WATER RESILIENCE IN NSW WHITE PAPER
UNSW WATER RESEARCH CENTRE
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AUSTRALIA IS NOT ONLY ONE OF THE DRIEST COUNTRIES ON EARTH, but the country with the greatest weather extremes. While drought destroys crops and empties water reserves, severe flooding causes damage to our built environments. The impact of these events will only increase with climate change. Drought periods are likely to be more frequent, longer, and hotter, so storages are less likely to fill. Extreme floods are likely to be less frequent but may be more intense when they occur.

The state of NSW is just emerging from another punishing period of drought. Every river west of the Great Dividing Range in northern NSW ran dry in the summer of 2019/2020. Many regional producers were unable to grow a crop in three years, resulting in widespread income and job losses (DRF, 2020, p.12).

In times of plenty for any resource, system anomalies, special deals, poor data, inefficiencies, poor communications and even mistakes can be ‘weathered’. But in a time of scarcity or insecurity, the social fabric can be severely tested, and community mental health impacted. Tensions over water between farming communities and corporate agriculture/irrigators and mining companies, and between farmers/irrigators and the federal government over allocations and environmental water flows, have been increasing for several years.

The restorative rains of 2020 – in a year otherwise marked by the coronavirus pandemic – have eased but not erased those tensions. It is imperative for the health of our land and water, and our social cohesion, that governments, business and communities come together to ensure policies and governance that will move our vital water resources and infrastructure from crisis to resilience. Our economic and cultural systems depend utterly upon the health of our ecosystems. With such a precious common good at stake, sector interests cannot be allowed to drive the political agenda.

In February 2020, UNSW’s Water Research Centre (WRC) held a Drought Resilience Forum (DRF). UNSW WRC is an internationally respected research centre that undertakes multidisciplinary research in water resources and management, hydroclimatology, humanitarian engineering, water quality & treatment, and in the development of tools for environmental management and sustainability.

The Forum brought together over 100 prominent water experts from academia, industry, all levels of government and not-for-profit community groups from across the state, to discuss our current water challenges and, most importantly, to explore how we can build water resilience in NSW.

THREE MAIN THEMES
Three main themes emerged at the Forum – in order to build water resilience in NSW we need:
1. Integrated catchment management across the region
2. Water sensitive urban design and integrated urban water management
3. Evidence-based solutions, working with improved data and process transparency

Effective regional catchment management across the state would involve:
- An integrated evidence-based water strategy for the entire state
- Extensive community involvement in developing strategies and implementation
- A state-wide authority setting consistent policies
- Catchment based water governance coordinated from the mountains to the coast
- Large scale restoration and regeneration works of our damaged catchments
- Listening to and being guided by First Nations knowledge holders
- Support for regenerative agriculture

Integrated water management in cities and towns would involve:
- Consider all water supply options when selecting urban water sources
- A unified water recycling system
- Water-sensitive urban design
- Significantly increasing stormwater harvesting
- A purified recycled water for drinking demonstration plant/ community education centre

Evidence based solutions, working with improved data and transparency would require:
- Better data collection, management and sharing
- More support for farmers, gardeners, communities and councils working to enhance soil water and carbon holding capacity, and implementing less water intensive crop and animal production systems.
- Setting water policies that place ecosystem health first, and challenging paradigms that see ‘the environment’ as a competitor for water.

ACTIONS TO BE TAKEN
To begin building water resilience in NSW, three main actions need to be taken
- Deep listening to First Nations knowledge holders – Aboriginal representation should be integrated at every level of decision making.
- Integrated catchments authority established by 2022.
- Government commitment to full transparency of and accessibility of information about water usage – public website (cf BOM)
THE WHITE PAPER MAKES 34 RECOMMENDATIONS UNDER 8 RELEVANT SECTIONS. THESE RECOMMENDATIONS INCLUDE:

PART ONE: EFFECTIVE & INTEGRATED CATCHMENT MANAGEMENT

Building on the work of the NSW Marine Estate Management Plan and DPIE Regional water Strategies, create a NSW Water Strategy Plan with full community consultation based on "good outcomes" benchmarks and subject to periodic evaluation, reporting and improvement processes.

