Creating habitat through WSUD

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McMillan, Andrew

Urban habitat, and hence the biological diversity supported by this habitat, has been significantly lost from our cities. Furthermore urban habitat and biodiversity are under increasing pressures, both direct and indirect, and from urbanisation past, present and future. The overwhelming majority of Australia's population live in major cities and these cities are continuing to grow in population. This has resulted in our cities increasing their physical footprint and increasing in population density. This places greater stress on limited habitat, however there is increasing recognition that urban areas support a wide range of flora and fauna.

Aquatic habitat in particular has been substantially lost in the process of urbanisation. Many wetlands and ephemeral floodplain zones have been filled and reclaimed for land development; many of the bays on our cities' rivers and estuaries have likewise been reclaimed, often as playing fields; many waterways have been piped, channelised, concrete lined, straightened and stripped of their riparian zones.

In addition to providing homes and feeding-grounds for wide range of animals urban habitat also plays other important roles. For most Australians, urban habitat is the form of the natural environment that they are most likely to have a connection with on a regular basis. This both helps to build awareness of our natural world and also provides health and spiritual benefits to individuals living in cities.

Water sensitive urban design (WSUD) offers a unique opportunity to go further than managing the impacts of water from urban areas on receiving water to restoring aquatic habitat to our urban environments. Through case studies, this presentation explores how WSUD can be used to restore aquatic habitat, adding additional values to our stormwater systems, and allowing a re-framing of stormwater systems and their role. The case studies include:

- Sydney Park, the creation of a biodiversity hub in the City of Sydney
- Frog ponds to support an endangered frog species
- Restoration of a key refuge breeding site for Australian White Ibis

Introduction

The majority of Australians live in cities and the trend is increasing. Ninety per cent of Australians are estimated to live in one of our major cities. Urbanisation has an impact on biodiversity by replacing natural habitat with housing, roads and physical and social infrastructure. Past urbanisation practices have often completely replaced all habitat within our urban areas.

In 2010 the Convention on Biological Diversity undertook a global assessment of the state of biodiversity in urban areas. Their findings found that cities have lost an average of one-third of the native species found in their surrounding region. It is not hard to find local examples. Where I live use to be part of Gumbramorra swamp. The swamp was drained with a concrete channel and developed for housing, industrial land and transport infrastructure. Urban waterways such as the Cooks River and its tributaries have been either completely lost or been left with little remnant vegetation.

A recent global study of biodiversity in urban areas found that density of species - the number of species per unit area - has declined in cities (Aronson M.F.J., et al, 2014). Furthermore the study found that in high density parts of cities where there is lots of concrete and paved surfaces and very little vegetation, the bird diversity drops.

The impacts of urbanisation also extend beyond the boundaries of urban areas. For example urban stormwater runoff has an impact on downstream waterways. The reduced biodiversity of macro invertebrates has been well documented. For example Chessman and Williams

(1999) found in a study of 45 waterways in the Hawkesbury Nepean catchment that urbanisation had a marked impact on the diversity of macro invertebrates and identified urban expansion as the greatest threat to biodiversity in waterways. Furthermore the impact of stormwater in bushland reserves is also well documented (for example see Leishman, 2004). Stormwater brings excess nutrients and moisture which creates conditions for non native species to thrive and out-compete local native species.

However while urbanisation has impacted on biodiversity there are still substantial values within urban areas. For example a recent global study which included a number of Australian cities found that twenty per cent of all bird species lived in urban areas and five per cent of plant species (Aronson M.F.J., et al, 2014). Australian researcher Nick Williams at the University of Melbourne who was part of that study stated that

"*Our study has found they actually do support a lot of the world's biodiversity, and that biodiversity is remaining as a native biodiversity. So they're maintaining the native species in the cities to a large degree.*"

Sydney also has a form of development particularly in the south and north of Sydney which has not only protected vast areas of bushland but indeed celebrates these areas. Hornsby Council for example refers to itself as the bushland shire. The bushland is highly valued by the local residents.

Urban biodiversity can be diverse and unexpected. Lane Cove National Park, which is surrounded by residential development has more than 20 species of fungi. The combination of its soil types and topography has created a unique range of environments which support the wide range of different species (Sydney Fungal Studies Group, 2015).

Lizzie Lowe, a researcher at the University of Sydney, found 160 species of spiders in private gardens, urban parks, patches of remnant vegetation and five bush land sites (Lowe 2015). Her study found that even though cities are very different to natural habitats, the green space in urban areas such as parks and gardens can support an amazing array of species. Her study found that there were just as many spiders in Sydney backyards as in bush land, and there were more species in patches of bush within the city than in National Parks.

Biodiversity and the community

Australia's high level of urbanisation means that most people's contact is with urban biodiversity. A study for example by CSIRO found that people highly valued parks and greenspace and most visited their parks on a weekly basis however people's knowledge of the urban biodiversity is low (Barnett G., et. al., 2005). The same study found that people were unaware of the local biodiversity.

There is also research which shows that vegetation and biodiversity is also important for our well-being. The classic study of this is a 1984 study in the journal *Science* by Roger Ulrich who reviewed the medical records of people recovering from gallbladder surgery at hospital. All other things being equal, patients with bedside windows looking out on leafy trees healed, on average, a day faster, needed significantly less pain medication and had fewer postsurgical complications than patients who instead saw a brick wall.

Multiple objective design

Due to the emphasis on quantitative objectives e.g. pollutant load reduction targets, it is typical for WSUD to be reduced to building stormwater treatment systems with the overwhelming dominant objective to improve water quality. There is a strong tendency to ignore the receiving water context and the value to the receiving water of achieving stormwater pollutant loads. For example in highly urbanised waterways where receiving waters

have large upstream catchments (e.g. the Cooks River, large parts of the Georges River and Parramatta River) no one project alone can achieve substantial or even significant gains in receiving water quality. Due to the hundreds of upstream catchments that contribute to water quality, projects in catchments of waterways such as these are by their very nature long term projects with a horizon of fifty to one-hundred years before change is likely to be seen in the receiving water. One-off projects in this context are often criticised as the benefits of the isolated project alone will not have any measurable impact on the waterway. They are only beneficial if seen in a broader management context, where the project is the first of many and that ultimately all the projects will together make a significant impact. However due to the fragmented nature of catchment management in urban areas, diverse land ownership and competing social and political agendas, coordinated catchment management approaches are complex and difficult.

Many catchment management strategies across Australia have focussed almost solely on water quality and pollutant load reductions. The narrow objective setting is driven by a very targeted direction on pollutant removal with minimal justification as to why and what this is going to achieve. There is almost invariably no modelling of how these catchment management strategies would improve water quality in the receiving water.

In contrast the community focus tends to be more immediate with a focus on primary and secondary recreation. These objectives could be achieved if desired with a much more targeted approach to water quality. For example for large tidal river a water quality project could be more focused on specific areas within a waterway such as a specific treatment train treating in-stream water which feeds a river bath or pool.

This paper argues that most urban water projects need to have broader objectives which achieve more immediate goals. The dominant paradigm of stormwater quality needs to be continually assessed and determined for its appropriateness. Projects which solely focus on stormwater quality objectives miss the true potential of such projects by being too narrow and insular in their focus.

