It needs to be soundly embedded in local administrative plans; it needs proper ongoing funding; and, ideally, it is anchored into place with regulation and/or legislation. In this way, it can produce long-term results, with all the health and well-being benefits that people living in an increasingly crowded city need to live a good life.

In contrast, the 2008 election of Vancouver's 'green mayor' Gregor Robertson sparked major investment in green infrastructure in response to his commitment to make the city the 'greenest in the world' by 2020. Under his leadership, 35,000 residents and 180 organisations have been involved in crafting a plan to reach this goal. So far, there have been 150 initiatives including a large farm in the middle of Vancouver, a commitment that all citizens will live within a five-minute walk of a park, and the planting of thousands of trees (WWF International, 2016).

Deputy Mayor Andrea Reimer explains the success of the program to become 'greenest city in the world' lies in "... how you marry a government to residents, business and different civil society groups and make it a collective effort" (WWF International, 2016). In a media interview last year, Mayor Robertson said "... there's plenty of cause for confidence that we can ultimately be the world's greenest city by 2020. But we have stiff competition" (Robinson, 2016). Vancouver offers an excellent example of how a passionate leadership team can harness the necessary community enthusiasm and action to achieve big green goals.

7.2. Leadership – the Sydney story

While Singapore might be an example of a top-down approach to green infrastructure delivery, and London and Vancouver show how progress is possible by leaders drawing on broad support, the situation in Sydney faces great challenges. While the city has its own Green Grid built into the regional plan, implementation relies on a diffusion of power and responsibility through the GSC, a multitude of councils, state agencies, utilities, and commercial organisations. Even the Commonwealth Government through its forthcoming National Cities Performance Framework is likely to have indicators that address green infrastructure delivery in Sydney (Australian Government, 2017).

Earlier this year, the consultancy firm AECOM identified a raft of hurdles in the provision of street trees in Sydney's public domain, and recommended a dedicated authority be established for green infrastructure. "We need a Greater Sydney Tree Authority or a Minister for Trees, and they need to own the value of tree because at the moment there is not one entity that negotiates on behalf of green infrastructure," says Roger Swinbourne, co-author of *Green Infrastructure: a vital step to Brilliant Australian cities*, a report which has placed a value on street trees. (Swinbourne & Rosenwax, 2017)

A leader with responsibility for trees or a tree authority would, say authors James Rosenwax and Roger Swinbourne, address two major policy obstacles that currently leave Sydney's public trees and other green infrastructure undervalued, ignored, or at the end of a long list of competing infrastructure needs.

Firstly, there's a lot of complexity between the roles that agencies [such as Ausgrid, Roads and Maritime Services, Endeavour Energy, Sydney Water] and every other public entity need to negotiate, and the role of trees. For example, let's imagine you're putting a cycle path down a road and you're Transport for NSW or a council, and you hit a tree, and then a bit further down the road there is a stop sign. Because you have a right as a government agency or as a council to manage trees that pose a risk, you have the right to remove that tree. But with the stop sign you'd have to call the relevant agency and the negotiation would take three months and it would be a nightmare. So, it's easier to go around the stop sign.

Roger Swinbourne and James Rosenwax, AECOM

This, says Swinbourne, means that in contested spaces such as footpaths, verges and other public areas, it is too easy for trees to be removed or never planted if they offer the slightest inconvenience or risk to any of the many authorities with a stake in that space. Swinbourne uses electricity infrastructure as an example:

...someone owns the power poles. There's a yield and return. The owner of the asset is responsible from design to capital investment to operational expenditure. Everything is managed by a single entity and that single entity has an interest in maintaining it. The thing is, urban trees are not managed the same way. With trees, all the benefits and the value returned are above the line, but the impacts and costs are below the line. The biggest issue is that the benefits and value returned [of trees] sit with the wider community, while the costs and impacts sit with government and agencies.

Roger Swinbourne and James Rosenwax, AECOM

A Minister for Trees, says Swinbourne, could help address a further problem facing green infrastructure delivery in Sydney: public opposition. He found that councils, while generally keen to green streets and plant trees, often encounter residents concerned about the maintenance cost of leaves and tree roots getting into pipes.

Think of the communication campaign over conserving water that was run during the big drought of the mid-2000s. It totally changed our relationship culturally with water. Even though our dams are now full, we still don't leave taps running. It's no longer part of our culture. I think if we invested that kind of effort in a campaign about valuing green infrastructure, you'd be pretty successful in moving the dial.

Roger Swinbourne and James Rosenwax, AECOM

The need for stronger, clearer leadership supporting green infrastructure is backed by Julian Szafraniec from SGS Economics and Planning who, when interviewed for this research, likened the difficulty in explaining its value to that of a new transport line.

If you're building a big train line into the city it isn't about saving two minutes to station X, it's about the broader benefits, making the city function better...people understand the value of bike paths and trees from an anecdotal perspective, now the challenge is trying to place that within a cost-benefit analysis framework.

Julian Szafraniec, SGS Economics and Planning

Szafraniec sees a leadership role for academics in helping explain the true value of green infrastructure to the broader community and, also, to NSW Treasury "...fleshing out what the metrics are and the best way to quantify them is where academia can help."

Across Sydney, there are some good examples of councils leading the way. For example, the City of Sydney's *Urban Forest Strategy* supports its *Environmental Action 2016 – 2021 Strategy and Action Plan* by setting a path to increase existing tree canopy by 50 per cent by 2030 and 75 per cent by 2050. In addition, the City's 29,500 street trees and 12,000 park trees (tree on private land are not included) are individually registered on a database that is regularly updated, and "records the tree location, species, size, health and condition, and all maintenance works performed on the tree" (City of Sydney, 2013). The City also places a bond on trees so that construction projects must work around them, rather than take the easy option of removal.

In Parramatta, the council has committed itself to the difficult challenge of creating "a green, active and walkable city" out of one that has been historically car-dominated. Greater Parramatta is a designated NSW Government Priority Growth Area and in the midst of a major renewal program, with many new and planned medium and high-rise housing developments. The City of Parramatta's *Parramatta Ways* program sets strategies and targets to rejuvenate the city into one where better pathways and 'greener' streets encourage both walking and cycling. *Parramatta Ways* forms part of Sydney's Green Grid program (City of Parramatta; NSW Government, 2017).