Undertake large-scale ecosystem restoration of priority lands in order to build up resilience for droughts, fire and floods.

Improve the transparency, accessibility and availability of water information—as well as people’s ability to interpret and understand it—as an urgent state government priority.

Large water users, especially in agriculture and mining, need to be metered, regulated and reported throughout the state. Strengthen NSW water use compliance and enforcement agencies.

Ensure Indigenous representation at all levels of water strategy planning and management.

Establish a Regenerative Agriculture Advisory Group to work with the NSW Minister for Agriculture and Western New South Wales.

Provide financial support and training to community-based groups who are involved in environmental practices that will build water resilience in NSW.

PART TWO: WATER RESILIENCE IN TOWNS & CITIES

Consider all water supply options when selecting urban water sources.

Prepare a transition strategy for moving from existing forms of recycling wastewater to purified recycled water for drinking.

Develop an overarching statutory Water Sensitive Urban Design (WSUD) policy to support the implementation and ongoing maintenance of WSUD systems and encourage wider uptake by developers and councils.

Financially support and incentivise local government and developer schemes to harness and recycle stormwater as a valuable community resource.

Establish clear policies on urban dwellers’ access to irrigated open space and tree canopy cover. Develop governance principles and water plans that reflect the importance of water to liveability.

Allocate funding, resources and accountability to green-blue infrastructure liveability outcomes in the same way as other social infrastructure such as health and education.
INTRODUCTION

THE PERSISTENCE OF DROUGHT
For most of NSW’s population, the collective trauma of summer 2019-2020, characterised by the twin crises of drought and bushfires, has eased. It was followed and possibly obscured by the coronavirus crisis, but thankfully, also by the state’s wettest winter since 2016. Yet NSW has not fully recovered from one of the most severe droughts on record, with the Central West, Far West and North West regions the worst affected. Some of those areas recorded the lowest river inflows since records began. Areas in western NSW including Broken Hill, as well as far northern NSW and areas around the far south coast remain affected. Regardless of current supply conditions, many regional councils such as Tamworth wisely have permanent water conservation measures in place.

With the state’s winter rainfall 5% above the historical seasonal average, crops have been planted, and a bumper harvest predicted; but as Brett Hosking, chairman of Grain Growers, remarked to the Guardian, “one of the things about drought is you never fully recover from them” (Guardian, 22/9/2020).

One of the greatest risks facing improved water resilience in NSW is the downgrading of the climate/water agenda due to the COVID-19 pandemic, and the rains of 2020. There is a grave danger that this will be reflected in future investment levels and public perception of risk.

WATER RESILIENCE AND THE SPECTRE OF CLIMATE CHANGE

Australians have collective and cultural memories of water availability within cycles of drought and flood, as expressed in the anthemic poem by Dorothea MacKellar (1885 – 1968), “I love a sunburnt country... of droughts and flooding rains.” A poem which expressed confidence in Australian agricultural resilience within such a climate - “For flood and fire and famine! She pays us back three-fold.”

But, as the Keelty review into the Murray-Darling Basin affirmed, “There is a high likelihood that historical expectations of [water] reliability are no longer accurate because climatic conditions have changed” (IGMBD2020, p.21). One of the most telling findings of the Keelty inquiry was that more than half of the driest 10% of years in the colonial historical conditions have changed” (IGMBD2020, p8). Researchers at UNSW’s Water Research Centre (WRC) have shown that reservoir reliability—or the frequency with which a reservoir can supply surrounding populations without restrictions—will fall across the country as we head towards the end of the century (DRF, 2020, p.20). This is likely to translate into increasing water insecurity as the demand of rising urban populations and intensive agricultural irrigation threaten to outstrip supply.

As in most parts of the world, the agricultural industry is the largest consumer of water in NSW, consuming approximately two thirds of distributed water, as well as directly extracting significant amounts from the environment, that is, from rivers, lakes, groundwater and/or private dams. (ABS, 2019). Due to increases in crop planting and livestock counts the sector recorded high total consumption rates in the years 2016-2018: 4,509 gigalitres (GL) in 2016-17 (including 909 GL extracted water) and 4,838 GL (966 GL distributed) in 2017-2018. (ABS, 2019).