An example of this is the perceived dilemma about putting trees in rain gardens. A position which states that trees cannot be used in bioretention systems because the treatment system will need to be rectified in twenty years is an example of the dominant paradigm ignoring more immediate benefits. It prioritises stormwater treatment over all else and ignores the substantial synergistic benefits of trees in rain gardens, which are achieved in a much shorter time frame. The exclusion of trees in treatment systems may well be justified where the treatment system is treating water discharging to a sensitive receiving environment and the treatment device is playing a critical role in ameliorating the impacts of stormwater on the environment. However in most circumstances this is unlikely to be the case.

A recent example of this approach to highlight how we are influenced by this as an industry is a project centred on an existing modified aquatic environment. The existing wetland is a modified environment, impacted by control structures placed on a former waterway and the water quality is significantly impacted by an adjacent former landfill. However the environment had adapted and a significant stand of wetland vegetation had established, covering an area of approximately 1 hectare in total. The project team had proposed to remove the vegetation to replace it with a constructed wetland to improve water quality. There was an implicit assumption that the existing wetland was not having a substantial impact on water quality and was inherently low value. This project clearly highlights how dominant a focus water quality improvement is and its focus on designing a 'widget' rather than a holistic context specific based approach.

Designing for habitat

Intentionally incorporating habitat into WSUD projects is not common practice in our industry. For example the highly influential, well regarded and well used Water by Design Concept

Design Guidelines for Water Sensitive Urban Design barely mentions habitat as a component of WSUD. Where it is mentioned it is simply assumed that by providing treatment systems habitat is created. There is no discussion within the guideline that creating habitat could be an explicit objective and that guidance on how to achieve this would be beneficial. This is not to criticise the guideline but to underline the prevailing view in the industry about the relatively narrow focus of WSUD.

Designing for habitat requires a more site-based sympathetic approach to design. It requires an analysis of the potential for habitat, an understanding of the potential species that currently and potentially use the site and an understanding of these species habitat requirements.

What is not well understood is that simple urban biodiversity can be created. This can also create interesting opportunities for local communities to interact and explore these features better reflecting community values as well as providing broader and wider community support for WSUD.

This paper provides how habitat can be intentionally designed into WSUD projects using three case studies as an example.

Sydney Park

A deliberate focus of the Sydney Park project was to improve biodiversity by creating a variety of habitats, including microhabitats. The works at Sydney Park include specific habitat being created for animals including: frogs, small birds, lizards, mammals (including microbats) and insects such as dragonflies and other aquatic species. A specific strategy for a wide variety of habitats was developed and is shown below.

The strategy includes enhancement and creation of the following habitats

- retention and enhancement of an existing ephemeral marsh between open water in Wetland 4. This area contains shallow muddy areas which is excellent bird foraging habitat particularly after rainfall events
- Retention and enhanced island habitat. The island is currently used extensively by birds as a safe refuge. Enhancements include provision of more extensive log bird roosts for nesting typically for larger birds as well as thick reeds and smaller shrubs as nesting habitat for smaller birds
- Retention and enhancement of an excellent stand of *Cladium procerum* which is currently used for foraging and habitat for smaller birds. This thick stand of *Cladium procerum* also provides protection to the open water behind. This edge will be further enhanced by extending the edge planting all along the eastern edge.
- Creation of a significant new gully habitat. The sheltered gully habitat provides a shady cool moist environment and characteristic understory planting type which is different to the typically dry, open and sunny aspect of Sydney Park. The shallow ponds and wetlands create excellent frog habitat for foraging and spawning as well as habitat for a wide range of aquatic macro-invertebrates and small birds and fauna.
- Creation of a new shallow wetland area. The shallow water areas will allow a high diversity of wetland planting. This wetland will provide a wetland edge habitat to

Wetland 1 which currently has no habitat value. The wetland edge can also be integrated in to the forested slopes behind the wetland.

- New planting within the different areas of bioretention will be made up of similar species but the dominant planting within each area will vary to further increase habitat diversity. Embankments of shrub planting will link areas of bioretention habitat with the wetland habitats.
- Significant new habitat to a dry casuarina swale which currently has no groundcover or mid-story planting. The swale has high potential for good micro-habitat due to its sheltered position. This area is a rarely visited part of the park and also has a good canopy structure and the addition of a pool and riffle environment which will create a wider range of habitat including small permanent pools suitable for frog habitat.
- New swale which provides connectivity and ability for small fauna and aquatic macroinvertebrates to move from the existing adventure swale in the playground to the new and enhanced habitat at Wetland 1. This new creek and reed bed understorey planting will blend into new shrubby understorey planting on the mounds.
- Enhanced woodland planting with a shrubby understorey will increase habitat potential for small and larger birds, and small marsupials. Extension of these woodlands towards the water based habitats will allow for better connection between habitat zones and hence the range of areas fauna can easily inhabit and move through. This will reinforce the network of planting and the functioning natural zone at the heart of the park. The woodland and understorey planting design will enhance spatial definition between the wetland pond areas and helps create a sense of enclosure at pedestrian gateways into the habitat zones.

Lake Gillawarna

Lake Gillawarna is located in Mirambeena Regional Park in Bankstown LGA and is located along Prospect Creek. The site has been identified as one of three regional breeding site for Australian White Ibis (AWI) in Sydney. The Lake consists of a number of islands one of which has been substantially colonised by AWI. Studies have found that in the past over 1500 AWI have resided at the site. However the AWI were impacting on the site due to their damage to vegetation, odour, impact on water quality and noise.

The Lake was experiencing poor water quality, suffered from odours, significant weed and algal blooms, bank erosion exacerbated by carp foraging in the banks, and the edges were assessed as being unsafe. Council had identified the site as a key site for improvement. Furthermore a number of threatened species were identified which used the regional park including the Regent Honeyeater and White Bellied Sea Eagle.

As part of the project the habitat needs of the key species were identified. For example the Regent Honeyeater requires dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak with mature trees, high canopy cover and abundance of mistletoes. A shrubby understorey is an important source of insects and nesting materials. These site needs were then considered in the design including the structure of the planting and type of planting.

For the AWI it was decided to concentrate the impacts of the AWI in one area. As the site was a regional breeding habitat it was not acceptable to remove all AWI habitat. The approach adopted was to effectively allow the AWI to colonise one of the islands. Rather than attempt to revegetate the island, the island was created as a 'stick island' with purposely created nests for the AWI to encourage them to use this island in preference to the other islands which were to be re-vegetated and which AWI were to be discouraged from using.

An example of the stick island that was created for the AWI is shown in the image below.

18 months after the completion of the project the restored habitat is well used and the AWI numbers are being maintained at a sustainable level.

Frog Ponds

The City of Sydney's *Urban Ecology Strategic Action Plan* (2014), outlines that frog-friendly freshwater water-sensitive urban design ponds will be constructed wherever possible in City-managed parks. The City has recently undertaken feasibility assessment and design of a frog pond in Kimberley Grove Reserve in Rosebery. This site was selected because a small population of the threatened Green & Golden Bell frog inhabits a converted backyard pool and surrounds in a nearby house.

This project is different because the primary driver is the creation of frog habitat. The more commonly recognisable WSUD element of the project, roofwater harvesting which will supply water to the pond, is a secondary feature. Whilst the size of the frog pond is limited due to the roof catchment area a surrounding frog foraging area will be many times the size of the pond.