Source: City of Parramatta

In its 255,000 square metre Central Park development in Chippendale in inner Sydney, Frasers Property focussed heavily on incorporating green infrastructure as part of a suite of eco-friendly initiatives. The company wanted to set an industry standard, and its Central Park development has gone on to win a raft of awards around the world. Frasers says its environmental focus has proved good for business attracting a high standard of investors to the site, as well as residents keen to enjoy 'green living' within the heart of the city.

Case Study: Frasers' business model thrives on green infrastructure



Source: Frasers

The successful provision of green infrastructure is not only the result of political and community leadership; there is also growing evidence of it in the business world. Frasers Property, for example, is in the final stages of developing CentralPark, a 255,000 square metre urban development at Chippendale on the edge of Sydney's CBD.

Central Park sits on the former Carlton United Brewery site, and posed a number of initial challenges for the developers, in particular questions over the site's capacity to provide sufficient water and energy infrastructure to supply the demands of a major new commercial, shopping, hotel, and residential precinct. CentralPark property project director, Mick Caddey, says those early challenges provided an opportunity for Frasers to devise a range of solutions that would make the site a model sustainability precinct. These solutions include a centralised thermal plant to provide heating and cooling, and an on-site sewerage treatment plant.

However, as Caddey points out, those utilities are out of sight, and you would need to be an engineer to fully appreciate the innovation that had gone into their construction and implementation. However, it is impossible to miss the site's flagship building, One CentralPark. With its exterior walls of cascading vegetation, the tower sits in dramatic contrast to its neighbour, the University of Technology, Sydney, one of Sydney's finest examples of brutalism. The plants covering One CentralPark are fed by recycled grey water and form the equivalent of a tiered vertical park.

The building has won a raft of international awards, including the Best Tall Building Worldwide by Chicago's Council for Tall Buildings & Urban Habitat (skyscraper.com, 2017). So far, the Central Park complex has won 60 national and international awards, including for landscape architecture,

construction, sustainability and design. “I am constantly putting staff on planes to pick up awards,” says Caddey.

CentralPark includes two parks: Chippendale Green, a 6,400 square metre park, and the pocket-sized Balfour Street Park which connects the development to Chippendale.

Caddey says Frasers is one of several Sydney top-tier developers to have made green infrastructure and sustainability a central plank of their business model.

“The whole [CentralPark] development has been very positive for us. People have all heard harrowing stories of problems that can eventuate when you buy apartments off the plan. So, residents tend to gravitate to quality developers. And sustainability is one of the factors they use when judging the quality of developments.”

Another advantage of developing a sustainability business model is the type of business partners that are attracted to buy into and invest in the site. “Good breeds good,” Caddey says.

7.3. Conclusion

Leadership is the key to successfully delivering green infrastructure. Not just leadership that lasts an electoral cycle, or the tenure of one committed executive, but that embeds enduring change into organisations, processes, regulations, companies, and governments. We have seen how a Mayor and his team in Vancouver can harness widespread community involvement, and set green infrastructure targets that have helped to make it among the most consistently liveable places in the world. (Mercer, 2017; The Economist, 2017).

We have also seen how early enthusiasm for building the quality and quantity of green infrastructure in London under Mayor Johnson led to some strong programs and projects. However, the passage of time, a change in leadership, and an absence of ongoing funding slowed progress. Indeed, it is now green community groups that appear to be leading the case for London to re-commit itself to green infrastructure across the city.

In the City of Sydney, a Mayor with an enduring commitment to supporting green cover and infrastructure has placed a high priority on preserving and building more. By placing a bond on trees, the City has provided unambiguous direction to developers that they must work around trees, rather than take the cheap and easy option of removing them.

In Penrith, in Sydney's west, rising summer temperatures, population growth and rapid urban expansion all suggest an urgent need for a comprehensive green infrastructure policy across the municipality. Yet even though two council reports have identified the role that a greater level of green infrastructure could play in ameliorating these challenges, support to date seems haphazard; even timid.

Engaging a small group of residents in a community pilot project in Blacktown showed how resistance to the planting of new street trees could be overturned with the right approach and information. *Cooling the Street* allowed the council and project leader Dr Libby Gallagher to create a successful model that could be adopted by councils anywhere. Sadly, funding has not been provided to repeat the project.

And, Sydney's Central Park project has won sustainability, innovation and design awards around the world for Frasers Property. The site's flagship property, the vegetation-draped One CentralPark, stands in contrast to its stark brutalism-style neighbour directly opposite, the University of Technology Sydney. Frasers has found that as well as solving local water and energy challenges, a commitment to sustainability is an effective business model, offering potential investors and residential buyers confidence that the project offers both amenity and quality.



8. Recommendations

Based on the research, the following recommendations for alternate regulatory and funding mechanisms are provided alongside other mechanisms required to support effective green infrastructure delivery in urban infill areas.

The centrality of strong leadership, underpinned by substantial institutional value, to the success of these recommendations cannot be emphasised strongly enough. Indeed, the team insists that, without it, it will exceedingly difficult to implement the recommendations.

Therefore, the team's first recommendation is to:

1. Make green infrastructure a NSW Premier's Priority. This will raise the profile and place green infrastructure at the apex of the Government's policy goals, thereby leveraging central and line agency funding support and coordination in further reviewing policy and regulations.
 - a. Designating green infrastructure as a Premier's Priority will help drive the necessary legislative changes to unlock new finance and funding mechanisms and smooth policy and regulatory barriers. This has been crucial in other jurisdictions, such as the ACT Government's legislation for BIDs.