Drought impacts in 2018-2019 inevitably curtailed this steep rise. In the 2018-2019 period, the average area rainfall across Australia was 352 mm, down 20% year on year, and agricultural distributed water use decreased by 30% nationally.

The ABS Water Account report noted that it was “NSW [which] drove this decrease, down 48% to 2,032 GL [of distributed water]” Self-extracted water for the agricultural sector was an additional 934 5GLs.

Rather than continue to endure such sharp market ‘corrections’, with all their human costs of dislocation and emotional suffering, we need to more strategically rethink our current land and water management.


Data for mining industry usage of water in NSW from the ABS is partial – with many categories listed as ‘np’, not for publication. (ABS figures for 2018-2019 list 146GLs, cf to 159GLs in the previous year). Researchers at the Drought Resilience Forum commented often on the difficulty of getting good quality data from the industry. It is not, of course, just the quantities used by the mining industry, which is of concern to many communities, but the impact on water quality, present and future.

BALANCING SUPPLY AND DEMAND

Research indicates that soils are becoming drier and, even in regions with increasing rainfall, floods (the kind that fill our dams) are decreasing. Using Reliability, Resilience and Vulnerability (RRV) Analysis, researchers from UNSW’s Water Research Centre (WRC) have shown that reservoir reliability—or the frequency with which a reservoir can supply surrounding populations without restrictions—will fall across the country as we head towards the end of the century (DRF, 2020, p.20). This is likely to translate into increasing water insecurity as the demand of rising urban populations and intensive agricultural irrigation threaten to outstrip supply.

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WATER AND POLITICS

Australian water management is inextricably wrapped in politics, and, where there have been successes, this is because the politics were managed adroitly. When political challenges proved insurmountable, reform has stalled (Haneman & Young 2020).

Changing the status quo is challenging and decision makers in the state face complex decisions as well as intense lobbying from specialist industry groups who can be expected to argue against water allocation reductions.

In a drought impacted landscape, building more water holding infrastructure such as dams, may simply exacerbate water shortages and community tensions. As WRC’s Professor Ashish Sharma says, there is a real urgency to rationally face the changes that are coming (DRF, 2020 p.25).

“We need to put all the options on the table and assess which ones make the most socio-economic sense…[and] we need to at least start the assessment process now.” (LG)

In a risk scenario of diminishing supply and under-regulated increasing demand, we must agree on a hierarchy of beneficial uses and properly prioritise supply for future water management.

AN EVOLUTION IN MANAGEMENT PRACTICES AND PUBLIC AWARENESS

For attendees at the DRF, it was clear that evidence-based, big-picture, long-term management of water in NSW is urgently needed. NSW cannot afford to leave this valuable resource to old fashioned ‘free’ market policies and must re-examine the rules of the market for water rights. Continuing to preference the financial interests of a minority means risking continued environmental degradation and embedding social and intergenerational inequities.

NSW must make significant adjustments in vision, planning, policy, regulation and practice. These adjustments need to be both integrated and flexible, allowing local communities to have individuated responses that fit into a broader catchment management strategy.

Agreement on what good outcomes for water management, distribution and long-term water resilience would look like for NSW need to be framed within a set of agreed community values and priorities. We must re-think the idea that our rivers are merely a resource for human use and see it as the lifeblood of our land. As Badger Bates, Barkindji elder notes, “A river is tied to everything” (ABC 2018)

Keelty noted in his report, “The suggestion that environmental water be given up for irrigation in times of drought implies that the environment does not need water during a drought” (IGMDB2020, p.36).

It also implies that the environment is a competitor for water with farmers or cities. There is a need to move away from treating water as tradable commodity, to understanding (as most ‘ordinary’ people do) that water is precious shared resource. As in Aboriginal cultural practice, we need to reset the agenda to caring for as well as using our water systems.

THE ORIGINS OF THIS WHITE PAPER

This White Paper uses a mix of sources, including presentations at the Drought Resilience Forum, and relevant publications by UNSW WRC academics and industry colleagues; a desktop review of publicly available literature; and information provided by key stakeholders and managers in the water sector. The driving force, and many of the ideas were derived during UNSW’s Drought Resilience Forum (DRF) in February 2020.