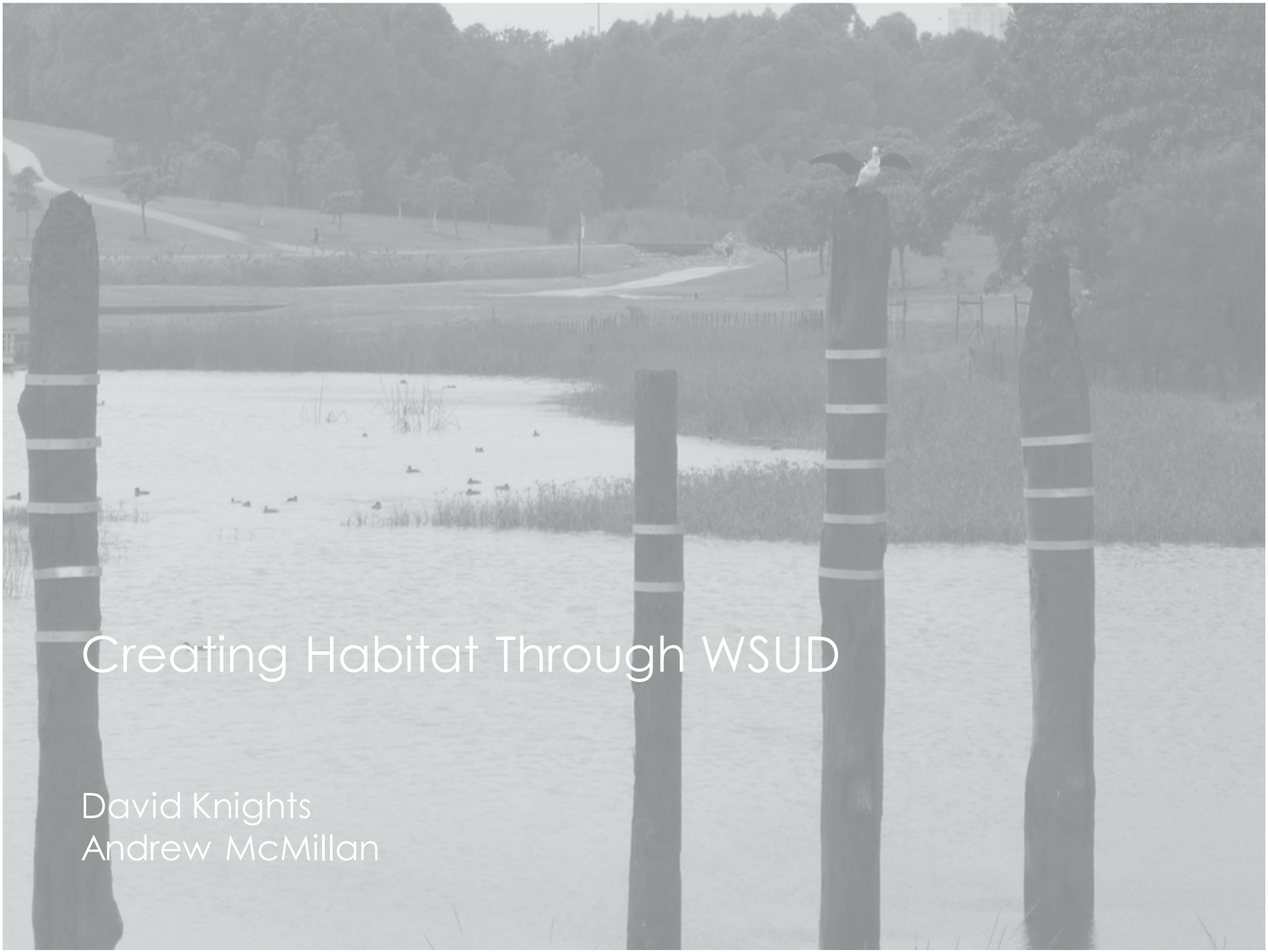
Key considerations for the frog pond included:

- approaches to discourage more common non-targeted frog species,
- ensuring that the pond can be drained should *gambusia* find their way into the pond,
- pond sizing to ensure that there is a deeper zone that should always contain some water, and
- plant species to encourage GGBF.

Whilst in NSW frogs cannot be relocated or introduced to any new habitat, the exploring range of these frogs means that they should eventually find and colonise the pond.

There are some unknowns in what makes a good frog habitat pond. For example, a study completed at Sydney Olympic Park involved the construction of two identical frog habitat ponds. Frogs colonised one of the ponds but not the other, and when some of the frogs were moved into the unoccupied pond they soon returned to their favoured pond. Another anecdotal report is that in one location where ponds have been built the frogs have shunned the pond and decided to take up residence in a nearby stormwater pit!

Regardless of the habits of the frogs it is clear that WSUD targets and habitat objectives can be combined to provide more a richer urban environment.

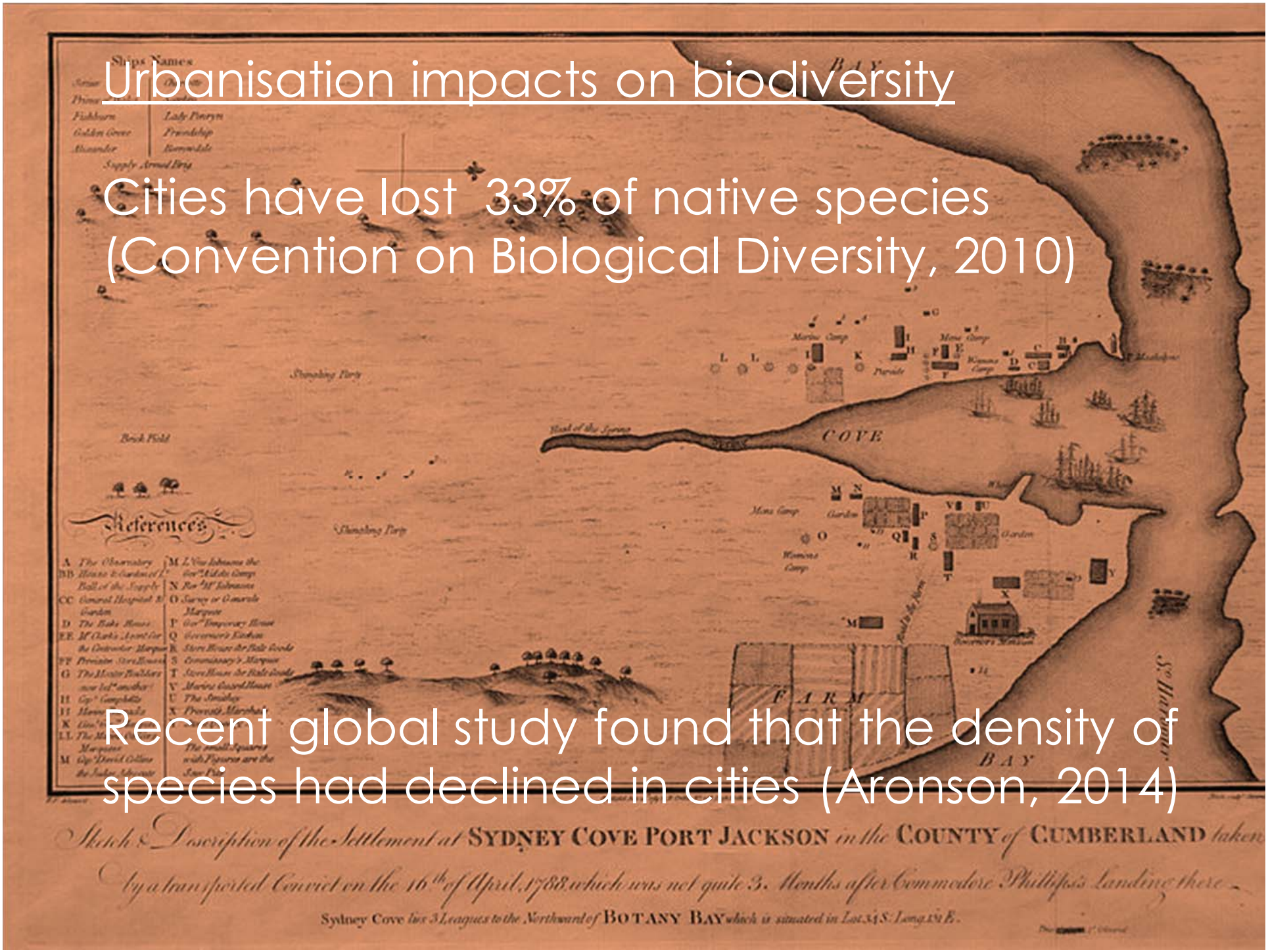


Creating Habitat Through WSUD

David Knights
Andrew McMillan

Urbanisation impacts on biodiversity

Cities have lost 33% of native species (Convention on Biological Diversity, 2010)