Then:

2. Submit funding bids to the NSW Environmental Trust Environmental Research Grants and Climate Change Fund to develop an evidence base of the benefits of green infrastructure to the NSW Government and economy.
 - a. This bid should be whole-of-government and involve central and line agencies such as NSW Treasury, NSW Health, Transport for NSW, NSW Roads and Maritime Services, OEH, Sydney Water, the NSW Environmental Trust and NSW Environmental Protection Authority.
 - b. The evidence base could be developed through pilot projects delivered by the NSW Government in collaboration with councils and universities. Melbourne's Greening the West initiative provides a model for this.
3. The evidence base will help unlock new finance and funding mechanisms such as Green Bonds that require an economic evidence base to value infrastructure investments, Special Infrastructure Contributions that rely on evidence of property value increase, and tax increment finance that relies on evidence of future tax revenues. Development of the evidence base should:
 - a. Be led by NSW Treasury to identify acceptable economic metrics for valuing green infrastructure in capital business cases. The following are recommended:
 - i. Cost effectiveness assessment (i.e. avoided costs), Total Economic Value (i.e. new jobs and economic activity) and Gross Value Added (i.e. wider economic benefits and land use change)
 - b. Identify and quantify the direct and indirect economic and financial benefits of green infrastructure to property owners (i.e. property value uplift, reduced insurance premiums

and energy bills etc.), agencies (i.e. avoided costs to NSW Health, Sydney Water, NSW Roads and Maritime Services, Transport for NSW, NSW Environmental Protection Authority etc.), and local councils (i.e. avoided costs from reduced insurance premiums etc.). This should be supported by:

- i. An institutional logic chain that maps policy goals for central and line agencies that directly and indirectly benefit from green infrastructure.

Once the evidence base is developed, then:

4. In collaboration with NSW Treasury, update the UK's Green Infrastructure Valuation Toolkit with the local evidence and establish it as the standard approach to valuing green infrastructure in business cases.
 - a. This should include an update of the NSW Treasury business case guidelines to ensure that wherever a grey infrastructure solution is proposed a green solution is included as a comparator.
5. Use the evidence base to demonstrate to IPART that green infrastructure is a more cost effective use of contributions, and impervious surfaces should be the basis for stormwater user charges. For example, the stormwater management charge used by councils defines stormwater management as a function of both quantity *and* quality.
 - a. This should include an update of the NSW Department of Planning and Environment's contribution practice note to explain green infrastructure serves dual purposes of open space and stormwater management.
6. Seek general revenue funds for green infrastructure from agencies such as NSW Health, Transport for NSW, NSW Roads and Maritime Services, Sydney Water and the NSW Environmental Protection Authority.
 - a. Funding should be proportionate to the avoided costs they receive from it. This allocation should be diverted to the NSW Metropolitan Greenspace Program to deliver green infrastructure identified in *A Plan for Growing Sydney* and District Plans. Then, the GSC can mandate delivery through local plan review and sign off.
7. Use the evidence to advocate to the CEFC to include natural solutions within its investment strategy. The evidence-base should also be used to develop a financial model that incorporates natural solutions within EUAs. This may require regulatory change to extend EUAs to natural solutions.
8. Encourage councils to use cross-boundary VPAs to maximise the benefits and leverage economies of scale of green infrastructure through sub-regional delivery.
 - a. The CPB3 model could use VPA payments to act as security for PPPs that aggregate projects across councils, thereby reducing private capital transaction costs. Changes may be required to the EP&A Act and Local Government Act to allow use of VPA funds for this.

General revenue from avoided costs to government and improved economic activity would serve as repayment for the private capital. As a beneficiary, this would require the NSW Government to partner with councils in PPPs. PPP structuring could be undertaken by the NSW Treasury PPP Division. If changes were made to its investment strategy, the CEFC could be a potential investor in this model.

- b. Once green infrastructure is delivered, councils could apply for Biobanking Agreements to provide ongoing maintenance funding for the sites. Whilst Voluntary Conservation Agreements are possible, they should only be used in conjunction with Transferrable Development Rights to avoid the opportunity cost of foregone development.

Once these recommendations are implemented, then:

9. Undertake a forensic review of direct and indirect policy goals and regulations that contradict or circumvent green infrastructure delivery.
 - a. This could follow the approach to the current review of NSW State Environmental Planning Policies. Once completed, consideration should be given to the appropriate balance of incentives for green infrastructure within the system.
10. Issue directions for councils to consider green infrastructure when developing, monitoring and reporting on LSPS, and work with the GSC to incorporate green infrastructure indicators in the City Dashboard.
11. Develop a clearinghouse of information on the range of green infrastructure benefits, how to value these, and finance and funding options.
 - a. This could be developed using persona profiles such as developers, community groups, local councils etc.
12. Demonstrate leadership by including precinct scale green infrastructure in NSW Government-led urban renewal projects.
 - a. Plans for all Priority Precincts could be assessed using the Green Star Communities and PRECINX tools. The Precincts could also act as test cases for improving green infrastructure performance criteria in the tools.









9. Sydenham-Bankstown case study

9.1. Sydenham to Bankstown Corridor

The Sydenham to Bankstown Corridor was first identified as priority area in *A Plan for Growing Sydney* (NSW Government, 2014). In addition, the proposed Sydney Rapid Transit line will connect Chatswood to Bankstown via Sydenham, and provide improvements to the corridor's rail line, allowing for faster and more frequent services.

A Plan for Growing Sydney focuses on providing new housing in areas with good public transport connections, including a specific focus on urban renewal of the Corridor. The intention of the Plan is that new housing will be complemented by additional jobs and social infrastructure, such as schools, community facilities, public spaces, and, importantly, open space.

DPE is preparing renewal strategies around each of the train stations along the Corridor to increase housing supply, revitalise existing neighbourhoods, and, significantly, “create a network of interlinked, multipurpose open and green spaces across Sydney” (NSW Government, 2014).

9.2. Canterbury

The Corridor's Canterbury precinct has a mix of low density single and semi-detached dwellings, a small, linear business centre, several parks, and areas of new, increased density close to the train station. It is split by the Cooks River, Canterbury Road and the rail line, which all intersect in one key location. The linear green space that lines the river offers residents an opportunity to enjoy nature close to the city, and provides a real sense of identity to the area.

The Corridor's urban renewal strategy flags several zones for redevelopment in Canterbury. The core area, closest to the station, has been identified for intensification. High rise and mixed-use developments will replace existing residential and low-rise uses, and shop-top housing will be located above new business and retail developments along Canterbury Road. Some existing open space is currently included in this area.

Further from the station, residential areas are highlighted for increased density – from low to medium-rise, particularly adjacent to the river and existing parks. Finally, there is the Canterbury Park Racecourse. The Corridor strategy identified that, should this site become surplus, it would be suited for a master planned residential community with heights ranging from three to 18 storeys and significant open space.

From the entire Canterbury precinct, we have focused our attention on two areas: a low density residential area that will be intensified to high density, and the racecourse itself. Our recommendations for these case study areas are based on the recommendations in the report. With the evidence gathered, the research team workshoped the site and used the knowledge gathered to develop the recommendations. We present examples of the options for developing and funding components of green infrastructure for these sites.