UNSW WRC is an internationally respected research centre that undertakes multidisciplinary research in water resources and management, hydroclimatology, water quality & treatment, humanitarian engineering, in the development of tools for environmental management and sustainability, and in improving aquatic and atmospheric environments. The Centre has a research staff of 75, and in 2020 was involved in 115 research projects, including 20 Australian Research Council (ARC) Discovery and Linkage Projects. In 2020 WRC worked with over 90 academic, industry and local, state and federal government clients and partners.

The DRF brought together about 100 prominent water experts from academia, industry, all levels of government, and not-for-profit community groups from rural and urban areas across the state, to discuss our current water challenges and, most importantly, explore the solutions. The Forum was convened by Professor Denis O’Carroll, director of UNSW Water Research Centre, and chaired by Professor Robert Care, Professor of Practice at UNSW Civil & Environmental Engineering.

The keynote speaker was the NSW Chief Scientist & Engineer, Professor Hugh Durrant-Whyte, while industry panellists included Jim Bentley, CEO Water at NSW Department of Planning, Industry & the Environment (DPIE); Richard Beecham, Manager Water Modelling, DPI; Narelle Berry, Collaborative Services Planning Manager (Major Projects) from Sydney Water; Erin Cini, Manager Liveable Communities, Water Services Association of Australia; Adrian Langdon, Executive Manager System Operations, WaterNSW; Dr David Reid, Aquatic Ecologist, Georges Riverkeeper; Kylie Russell, Senior Manager, Aquatic Environment, Coastal Systems - NSW DPI; and Stefanie Schulte, Principal Regional Water Strategist, Water Group - NSW DPIE.

UNSW academic panellists included experts in water sensitive urban design (Professor Ana Deletic), water quality (Professor Stuart Khan), rainfall data and modelling (Associate Professor Lucy Marshall and Professor Ashish Sharma), restoration of wetlands and estuaries (Associate Professor William Glamore), and environmental law (Professor Cameron Holley).
1. EFFECTIVE & INTEGRATED CATCHMENT MANAGEMENT

The Tragedy of the Commons

Much public and media attention has focused on NSW’s largest river network, the Murray-Darling, which has been subject to several crises over recent years including algal blooms, fish kills, wetland degradation, salination, and interstate and inter-community conflicts. But it is not just Murray-Darling basin communities who struggle with uncertain water supplies and ecologically threatened waterways. Drought, acidification, over-use and pollution have also impacted the NSW coast.

In NSW, 183 rivers rise in the Great Dividing Range and flow eastwards to the sea, nourishing the land on which 85% of the state’s population lives. According to Associate Professor William Glamore from UNSW Water Research Laboratory (WRL), no other rivers in the world are used as extensively as NSW’s major urban coastal rivers, the Hawkesbury, Parramatta, Georges and Port Hacking Rivers. These rivers are in constant use for our leisure, transport, fisheries, agriculture, tourism and aquaculture (DRF 2020).

Decades of agricultural over-drainage has created acidic waters rich in toxic heavy metals but low in oxygen, says Glamore, leading to the deaths of fish and other marine species. The NSW Department of Primary Industries (DPI) recorded 31 significant fish kills in coastal catchments in February 2020, mostly caused by low oxygen levels due to organic material runoff (AAP, 2020). Bushfire ash brought by late summer storms further decreased oxygen in the water.

Glamore states categorically that the lack of integrated catchment management is to blame for the ecological crises, what Glamore called the “Tragedy of the Commons” at the DRF.

“The integrated catchment management is currently non-existent in NSW. I am incredulous that people are surprised when there is a fish kill or acid plume. The system as it stands is like leaving your dirty dishes out and waiting for someone else to clean the kitchen. It’s death by 1,000 cuts.” (DRF, 2020, p.7)

We are risking the health of our community water supply by not guarding the riverine environment. We urgently need to take a whole-of-system, evidence-based approach for managing our river systems for the maximum benefit of the social, political, economic and ecological communities that they support.