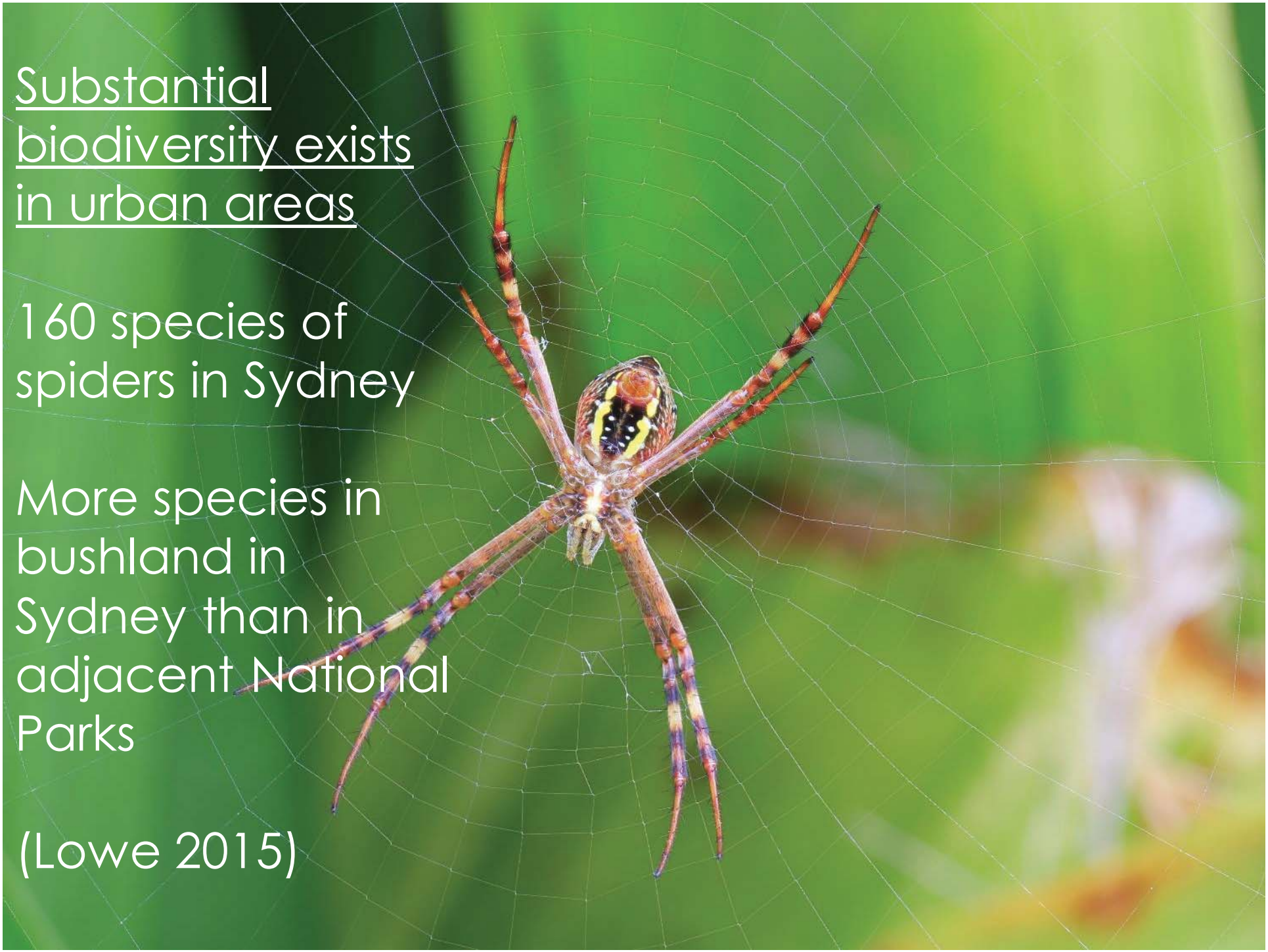
Recent global study found that the density of species had declined in cities (Aronson, 2014)

Urbanisation impacts on biodiversity

Would you like a waterway with that?

Substantial biodiversity exists in urban areas

Twenty percent of all bird species lived in urban areas (Aronson, 2014)


Substantial biodiversity exists in urban areas
160 species of spiders in Sydney
More species in bushland in Sydney than in adjacent National Parks
(Lowe 2015)


Substantial biodiversity exists in urban areas
More than 20 species of fungi in Lane Cove National Park (Sydney Fungal Studies Group)


An urban nation
90% of Australians live in cities
50% of adult Australians have visited a national park in the last year

An urban nation

People highly value local parks and the diversity within them…. despite not knowing what biodiversity a site has (CSIRO, 2005)

Improves our well being….

Stormwater Quality Über Alles

Projects which focus solely on stormwater quality miss the true potential of a project

A story of a wetland and you and me….