9.2.1 Triangular residential site

Close to critical public amenities – both transport and open space – and with the potential for greater foot and road traffic encouraging increased business and retail activity, the area adjacent to the train station is typical of many residential areas throughout Sydney. Green infrastructure solutions that retain and improve the quality of existing green space, and increase the quantum are critical to the success of this area.

9.2.2 Racecourse

The Canterbury Racecourse, the largest single open space along the corridor, has been flagged for further investigation as part of a Priority Precinct. This follows recent statements by DPE that the NSW government is exploring options to rezone the site in anticipation of its eventual sale (Visentin, 2017). The Australian Turf Club, which owns the 35-hectare site, has not ruled out the future sale, although it is currently constrained by a 10-year legal requirement preventing its sale until 2021. It is expected there will be significant interest in this area in the coming years, with increasingly intense development pressure to use this open space for medium- to high-density development.

Similarly, there are open spaces dotted throughout Sydney's suburbs – pocket parks, playing fields, unused open land – which may face similar development pressure over the coming decades. This site is an opportunity to explore interventions and mechanisms that can be used when developing previously undeveloped green space.



9.3 Case Study 1 – up-zoned residential site

Cycleway and pedestrian walkway

- Cycleways provide a range of benefits, including better access between businesses and markets, new tourism opportunities, a reduction in traffic congestion, physical health benefits from increased exercise and reduction in vehicle emissions, and mental health benefits for those participating in exercise.
- As part of a masterplan for the area, the council and state government can establish a regulatory requirement for cycleways and pedestrian walkways. This will ensure these street elements are incorporated in any final design and could be achieved through a mandatory positive provision policy that requires developers to include a separated cycle path. Funding can be directed from State government and council revenues as a result of new business rates, reduced need for roads and other public transport, and avoided cost to NSW Roads and Maritime Services and Transport for NSW, and the health benefits from increased walking and cycling result in lower overall costs on the health system. The use of business rates to underpin tax increment financing, which is not currently possible due to restrictions on council borrowing, and would require legislative change.

Street planting and green canopy

- Green grid being established by the GSC in the District Plans, which will give statutory weight to the plan for highly connected and diverse green network throughout Sydney.
- A site specific Special Infrastructure Contribution as has been used for Parramatta Light Rail could be used to capture property value uplift from State Government general revenue funding of street plantings. Funding could also be directed from general revenue value capture as street plantings are proven to increase property values and would generate more stamp duty, and from avoided costs to the health system and air quality improvement programs.
- Alternatively, developers could be exempted on public good grounds from part or all of their contribution requirements if they fully fund planting. Increases in rating revenue from property value uplift could also be hypothecated to fund a portion from council general revenue. Developers could enter into an environmental upgrade agreement if the mechanism was adapted to natural green infrastructure solutions, such as reduction in energy consumption due to a cooler urban environment.
- The NSW Government already runs a raft of public information campaigns to address issues such as excessive alcohol consumption, household energy and water saving, littering and speeding on our roads. It could run a similar campaign ‘putting the case for trees’, explaining their economic, health, and well-being benefits, and asking residents to adopt and maintain a tree in their neighbourhood.

Equivalent green space

- The State Government could commit to including a green plot ratio clause in the Standard Instrument LEP, to be adopted in all NSW LEPs, requiring the equivalent site area covered by impermeable development to be included as green space on the development itself. These built elements would be a DA requirement, and would therefore be funded by the developers as has been the case for CentralPark.
- There could also be an opportunity to enter into an environmental upgrade agreement if adapted to natural solutions, or apply tax increment funding.

- As is the case in the United States, a further incentive could be established by offering a reduction in Sydney Water's stormwater usage charges based on the pervious / impervious ratio rather than on-site detention. This would require a change in decision-making by IPART.

Green roofs and walls

- Green roofs and walls increase vegetation on sites, reduce the urban heat island effect, and lower internal temperatures and energy bills. There are also health benefits from increased vegetation and the improvement in oxygen levels it provides.
- The State Government could commit to including a green roof and green wall clause in the Standard Instrument LEP, to be adopted in all NSW LEPs, requiring a certain area of new developments to be covered in either a green roof, or green walls, or to institute a green plot ratio, as above.
- These would be a DA requirement, funded by developers, and would provide a selling point as a development targeting the increasing number of green consumers (Duke, 2017). Developers could also be offered an exemption from contributions that is then paid into a fund and the green infrastructure is then provided by councils, as has been the case in Malmo.
- There could be an opportunity to enter into an environmental upgrade agreement if they were adapted to natural solutions. Green infrastructures, such as green roofs and walls, have also been funded through BIDs and would require a legislative change to enable this, as has occurred in the ACT. Green roofs and walls also attract new businesses, allowing potential application of TIFs by drawing on expected future government revenues from increased business activity and rating revenue.
- As mentioned above, funding can also be directed from consolidated revenue as the health benefits from increased vegetation can result in avoided costs on the health system.
- Local council rates could also be increased in line with expected energy savings for households and businesses, a mechanism that forms the basis of environmental upgrade agreements, and then hypothecated to fund delivery. This would require the NSW Government's cap on local council rates to be lifted.

Median strips

- Median strips can act as traffic-calming devices, providing a pedestrian refuge, as well as reducing the possibility of a head-on collision. As such, they offer benefits to health, by reducing the number of deaths on the roads that cost the health system upwards of \$200,000 each. This provides a strong case for consolidated revenue funding based on avoided costs.
- Median strips can act as a bioswale, filtering and redirecting stormwater that would otherwise run directly into the stormwater system, or flood adjacent properties. Funding can be directed from consolidated revenue and from Sydney Water, as there would be savings to both the EPA and Sydney Water due to the reduction in the need for waterway health programs and stormwater quality improvement devices. This would require IPART to calculate Sydney Water's stormwater usage charges on a pervious/impervious surface ratio, as used in Philadelphia and Portland.
- Stormwater management charges could also be used to fund stormwater components of the median strip.
- Bioswales also reduce the amount of water damage to roads, resulting in fewer potholes and reducing the need for maintenance roadworks. As such, funding can be directed from consolidated revenue from the avoided costs to NSW Roads and Maritime Services.

- Developers could also be offered an exemption of development contributions that is then paid into a fund and the green infrastructure provided by councils, as has been the case in Malmo.