1.1 HOLISTIC CATCHMENT MANAGEMENT

NSW has 40 designated catchments which vary greatly in size; the Georges catchment in Sydney has an area of 1,890 km2, compared to the NSW part of the Barwon-Darling catchment which is approximately 355,000 km2. Many different agencies, organisations and individuals are involved in managing piecemeal parts of the catchment, which has led to a situation where everyone and no one is responsible.

WaterNSW, which manages the state’s dams, protects the five catchments from which Greater Sydney draws its drinking water. These catchments cover 16,000 km2 and are home to over 120,000 people living across 15 local government areas.

About 30% of Greater Sydney’s catchment land is national park while over 60% of
these catchments are privately owned, including 600,000 hectares of agricultural land. In these areas WaterNSW works with local councils and landholders to help ensure human activities do not harm the environment our drinking water comes from. [www. waternsw.com.au/water-quality/education/learn/ catchments-managed].

Catchment Management Authorities (CMAs) were abolished in 2014 and replaced by 11 Local Land Services Regions (LLS) with the primary focus of “delivering quality customer services to farmers, landholders and the wider community” [https://www. lls.nsw.gov.au/ accessed 15/06/20]. The name change signifies a shift in emphasis – customer services to people replaces management of total environments.

The lack of an overarching agency means that there is no collective or coordinated action, in or out of drought. Glamore states that the cumulative impacts of drought are largely ignored or considered too hard to manage across the entire system. Responses to drought in the upper catchments are not connected to the rest of the river management.

The failure to manage holistically means that diffuse pollutants can flow out of one catchment and into the next. For example, on one bank of the Hunter River estuary a wastewater treatment plant has spent millions on treating the water it sends back to the river via an outfall. On the opposite bank dozens of cattle defecate directly into the water. Only a holistic river basin strategy including policy, planning, behavioural, regulatory, technology and infrastructure solutions can ensure long-term sustainable usage and survival of our river systems. Similar projects have been carried out successfully by the state. The NSW Marine Estate Management Plan was an enormous policy-making body or office created to carry out, manage and assess the water plan, the institution will need long-term political commitment and the highest level of authority to carry out its tasks. Whatever the form of the integrated catchment management term plan and set of objectives. Whatever the form of the integrated catchment management approach. Improve governance arrangements across each catchment to support coordinated, transparent, inclusive and effective decision-making and implementation, and streamline regulatory instruments.

Recommendations for holistic NSW catchment management
1. Building on the work of the NSW Marine Estate Management Plan and DPIE Regional water Strategies, create a NSW Water Strategy Plan with full community consultation based on “good outcomes” benchmarks and subject to periodic evaluation, reporting and improvement processes.

2. Investigate and acknowledge pressures on NSW aquatic environments and think strategically about actions to deliver evidence-based management and planning for long-term investment in our water.

3. Better integration between existing rural water management instruments and the proposed new water strategy plan with a whole-of-catchment management approach. Improve governance arrangements across each catchment to support coordinated, transparent, inclusive and effective decision-making and implementation, and streamline regulatory instruments.

4. Undertake large-scale ecosystem restoration of priority lands in order to build up resilience for droughts, fire and floods (see Big Swamp case study). See Appendix 1
1.2 IMPROVING CURRENT PRACTICE

Improved data collection & dissemination

A lack of data, and resulting knowledge gaps, was a recurring theme throughout both the DRF in Sydney, and in the Keeley report into the management of the Murray-Darling Basin, which reported that finding a single point of truth on many water issues was challenging or impossible (IIGMDB 2020, p.9). That report concluded that improving the transparency, accessibility and availability of information, and improving people’s ability to understand and interpret it must be a future focus for the MDB (IIGMDB 2020, p.10).

Walkley award-winning journalist Margaret Simons was unable to find the water usage data she required. She queried why it is so simple to find out who owns shares in an Australian company, or who owns real estate, yet it is impossible for an ordinary citizen to find out who owns water (Quarterly, March 2020, p.23).

Simons also noted huge discrepancies between water extraction monitoring systems in the Murray-Darling Basin. In the south, water extraction is monitored with high tech equipment, whilst in the Northern Basin (where most allegations of water theft occur), the Murray-Darling Basin Authority estimates that up to 75% of diverted water is unmetered. The volume of water taken by users is recorded in an ‘honesty system’ of logbooks (Quarterly, March 2020, p.47-48).