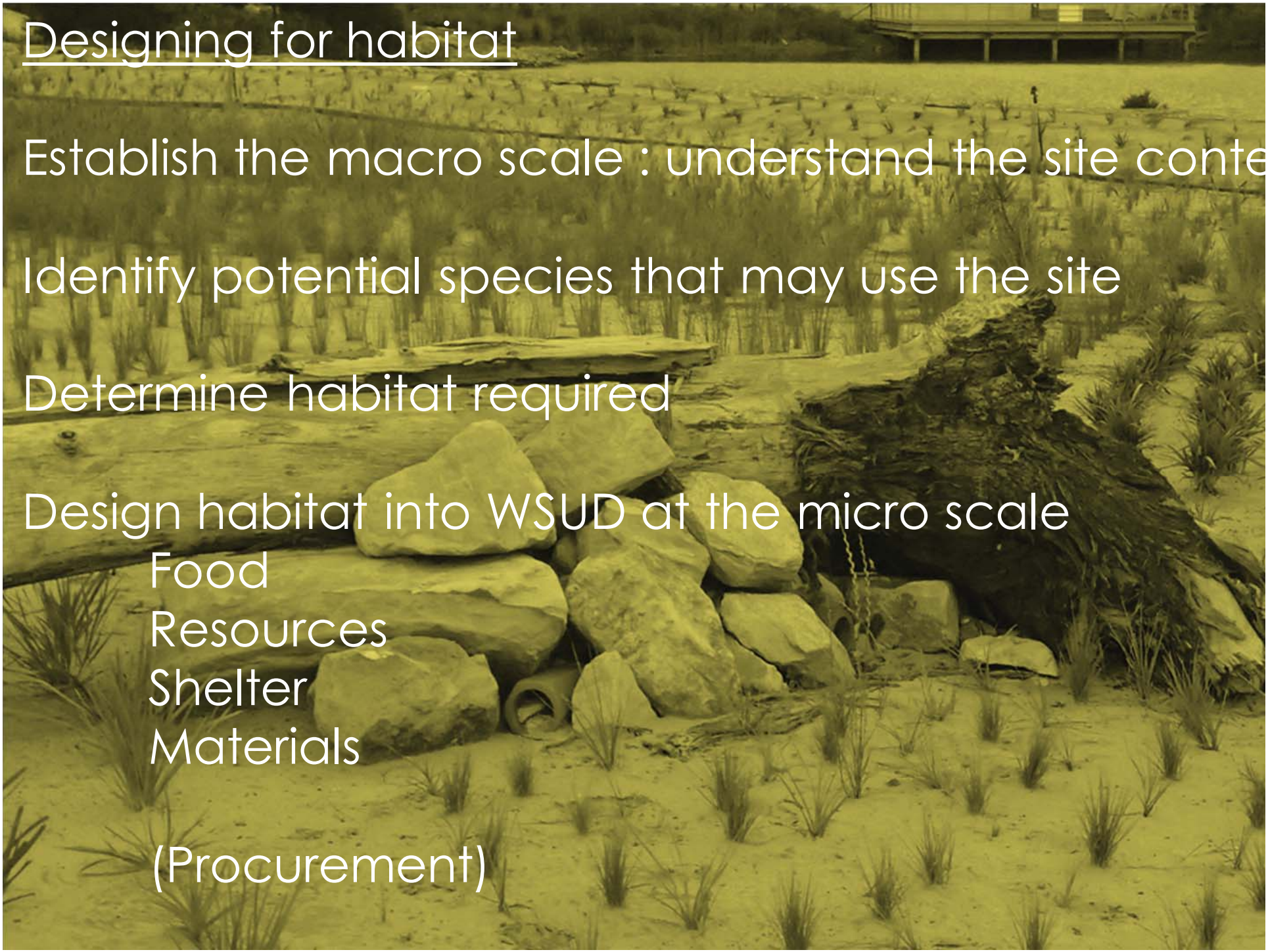
Do design guidelines dream of habitat?

Stormwater Quality Über Alles

Are you a flatlander?

Can I have some water please?

What does the community think?



Designing for habitat

Establish the macro scale : understand the site conte

Identify potential species that may use the site

Determine habitat required

Design habitat into WSUD at the micro scale

- Food
- Resources
- Shelter
- Materials

(Procurement)


Can't see the forest for the trees
Designing for habitat should not *just* be about habitat for iconic species… they are the icon not the end goal
design for me too please…

Sydney Park - Designing for Habitat – An illustration

- Identified Sydney Park as a high priority site for the City of Sydney for urban ecology
- Highest indigenous bird species diversity
- High flora diversity

- Retain and enhance existing habitats
  - Mud flats
  - Cladium procerum stand
  - Island
- Create new habitat
  - Sheltered moist gully forest
  - Native grasslands
  - Fast moving shallow water
  - Shallow still water
  - Micro-habitat


It sure is hot out there today .....


Water habitat strategy
1. Slow running water - macrophytes
2. Slow running water - sandy shore
3. Slow running water – open water
4. Fast running water - rocks
5. Fast running water - dense macrophytes