Private open space

- Encouraging the maintenance and improvement of private open space can be done in several ways, beginning with controls in LEPs and DCPs that require certain percentage of the lot to be permeable landscaped space. Owners and developers would fund the green space, with owners continuing to fund maintenance once construction is completed. Promotion of the low impact residential customer incentive introduced by IPART for Sydney Water's stormwater user charges could assist with this.
- Penalties could be applied to those developments that do not meet the minimum requirements, and contribution exemptions or reductions could be applied to those developments that deliver a greater percentage of open space than required in the regulations.
- Councils and the State Government could provide incentives to private owners who improve the amount or quality of private green space, such as by the removal of hardstand or impermeable paved areas, through rebates or discounts on rates.
- Councils can apply tree bonds during development, as the City of Sydney does, to ensure significant existing green space is protected during development.

Public open space

- The State Government should require detailed masterplans for new developments, highlighting the design of public green spaces. These requirements can be included in LEPs and DCPs, with guidelines for developers to ensure high quality green space is included.
- Public open space could also be used as BioBanking sites, which would provide a 20-year maintenance funding stream.
- A site specific Special Infrastructure Contribution that captures the up-lift in property value provided by open space as is being used to fund infrastructure improvements for Parramatta Light Rail.
- Funding can be directed from consolidated revenue as the economic and health benefits from public open space increase property value and stamp duties, grow business taxes, and avoid costs to the health system.
- High quality public open space attracts new businesses, allowing potential application of tax increment finance by drawing on expected future government revenues from increased business tax revenue.
- Public open space can be fully funded through not-for-profit/philanthropic ventures. These situations would require an agreement between the not-for-profit agency and the local council to ensure the final development meets the council's standards, and the needs of the local area.



9.4 Case Study 2 – Canterbury racecourse

The Racecourse is such a large, open area that all the following suggested interventions could take place simultaneously.

Park (public)

- The state government should require detailed masterplans for new developments, highlighting the design of public green spaces. These requirements can be included in EPIs and DCPS, with guidelines for developers to ensure high quality green space is included.
- Developer contributions, through a site specific SIC or s94 of the EP&A Act, could also be used to fund the public open space; alternatively, developers could be granted exemptions from part or all of their contribution requirements if they fully fund public open space.
- Funding can be directed from consolidated revenue as the economic and health benefits from public open space, through increased property value, economic activity, exercise and clean air opportunities, would increase stamp duty and business tax receipts and result in lower overall costs on the health system. The application of an economic valuation system would support this funding mechanism.
- High quality public open space has been found attract new businesses, allowing potential application of TIFs as funding mechanisms by drawing on expected future government revenues from increased business tax revenue.
- Public open space can be fully funded through not-for-profit/philanthropic ventures. These situations would require an agreement between the not-for-profit agency and the local council to ensure the final development meets the council's standards, and the needs of the local area.

Community farm

- A community farm offers the unique opportunity to provide active open space that has a direct economic benefit through new jobs and economic activity. Existing examples throughout Sydney operate where council land is provided for the operation of a community farm or garden, with users paying a direct fee for the right to use the farm and enjoy its produce.
- If the farm was operated as a commercial enterprise, a range of finance and funding mechanisms could be possible including public private partnership as well as TIF that draws on expected future government revenues from increased business tax revenue.
- Developer contributions, through a site specific SIC or s94 of the EP&A Act, could also be used to fund public space to be used as a community farm; alternatively, developers could be granted exemptions from part or all of their contribution requirements if they provide the open space for the farm.

Bioswale

- Bioswales filter and redirect rain and flood waters that would otherwise run directly into the stormwater system, or flood adjacent properties. Funding can be directed from consolidated revenue and from Sydney Water, as there would be savings to both the EPA and Sydney Water due to the reduction in filtration costs. This would require IPART to calculate Sydney Water's stormwater usage charges based on the pervious/imperious surface ratio, as is used in Philadelphia and Portland.
- Stormwater management charges could also be used to fund any stormwater components of a bioswale.

- Bioswales also reduce the amount of water damage to infrastructure, particularly roads, resulting in fewer potholes and reducing the need for maintenance roadworks. As such, funding can be directed from consolidated revenue from the reduced costs to RMS, once the economic valuation mechanism has been put in place.
- Developers could also be offered an exemption of development contributions that is then paid into a fund and the green infrastructure provided by councils, as has been the case in New York.
- Developer contributions, through a site specific SIC or s94 of the EP&A Act, could also be used to fund a bioswale. This would require IPART to recognise the dual purpose of bioswales as a form of open space as well as flood mitigation device.



10 Conclusion

The future liveability of Sydney rests on our collective capacity to properly value green infrastructure. We know that Sydney's population is expanding and almost all that growth will be within its current geographic envelope. That means more medium and high-rise development, with more people – families, those living alone, the elderly – living a style of life that until recent decades was rare in Australia. Such densification must be carefully managed so that people come first. And as the research throughout this report has shown, trees, gardens and places to connect with nature are critical to the physical and mental wellbeing of all of us. Increasing summer temperatures from climate change only add to the urgency for green infrastructure to step from being an arbitrary consideration to becoming essential infrastructure.

Green infrastructure is rarely valued in a way that gives it anything other than intrinsic 'soft' value. Unlike power poles, footpaths, roadways and water pipes, which are all costed by agencies with a statutory role to maintain and defend their assets, there is no such agency for green infrastructure. As Roger Swinbourne from AECOM points out: 'The benefits and value returned [from street trees] sit with the wider community above the line, while the costs and impacts sit with governments and agencies below the line... this is why we're getting the constant erosion of trees and canopy.'

Our current governance mechanisms are inadequate when it comes to the delivery of green infrastructure. Rules and protocols are haphazard and inconsistently applied. Far too often, the decision about whether to factor sufficient green infrastructure into a development is subverted by the prioritisation of short-term economic gains, without factoring in the long-term dividend greener places can provide. At present, a city-wide approach to building green infrastructure currently depends on the cooperation of councils, state agencies and private utilities imposing a multitude of hurdles that must be negotiated in the provision of green infrastructure.