Over the last decade, there have been numerous reform efforts designed to enhance compliance, enforcement and water monitoring, including national frameworks, national metering standards and state-led regulatory change. However, an independent enquiry by senior public servant Ken Matthews in 2017 found that the state’s water compliance and enforcement “have been ineffectual and require significant and urgent improvement,” and recommended a far-reaching reform package.

Lack of transparency on water metering and usage fuels community conflict, risks undermining the optimal operation of water markets and erodes trust in democratic processes. The mining industry has been noted in particular for its water usage secrecy. The 2020 report Water for Coal, commissioned by the Australian Conservation Foundation notes that, because comprehensive water use reporting is not required, there is no way of knowing the total amount of water used or impacted by mining activities (ACF, 2020, p.3-4). This gaping hole in data has obvious, and serious, impacts on the quantity and quality of water for the environment and other water users.

In 2018, the then NSW Department of Planning and Environment, now DPIE, established an Independent Expert Panel for Mining in the Catchment (IPEMC) to provide advice on the impact of mining on the Greater Sydney Water Catchment Special Areas. The resulting IPEMC report on the Dendrobium and Metropolitan coal mines acknowledges “The insufficiency, variability and limitations of information restrict the scope and accuracy of calculations of groundwater and surface water diversion from the catchment into mine workings and other storages” (IPEMC, 2019, p.8).3

3 Nevertheless, the report found that in the Dendrobian mine investigation it was estimated that up to 30% of water in the catchment area could be lost due to longwall mining impacts. (IPEMC, 2019)

Improved data equals better policy

There was consensus at UNSW’s DRF around the need for constant, effective and open dialogue between the key actors in the water industry, and related industries (such as mining and agriculture), as well as open access to data. The benefits of open access to data for informed decision-making, greater transparency and data discoverability far outweigh the negatives. A direct line can be drawn between improved and validated data and good water policy, for good data encourages confidence to act. To make data gathering efficient:

• Data methodology must be fit for purpose
• Data sets must be co-ordinated and validated and shared across all sectors
• Data must include social impact elements
• Data can be collected from many sources including citizens
• Government transparency is crucial

Even if all the obstacles around data collecting and sharing are resolved, we still need to acknowledge uncertainty. As Ed Couriel from WRRL noted: “Data from the past is not sufficient for managing into the future.”

The pitfalls of water trading

Early this century, laws changed so that water could be traded separately to land. This meant that anyone – corporate investors, superannuation funds, green groups, even celebrities – could buy and sell water. According to Federal Water Minister David Littleproud, about 14% of water trades each year are by corporations and individuals who don’t own land (ABC, May 2019).

The water market unbundled from land is of increasing concern for regional towns as well as farmers. Producing farmers contribute more to the regional economy than one selling water, but both will provide more support for their communities than an off-site investor. Justine Keech, insurance broker and vice-president of the Deniliquin Business Chamber reported to the ABC:

“I can’t say I blame the farmer because he’s not taking a punt on having to grow something — he’s got a sure bet by selling his water. The community is the one that has really missed out... if you just take your money from trading water, that money doesn’t go around” (ABC July 2019).

Selling water may be profitable, but the need to buy can bankrupt farmers. In a wet year, dairy farmers can pay as low as $40 per megalitre for water in northern Victoria. In July 2019 it was more likely to be $600 (ABC 2019).

Not just farmers, but rivers can be bankrupted. Farmer Michael Hughes, who grows rice and corn near Deniliquin, NSW, felt the water trading system “is working as it was intended, but I don’t think it’s the way the river was intended.” He felt that the scheme seemed to “have been authored by an economist and not vetted by a hydrologist and that’s put massive challenges on the river system” (ABC July 2019).
Nevertheless, UNSW’s Professor Cameron Holley, suggests that water trading arguably enabled higher water resilience during the millennium drought, increasing resilience for individual farms by trading for water during shortages, and securing loans for farming in ways they couldn’t pre water entitlements.