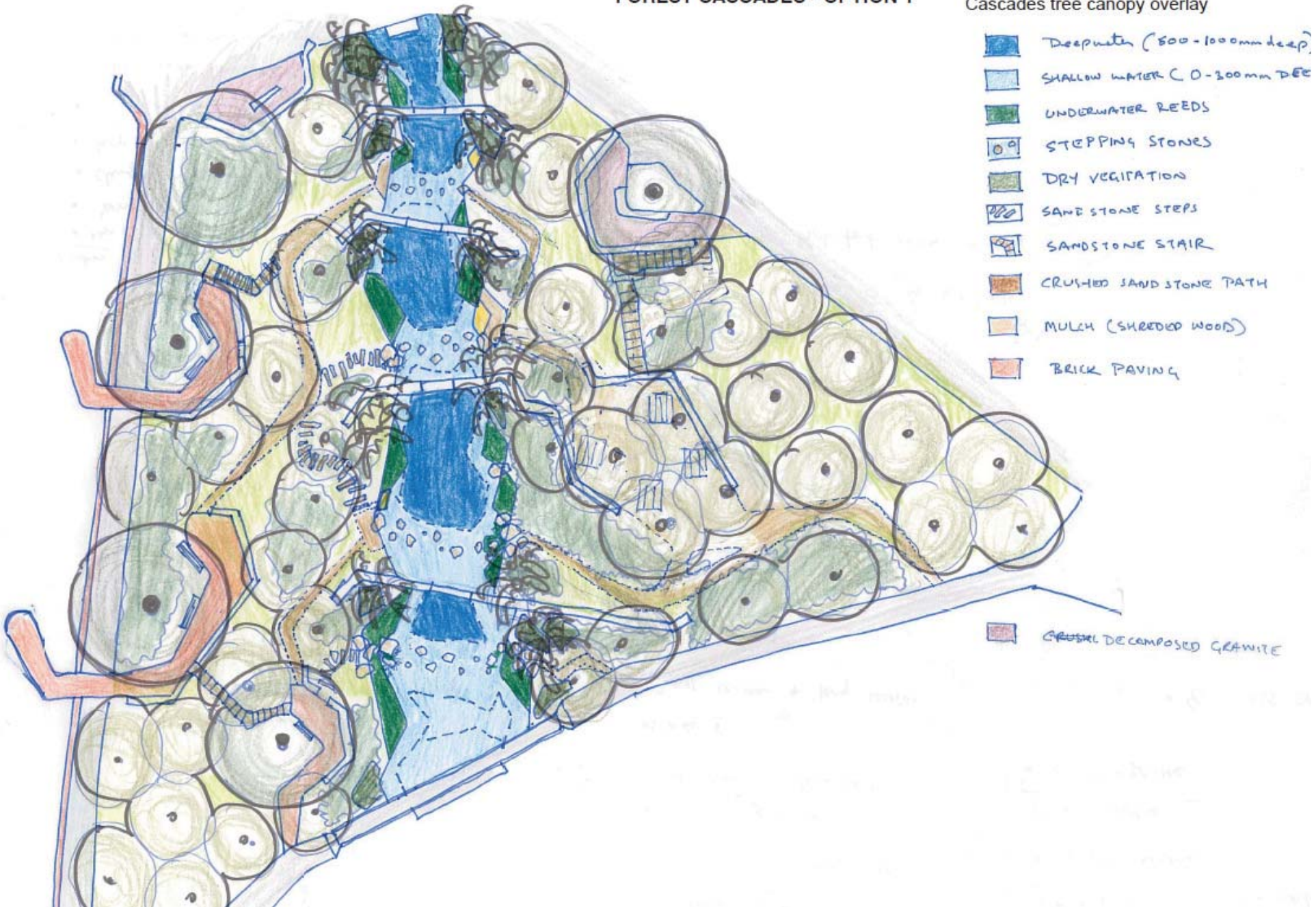

Fast running water – rocks
Blue skimmer dragonflies

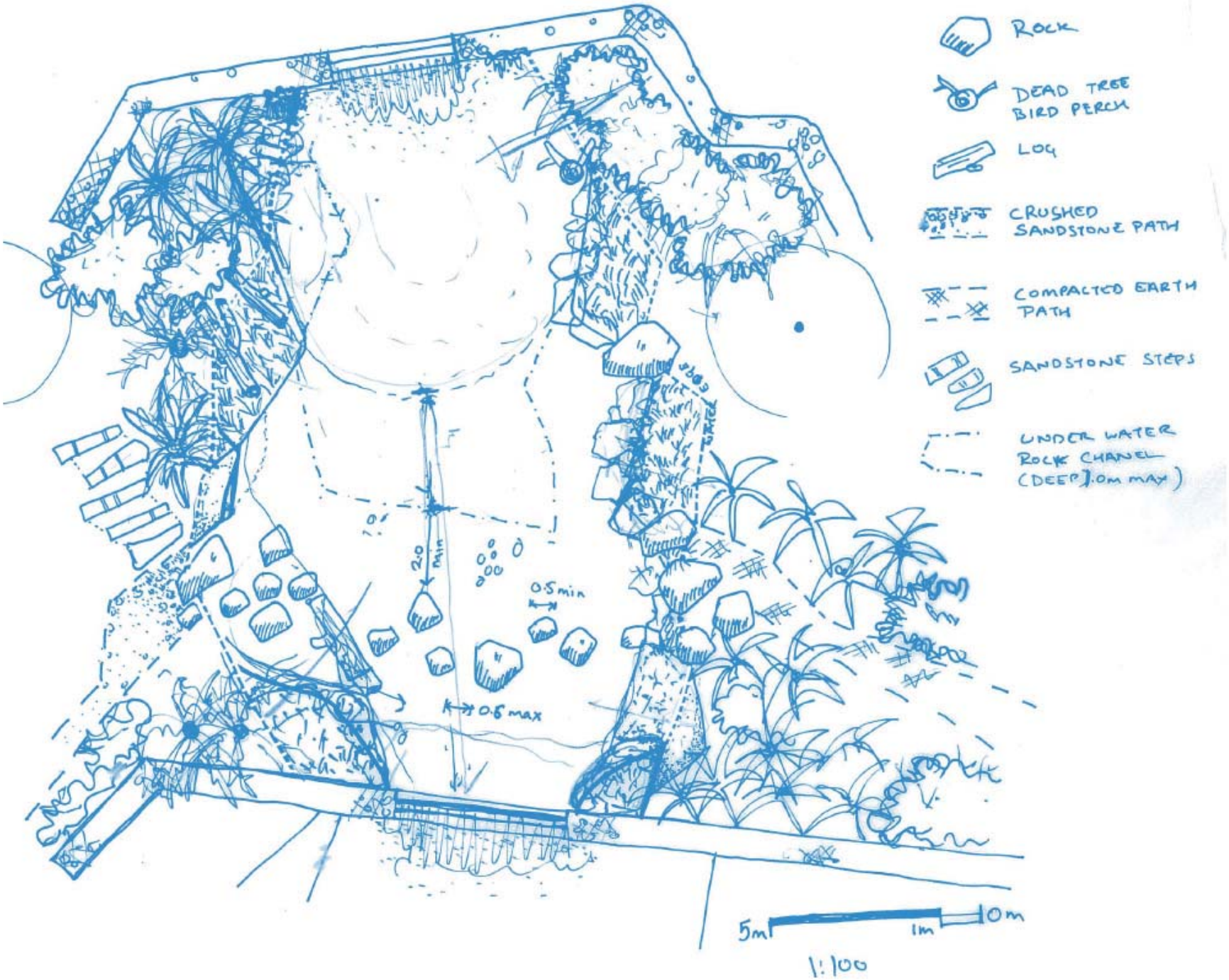

Fast running water - dense macrophytes
Common bluetail and flame head damselflies

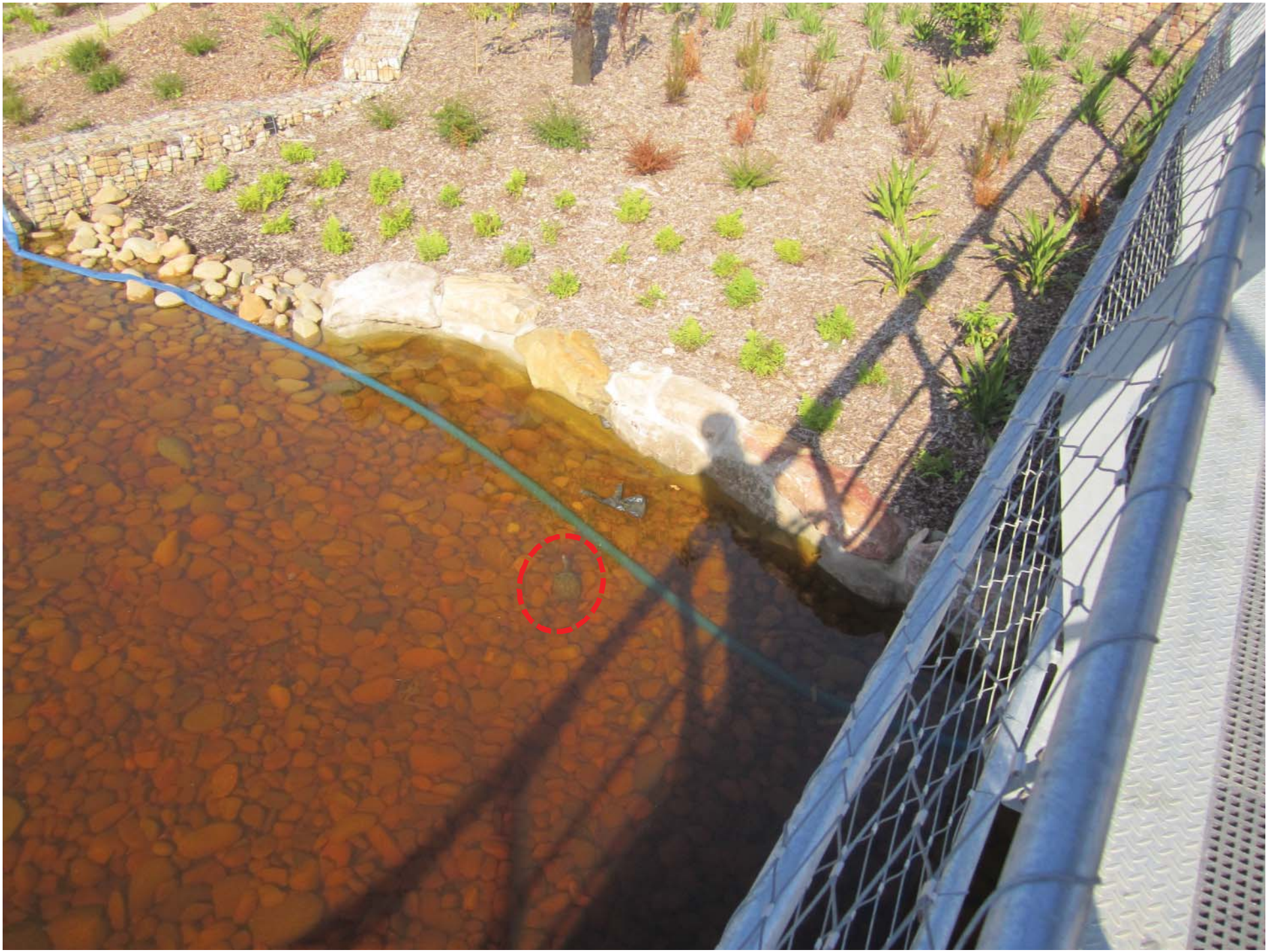

Slow running water – macrophytes
Australian Emerald and Australian Tiger dragonflies