However, there are some bright signs. There is the forthcoming release of the NSW Government Architect Office's draft green infrastructure policy, *Greener Places*. There is the inclusion of the Sydney Green Grid within *A Plan for Growing Sydney* as well as some new and forthcoming legislative changes to strengthen strategic planning. These positive signs could be due to a shift within Government Architect NSW which is driving a strong design-led approach to planning policy and regulation. It is also welcome that the current planning minister has expressed his intention that green infrastructure become a clear priority. All of this presents an opportunity to re-evaluate the role of green infrastructure at a state level, and value it as a core asset, rather than the 'bit left over'.

When leadership is strong, barriers are removed and green infrastructure happens. We have seen this in Singapore over many decades, we can see it today in Vancouver where the community and political leadership have partnered to generate a big investment in green infrastructure. Locally, we've seen consistent leadership from Mayor Clover Moore at the City of Sydney where trees are valued and protected, and from Frasers Property in Chippendale where the vegetation-draped One Central Park has won sustainability awards around the world.

Our first recommendation is that green infrastructure becomes a NSW Premier's Priority. After that must follow a review of existing regulations so that barriers can be removed, and changes made. We then propose that funding be provided so that an evidence-base can be created itemising the

economic benefits – both direct and indirect - of green infrastructure. Creating such an evidence-base will not be easy, indeed it will be highly complex.

For example, it must place a value on the avoided costs to the health budget from the cleaner air and greater liveability that will flow from residents' proximity to parks and street plantings. And it must quantify the savings to stormwater pipe maintenance bills when bio-swales are included on median strips as part of streetscapes. Other jurisdictions have successfully undertaken this task such as in the United Kingdom where regional development authorities in the northwest have produced the Green Infrastructure Evaluation Toolkit.

A local version of the kit could be funded through the NSW Environmental Trust or the NSW Climate Change Fund. Such a kit would enable a standardised approach to business case formulation which NSW Treasury could use to assess and compare the merits of a green infrastructure solution, wherever a grey solution is proposed. Once this evidence base has been collected, IPART can show the true value of green infrastructure when development contributions are being allocated for new developments.

This report has charted a course of action that will help with this process. We have demonstrated how our solutions can be applied in practice through a case study of the new Sydenham to Bankstown Corridor where we showed that with some practical interventions, including bioswales, green rooves, street plantings, a green plot ratio, it has the potential to become the city's newest Green Growth Corridor.

There is no easy path to rectifying our city's long history of failure in providing sufficient green infrastructure. But we must start now. This will require leadership, regulatory reform and new ways of valuing green infrastructure. The approach we propose - making green infrastructure a Premier's Priority, undertaking a regulatory review and introducing new methods for measuring the economic benefits of green infrastructure - will send a powerful signal that green infrastructure matters, that it has a quantifiable value both above and below the line, and is as essential as the transport, power, water and telecommunication networks that make up our built environment.

As our city continues to expand to house our growing population, the need is greater than ever to ensure that growth includes green growth. After all, the trees and gardens that we plant today will become the urban forests and parks of the future, providing the cool shade and restful places that will preserve Sydney's position as one of the most liveable cities of the world.



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Appendix

1. Project methodology
2. Reverse brief
3. Research ethics approval

Project Methodology

The method included: a literature and policy review; stakeholder interviews; observation of a GANSW workshop; and application of findings to a case study. These were supported by a reverse brief and ethics application, research protocol development, and process of collaborative analysis of the findings.

The relationship between the research questions and methods used is summarised below.

Research question	Primary method	Supporting methods
How is green infrastructure provided in urban infill developments?	Literature and policy review	Stakeholder interviews
What are the major barriers limiting the provision of green infrastructure in urban infill developments?	Stakeholder interviews	Literature and policy review, GANSW workshop
What alternative regulatory and funding mechanisms could contribute to the provision of more green infrastructure in urban infill developments?	Literature and policy review	Stakeholder interviews, Case study

Reverse brief

The reverse brief built on an initial scope provided by GANSW that outlined the context and aim of the research, and a set of research questions (see Appendix 2).

The team met for the first time over two days in mid-August to discuss this. This included a session with GANSW on the research origins and context, links to other GANSW work, and potential use of the findings. At the end of this first day, the team discussed potential barriers to green infrastructure delivery in Sydney, particularly regulation and funding.

On the second day, the team developed a draft theoretical framework, identified the target audience for the research, discussed potential stakeholders to interview, and refined the GANSW scope. The framework drew on the existing knowledge of the team, who are all experienced professionals in urban policy and planning, as well as insights from the session with GANSW and initial research undertaken by the team.

Stakeholders were identified on the basis of familiarity with delivering green infrastructure, likely experience of barriers, particularly regulation and funding, as well as different roles in the green infrastructure delivery chain, for example, designer, funder, decision-maker etc. These included representatives of local councils, NSW Government and the GANSW, consultants and academics in landscape architecture, development delivery and finance, environmental organisations, and politicians.

The scope was refined to include a clearer definition of green infrastructure, urban infill development and the delivery problem in Sydney, narrow the research questions to focus on green

infrastructure delivery in urban infill areas and regulatory and funding barriers, and use a case study to apply the findings to urban infill in Sydney.

The team then jointly prepared a UNSW Human Research Ethics application, including risk assessment, and appointed roles of project manager, research manager, report manager and presentation manager. After the first meeting, the revised brief was sent to GANSW for approval and UNSW provided ethics approval (HC17703 - see Appendix 3).

Research protocols

Following the first meeting, the team developed research protocols including an online project management system to track progress and a fieldwork system for allocating the interviews as well as scripting for booking and conducting interviews.

Interviews were allocated evenly across the team. This included consideration of potential conflicts of interest, such as ensuring team members employed by the NSW Government did not interview NSW Government stakeholders.

Literature and Policy Review

The literature and policy review investigated regulatory and funding barriers and solutions for effective green infrastructure delivery as they related to the elements of the theoretical framework. This included defining green infrastructure and its benefits, different approaches and methods for valuing it, current regulatory and funding mechanisms for green infrastructure delivery, alternative mechanisms in use in other jurisdictions, and the leadership and governance dimensions of these.

Literature reviewed included academic journal articles as well as grey literature such as industry research and news articles, thought leadership pieces, and regulatory and funding settings for green infrastructure policies, programs, initiatives and projects. The review was not limited by jurisdiction and covered Sydney, NSW, other Australian jurisdictions, and internationally. It encompassed solutions implemented by the public, private and non-government sectors. The review was limited to natural green infrastructure such as street plantings, rain gardens and green roofs and walls and did not consider built green infrastructure such as renewable energy and water efficiency devices.