Combating corruption and mismanagement through economic policy change
By July 2019, water prices in the southern Murray-Darling Basin reached their highest levels since the worst of the Millennium Drought. Towards the end of 2019, the Government announced it would direct the ACCC to conduct an inquiry into markets for tradeable water rights in the Murray-Darling Basin.

In 2019 and 2020, media reports raised that a significant segment of water entitlement holders are not water or land users. Concerns were expressed that water is being held off the market for resale at a great profit later. This could have devastating economic impacts on farming communities (ABC 07/05/2020). Whether this is legitimate entitlement holders are not water or land users. Concerns were expressed that water is being held off the market for resale at a great profit later. This could have devastating economic impacts on farming communities (ABC 07/05/2020). Whether this is legitimate speculative behaviour that should be discouraged, is something that will be debated as the Basin Plan and trading rules are revised (Hanemann & Young, 2020, pp108-131). The ACCC’s report is due in February 2021 (ACCC Website).

Professor Cameron Holley believes that key reforms and issues for policy attention include:

- Embedding a better regulatory underpinning for the water market
- Extending monitoring and water accounting
- Using alternatives to the market, especially for managing groundwater
- Enhancing water recovery efforts by opening up collaboration between government and non-governmental actors
- Resolving whether water entitlements are, in fact, property
- Developing new systems and tools for dealing with cumulative impacts
- Improving models of litigation and adjudication to extend participation in water governance

These areas will be central to improving Australia’s approach to managing water (Holley & Sinclair, 2016, p.283).

Recommendations to improve current practice

1. Improve the transparency, accessibility and availability of water information—as well as people’s ability to interpret and understand it—as an urgent state government priority.
2. Large water users, especially in agriculture and mining, need to be metered, regulated and reported throughout the state.
3. Regulate and restrict water use for the highest water-consuming industries and provide incentives for maximising water-efficient food/clothing production.
4. Strengthen NSW water use compliance and enforcement agencies.

1.3 INDIGENOUS PERSPECTIVES - A RIVER IS TIED TO EVERYTHING

Preserving cultural flow

We seek constitutional reforms to empower our people and take a rightful place in our own country. When we have power over our destiny our children will flourish. They will walk in two worlds and their culture will be a gift to their country. (Uluru Statement from the Heart)

Having been caretakers of Country for 60,000+ years, Aboriginal people know this land and its waters. However, despite their deep knowledge, Indigenous perspectives are not often given much weight by NSW institutions. This situation needs to change, and there are some signs that it is starting to shift.

“Let us have our water back” called Badger Bates, Barkindji elder, activist and artist on the ABC in 2018. “Barka 4 has a natural cultural flow. Leave it alone. … A river is tied to everything” (ABC 2018).

The National Cultural Flows Research Project (NCFRP) is an evidence-based solution for Indigenous communities that will improve the health of river systems. It combines “scientific methodologies and generations of cultural knowledge [to] inform the development of new governance approaches to water management” (NCFRP 2020). It is focused on the Murray-Darling Basin but hopes to extend its influence to all Australian First Nations communities. The NCFRP has published a comprehensive literature review of Traditional Owner water needs, uses, values, projects, justified terminologies and gaps in research.

Engaging with traditional knowledge to achieve water security

Kamilaroi NSW Indigenous environmental scientist Bradley Moggridge comments:

“Aboriginal people are only seen as storytellers of myth and legend, but the culture of science needs to change to allow traditional knowledge and observation to be part of the science” (Newcastle Herald 2019).

Many Indigenous activists, including Moggridge, are fighting for a future where the accumulated wisdom gained from thousands of years of land and water management is respected and utilised.

In some ways NSW appears to be going backwards—the demise of the Aboriginal Water Unit from NSW’s water sector in 2018 represents a lost opportunity (TheFifthEstate Oct 2019).

However, there are some positive steps forward such as the Yuwaya Ngarra-li partnership between UNSW Engineering, the UNSW Global Water Institute (GWI) and Dharriwaa Elders Group from Walgett, NSW. The partnership is a co-operative and mutually respectful collaboration that recognises the acute water vulnerabilities of Indigenous communities and seeks “systemic change around the security of our rivers and drinking water” (GWI News 2019).