Slow running water – sandy shore
Blue sprite damselflies

FOREST CASCADES - OPTION 1




ROCK
DEAD TREE BIRD PERCH
LOG
CRUSHED SANDSTONE PATH
COMPACTED EARTH PATH
SANDSTONE STEPS
UNDER WATER ROCK CHANEL (DEEP) .0m MAX)
2.0 min
0.5min
0.6 max
5m
1m
10m
1:100

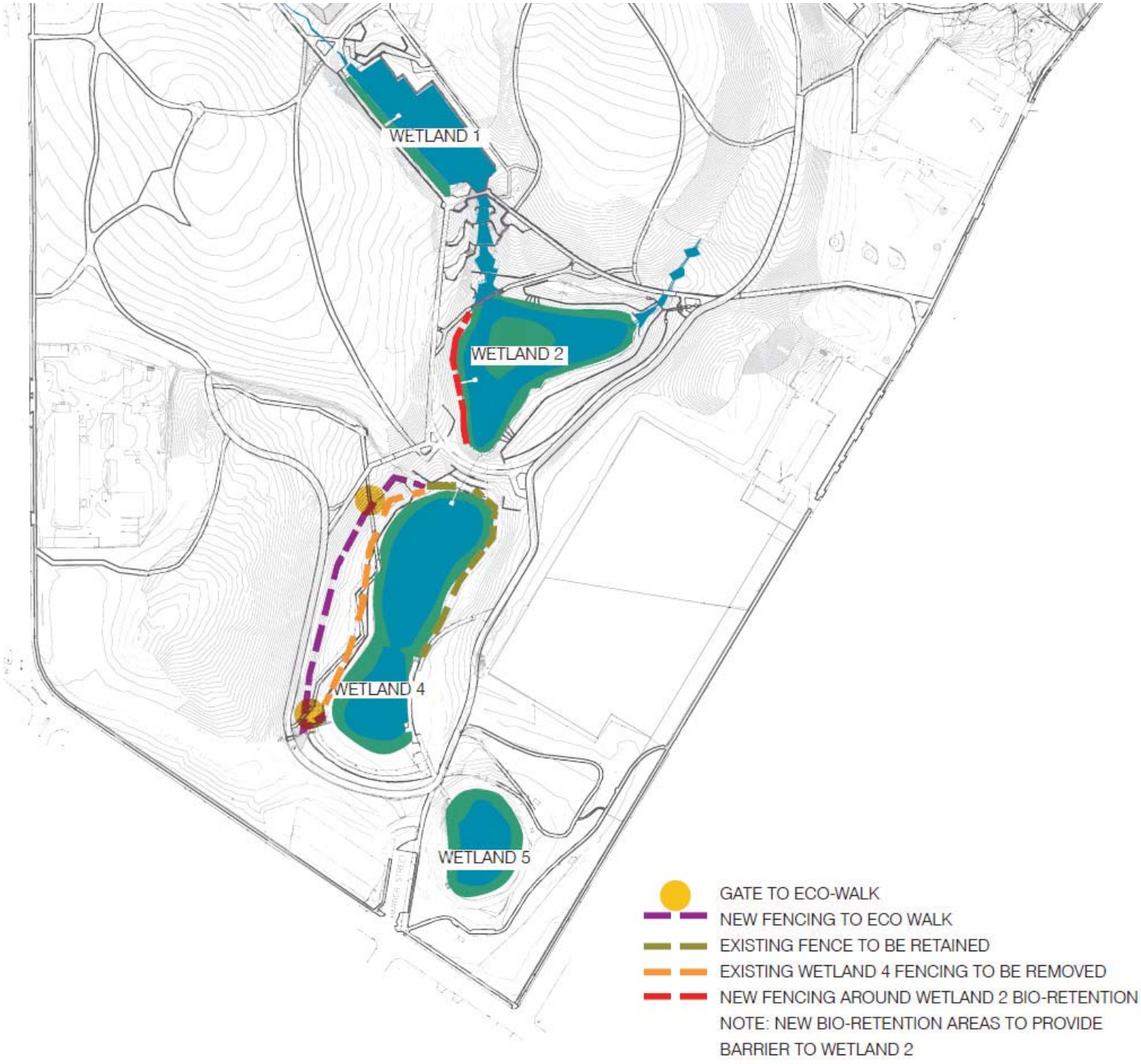


Swan death sparks resident push for tigher off-leash dog areas at Sydney Park

LAUREN MURADA INNER WEST COURIER INNER CITY JUNE 27, 2013 12:00AM

Christine Denny at Sydney Park's wetlands is upset about a swan reportedly killed by a dog. Picture: Craig Wilson

A MALE swan was found dead in Sydney Park last week, sparking calls from residents for tighter dog controls in the park.


WETLAND 1
WETLAND 2
WETLAND 4
WETLAND 5
GATE TO ECO-WALK
NEW FENCING TO ECO WALK
EXISTING FENCE TO BE RETAINED
EXISTING WETLAND 4 FENCING TO BE REMOVED
NEW FENCING AROUND WETLAND 2 BIO-RETENTION
NOTE: NEW BIO-RETENTION AREAS TO PROVIDE BARRIER TO WETLAND 2

Vegetation around wetlands

Excellent small bird habitat

Substantial potential to build on existing vegetation

Vegetation selection for target small bird species

- Provide a range of food sources (roots, shoots, seed)
- Provide vegetation which is suitable for next building

Vegetation – diversity

- Procurement process

Target species

- Small birds red warblers, golden cisticolas, chestnut mannikins, blue wrens

Sydney Park - Designing for Habitat – Micro Scale


Building socio- political capital
Through *design* we can engages with the community
Aussies are urban folk - spend more time indoors - work long hours
….but nature still inspires us…
Places where we "sensed for the first time the awe and wonder of the largeness of the world"
Robert Pyle Butterfly Specialist


SAT, 10/10/2015 AT 8:45 AM
Sydney Park Bird Survey
Meet at Sydney Park Kiosk, Sydney, NSW