Stakeholder Interviews

The team includes experienced professionals with connections to practitioners involved in green infrastructure delivery. To increase the likelihood of participation, the team drew on these connections to identify interviewees across the stakeholder categories.

A total of eight semi-structured interviews were conducted, ranging between forty-five minutes and one hour. To ensure participation was most convenient for the interviewees, three were undertaken face to face and five by phone at the interviewee's request.

Prior to the interviews, interviewees were provided with a Project Information Sheet and Consent Form outlining the terms of participation including the option to withdraw at any time and for quotes to be fully attributed, partially attributed or non-attributed. Interviewees were asked to sign and return the Consent Form prior to the interview and to indicate their preferred attribution. The semi-structured nature of the interviews allowed for deeper exploration of interviewee responses. The following interview questions were used as a guide:

1. Overview of interviewee experiences in delivering green infrastructure
2. How would you define green infrastructure?
3. What's your overall assessment of green infrastructure delivery in Sydney?
 - a. In your professional experience, what do you see as the barriers to delivering green infrastructure in Sydney, particularly urban infill areas?
4. Thinking particularly about planning regulation and funding
 - a. What do you think Sydney needs to do to enhance green infrastructure delivery in urban infill areas?
 - b. How should this be done? (i.e. technical mechanisms)
 - c. Who needs to be involved? (i.e. Commonwealth, State, private, local, NGOs, community etc.)
 - d. What do you see as the challenges in doing this?
5. Could you nominate some good examples of green infrastructure delivery in Sydney or elsewhere?
 - a. What makes these examples work?
 - b. How do these compare to your professional experience and assessment of green infrastructure delivery in Sydney?
6. Can you think of any particularly good resources on this topic we should look at?

GANSW Workshop

On 18 September 2017, GANSW hosted a workshop with around 50 stakeholders from NSW Government agencies responsible for urban renewal, environmental, health and other service and infrastructure delivery functions.

Members of the research team attended the workshop as observers and active participants. The feedback collected enabled the team to test its thinking with a wide range of stakeholders with an interest and role in the effective delivery of green infrastructure, and highlighted areas where further research was required.

The workshop sought feedback on a draft of Greener Places, the NSW Government's green infrastructure policy this research will further inform. The workshop commenced with an overview of the context and benefits of green infrastructure, as well as Greener Places. GANSW staff then facilitated small group discussions on 'what works' and good examples of green infrastructure delivery.

A representative of the Western Sydney Local Health District then presented on the importance of green infrastructure to health, and a representative of GANSW on the implementation of Greener Places. GANSW staff then facilitated small group discussions on barriers to and ingredients for successful implementation.

Case Study

A case study was used to apply the research findings. The Canterbury Precinct of the Sydenham to Bankstown Urban Renewal Corridor was selected as the case study location.

A number of factors influenced this selection. These included the Corridor's status as a live urban infill project GANSW is currently engaged with and the sub-regional scale of the Corridor. The Canterbury Precinct was chosen because significant density increases are expected, it contains a mix of residential and business land uses, relatively poor provision of existing green infrastructure, a number of land uses that are amenable to green infrastructure such as Canterbury Park horse racing track and the Cooks River, and the opportunity to demonstrate application of the findings to different types of green infrastructure including both blue and green solutions.

The team met to collaboratively apply the findings to the Corridor, focusing particularly on existing and alternate regulatory and funding mechanisms that could be applied to assist with effective green infrastructure delivery.

Analysis of Findings

The team met several times throughout the research to interpret findings of the literature and policy review, stakeholder interviews, and the GANSW workshop, as they became known. This was an iterative analysis process that provided a vehicle for synthesising and highlighting important links between the various findings as they related to the theoretical framework.

In collaboratively interpreting and analysing the findings, the team was interested in identifying barriers to green infrastructure delivery as well as policies, programs, initiatives or projects that respond effectively to these, or could do so with changes. The team focused particularly on the regulatory and funding settings of the policies, programs, initiatives or projects, and the leadership and governance aspects of these.

Benefits and limitations of method

There are several benefits to the method used, and some limitations. Benefits include the inter-jurisdictional scope for review of alternate regulatory and funding mechanisms. This meant the team was not limited to established practice in Sydney and could identify important contextual differences that will need to be overcome for effective green infrastructure delivery.

Another benefit was engagement with stakeholders involved at different points of the green infrastructure delivery chain from project origination through approval and onto project delivery. This meant the team could draw on real world insights on the relative importance of different points in the chain as barriers to effective delivery. A further benefit was the opportunity to seize on the GANSW workshop. This provided a valuable opportunity to gain feedback from a broader range of stakeholders than would have been possible through interviews alone.

A limitation of the method was lack of engagement with stakeholders involved in the alternate regulatory and funding mechanisms in use in other jurisdictions. This meant the team could not readily identify what was most important about these mechanisms to effective delivery, and the enabling conditions for them. However, the team's research plugged this gap through desktop review of interviews and thought pieces from stakeholders involved in the alternate mechanisms reviewed. For example, the approach to green infrastructure delivery in the UK is arguably world leading and, fortunately, has been well documented through first hand stakeholder accounts that were examined as part of this research.

A further limitation was the breadth of existing research on green infrastructure and the interplay with the inter-jurisdictional review of alternate regulatory and funding mechanisms. This meant all conceivable mechanisms could not possibly be reviewed. To mitigate this, the research focused on examples commonly cited across the literature. For example, several cities in Europe and the United States such as London, Manchester, New York, Philadelphia, Portland and Chicago were mentioned numerously as leading practice. This meant the team focused more so on these examples than others.

Greening Sydney: alternative delivery mechanisms for green infrastructure



Background and context

Sydney's population is forecast to increase 80 per cent by 2054, resulting in an additional three million people in the metropolitan area. As the number of urban infill developments increases in response to population growth, the challenge will be to shape Sydney's built environment to ensure it remains distinctive and liveable.

Green infrastructure is a hallmark of liveability. It is defined as the network of designed and natural vegetation and waterways found in cities and towns including public parks, recreation areas, sports fields, remnant vegetation, residential gardens, street trees, wetlands, community gardens and emerging urban greening technologies such as green roofs and green walls.