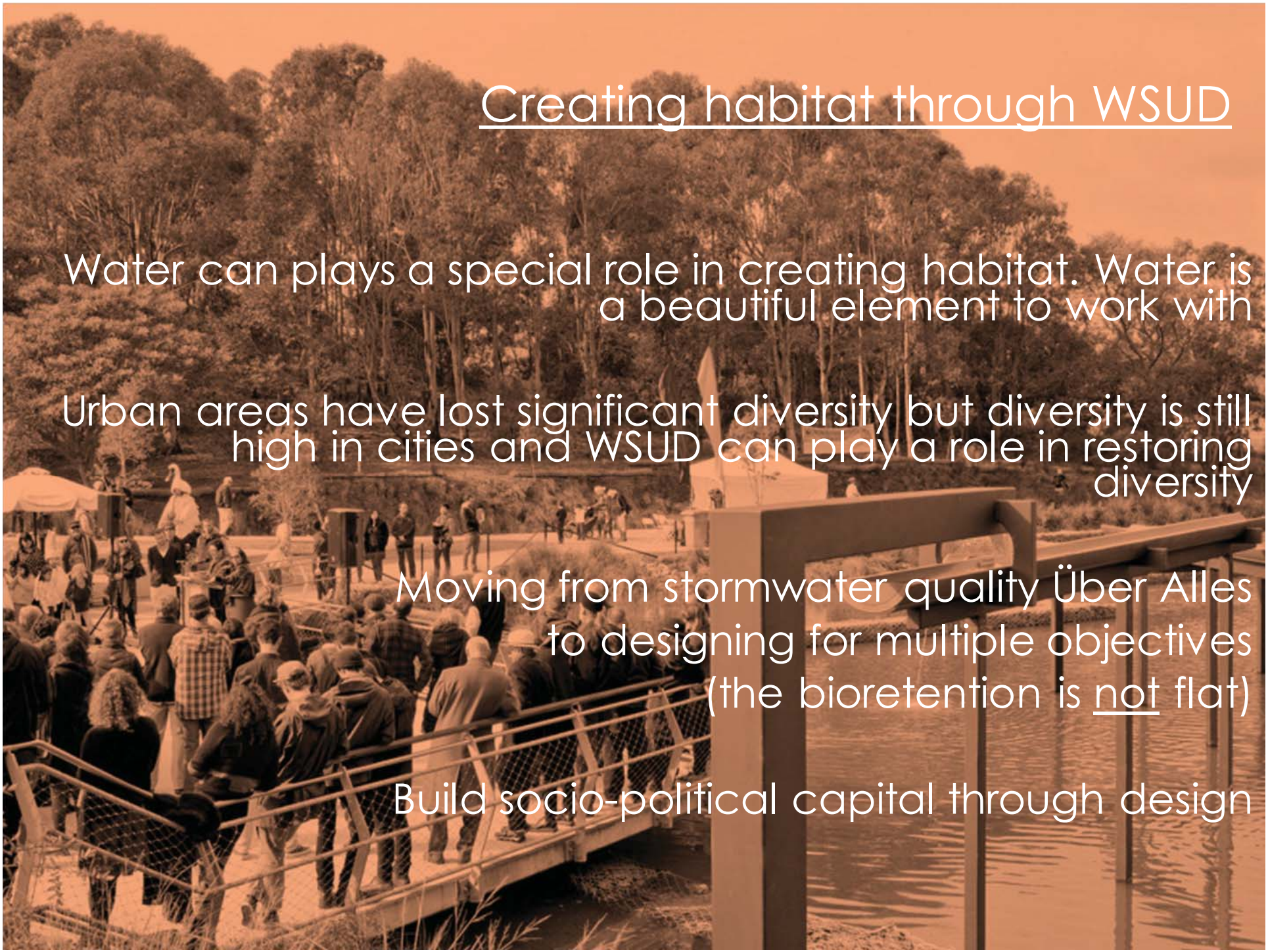
facebook Sign Up

Email or Phor

Keep me l

Wolli Creek Birdos added 2 new photos.
January 8, 2014 ·

Latham's (Japanese) Snipe at Sydney Park
4/1/14 from Gavin Gatenby
I can confirm Threrese's sighting of Latham's Snipe at Sydney Park. This afternoon there were three of them working the edges of the island pond. I thought at first they were Bar-Tailed Godwits, but the pix make clear they're Latham's.



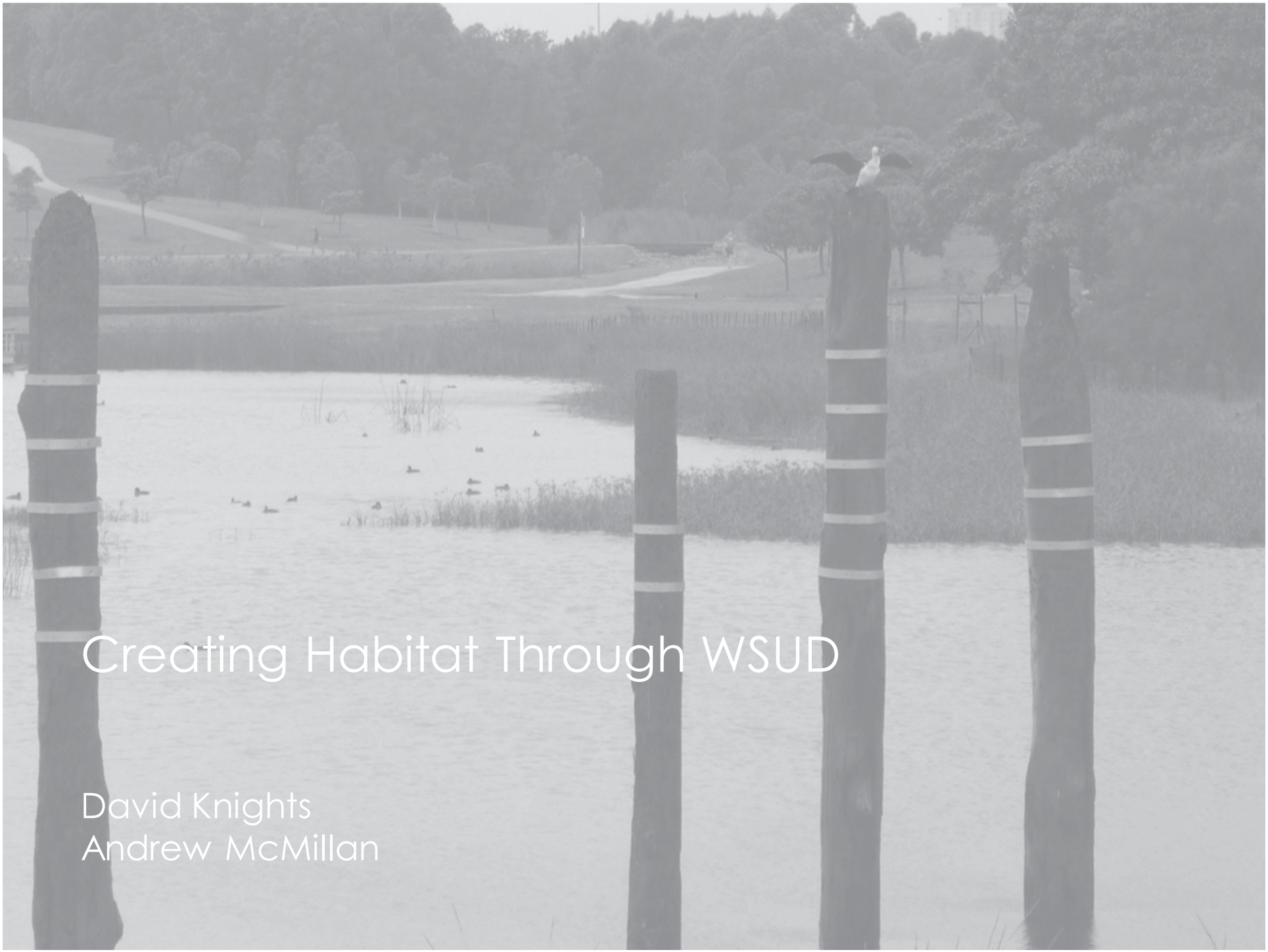
Creating habitat through WSUD

Water can plays a special role in creating habitat. Water is a beautiful element to work with

Urban areas have lost significant diversity but diversity is still high in cities and WSUD can play a role in restoring diversity

Moving from stormwater quality Über Alles to designing for multiple objectives (the bioretention is not flat)

Build socio-political capital through design



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