Well-planned green infrastructure helps absorb floodwater, cools the urban environment, cleans the air, enables local food production, ensures the survival of Sydney's fauna and flora, and provides space for recreation, sport and leisure.

There is recognition across government and the public that green infrastructure offers important health, economic, social and environmental benefits (Ely and Pitman, 2014). Despite this, a recent report by international engineering firm AECOM noted:

"Australian regulations and business models ... focus on concerns about litigation, operating costs and engineering problems, without fully appreciating the value green infrastructure provides to our cities." (2017:1)

GANSW (NSW Government Architect) is concerned the provision of green infrastructure in Greater Sydney is not keeping pace with population growth, urban densification and climate change. Regulatory and funding mechanisms have been identified as major factors when providing green infrastructure (Young *et al*, 2014).

Impact

This research will identify current challenges and provide options for alternative green infrastructure regulatory and funding mechanisms.

It will then demonstrate how these could be applied to the *Sydenham-Bankstown Urban Renewal Corridor*. In doing so, it will support the GANSW draft *Green Infrastructure Strategy*.

Aims & questions

The aim of this research is to provide GANSW with guidance on alternative regulatory and funding mechanisms for green infrastructure in Sydney. It will respond to three main questions:

1. How is green infrastructure provided in urban infill developments?
2. What are the major barriers limiting the provision of green infrastructure in urban infill developments?
3. What alternative regulatory and funding mechanisms could contribute to the provision of more green infrastructure in urban infill developments?

For the purposes of this research, urban infill development is defined as new mixed-use residential and commercial properties in existing urban areas, often at higher building densities.

Objectives

1. Describe current regulatory and funding mechanisms for green infrastructure in urban infill developments. This will include mechanisms such as VPAs, S94 contributions, planning controls and building regulations.
2. Describe the major barriers limiting the provision of green infrastructure in urban infill developments, with a particular focus on regulation and funding.
3. Develop a suite of options to enhance provision of green infrastructure in urban infill developments that respond to the challenges identified with current practice.
4. Apply these options to a single case study area in Greater Sydney.

Target audience

- GANSW
- State and local government planning departments
- Developers
- Architects
- Financiers
- Environmental consultants.

Approach

Stage 1

International desk-top audit to define green infrastructure and its value. A summary of benefits.

Stage 2

International and inter-jurisdictional desk-top audit of current best practice in green infrastructure delivery.

Stage 3

Desk-top audit of current policy and practice in delivery of green infrastructure across Greater Sydney.

Stage 4

Interviews with 6-8 professionals involved in the delivery of green infrastructure.

These may include architects, developers, environmental consultants, local and state planners and financiers.

The interviews will cover current practice, barriers and ideas for alternative regulatory and funding mechanisms for green infrastructure.

Stage 5

Drawing from the outcomes of Stages 1-4, provide options for regulatory and funding mechanisms.

Stage 6

Demonstrate how the options could be applied to the *Sydenham-Bankstown Urban Renewal Corridor*

Budget (time)

Research Stage	Hours
Stage 1	10
Stage 2	16
Stage 3	10
Stage 4	32
Stage 5	35
Stage 6	35
Presentation preparation	26
Report preparation	80
Total	244

Deliverables

- Presentation to GANSW (TBC, indicative 22nd October 2017)
- Research report (approximately 40-50 pages, 27th October 2017)

Timeline and milestones

Week commencing	14/8/17	21/8/17	28/8/17	4/9/17	11/9/17	18/9/17	25/9/17	2/10/17	9/10/17	16/10/17	23/10/17
Stage 1											
Stage 2											
Stage 3											
Research Ethics Approval											
Stage 4											
Stage 5											
Stage 6											
Report and presentation preparation											
Report and presentation delivery											

Research team

Chris Twitchen (Project Manager and Client Liaison)
Vivienne Skinner (Report Editor and Presentation Manager)
Kate Freney (Report Manager)
Alex Lawrie (Fieldwork and Data Manager)

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24-Aug-2017

Dear Dr Hazel Easthope,

Project Title	Greening Sydney: Overcoming barriers to the provision of green infrastructure
HC No	HC17703
Re	HC17703 Notification of Ethics Approval
Approval Period	24-Aug-2017 - 23-Aug-2022

Thank you for submitting the above research project to the **HREAP Executive** for ethical review. This project was considered by the **HREAP Executive** at its meeting on **22-Aug-2017**.

I am pleased to advise you that the **HREAP Executive** has granted ethical approval of this research project. The following condition(s) must be met before data collection commences:

Conditions of Approval:

N/A

Conditions of Approval - All Projects:

- The Chief Investigator will immediately report anything that might warrant review of ethical approval of the project.
- The Chief Investigator will seek approval from the **HREAP Executive** for any modifications to the protocol or other project documents.
- The Chief Investigator will notify the **HREAP Executive** immediately of any protocol deviation or adverse events or safety events related to the project.
- The Chief Investigator will report to the **HREAP Executive** annually in the specified format and notify the **HREAP Executive** when the project is completed at all sites.
- The Chief Investigator will notify the **HREAP Executive** if the project is discontinued before the expected completion date, with reasons provided.
- The Chief Investigator will notify the **HREAP Executive** of his or her inability to continue as Coordinating Chief Investigator including the name of and contact information for a replacement.

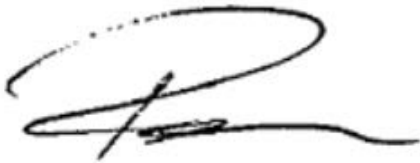
The **HREAP Executive** Terms of Reference, Standard Operating Procedures, membership and standard forms are available from <https://research.unsw.edu.au/research-ethics-and-compliance-support-recs>.

If you would like any assistance, or further information, please contact the ethics office on:

P: +61 2 9385 6222, + 61 2 9385 7257 or + 61 2 9385 7007

E: humanethics@unsw.edu.au

Kind Regards,

A handwritten signature in black ink, appearing to be 'Dr Ted Rohr', with a large, stylized 'R' and a horizontal line extending to the right.

Dr Ted Rohr

Director, Research Ethics Compliance Support (RECS)

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007). The processes used by this HREC to review multi-centre research proposals have been certified by the National Health and Medical Research Council.

Back cover image: Kate Freney



*The best time to plant a
tree was 20 years ago.*

*The second best time is
now.*