4 Indigenous name for Darling River
Now is the time for the NSW government to take an equally collaborative approach. The Murray-Darling Basin Authority recently added an Indigenous member. But one Aboriginal person on a white dominated team is not an effective way for Aboriginal representation. Indigenous appointments need to be more numerous, consistent, supported and legally required.

Governments must revise the place Indigenous Knowledge holds in Australian culture and thinking. The recent bushfires in eastern Australia propelled the idea of traditional burning methods into the media and public debate. This attention needs to be extended to water management.

**Recommendations to integrate Indigenous perspectives into water management**

1. Ensure Indigenous representation at all levels of water strategy planning and management.
2. Develop a public communications strategy to increase awareness of Cultural Flow and Indigenous water management practices
3. Fund collaborative research projects with Indigenous communities.

1.4 REHYDRATING THE LANDSCAPE

Rehydrating the land is a restorative concept that aims to slow water down as it travels through the landscape and, in the process, increase the water storage capacity of the land. Techniques to achieve this include leaky weirs, embankments and strategic watercourse plantings. According to The Mulloon Institute, slowing water down leads to powerful results, including a healthier and more productive system that can help mitigate climate change (Weber and Field, 2010; The Mulloon Institute, 2019; Hurditch, 2015).

**What is the current situation?**

Agricultural land use practices over the past 230 years have systematically removed native vegetation and introduced industrialised mono-cropping systems and continuous set stocking increasing the speed with which water moves through the landscape. This has led to the erosion of creeks and rivers, a lowering of the water table, drained wetlands and significantly reduced water-holding capacity of soils (The Mulloon Institute, Vimeo 2019; Prosser, 1991, p.139-154; Cowley et al., 2018, p.29-44). This process has occurred Australia-wide and caused a catastrophic decline in the health, function and resilience of the landscape (Mactaggart, 2008).

At the same time modern farming practices have mined the soil for nitrogen and carbon. The excessive use of nitrogenous fertiliser coupled with planting annual cash crops has led to overstimulation of soil bacteria (de Moraes et al., 2013, p.531-543), and reduced the carbon-storing capacity of the soil (Mulvaney et al, 2009, p.2295-2314; de Vries et al., 2006, p.2092-2103). The progressive desertification of the landscape and decline in soil health have increased the landscape’s vulnerability to climatic extremes including fire, drought and flood.

**Benefits of rehydrating the land**

Both regional and urban landscapes benefit from rehydration:

- **Environmental** – improves biodiversity, improves soils, provides habitat for native and threatened species, improves health of wetlands and natural water systems (The Mulloon Institute, 2020).
- **Social and economic** – improves agricultural production, food quality and profits; improves the physical and mental health of urban dwellers by providing more areas for recreation and outside activity; cools urban areas; and improves air quality. (IA, 2019, p.429).
- **First Nations** – provides on-country business opportunities as well as new service delivery businesses and supports cultural connections (QLD, 2020).
- **Disaster mitigation** – creates a natural fire break, dissipates the energy of a flood, speeds up recovery after a fire or flood, mitigates climate change via the increased absorption of carbon in the soil (The Mulloon Institute, 2020), and provides resilient water sources to complement rainfall-dependent water supplies (WSAA, 2019, p.11)
- **Carbon mitigation** – reduces carbon dioxide in the atmosphere by increasing the carbon stocks in the soil thus mitigating climate change.

**Issues preventing change**

An NSW leader in rural regenerative land management practice, Carolyn Hall CEO of The Mulloon Institute describes their experience of steering a course through the statutory approval framework as, “expensive and time consuming, and does not encourage or facilitate land rehabilitation and environmental restoration work” (Hall, 2020). In most cases, for each separate property in a catchment and for each set of works, staff and external consultants must navigate myriad legislation and regulations, submit appropriate applications and expert reports, and liaise with government officials and landholders.

According to Lorraine Gordon, who is closely associated with the Regenerative Agriculture Alliance and helped devise the world-first Bachelors’ degree of Regenerative Agriculture for Southern Cross University, traditional agricultural education doesn’t focus on holistic land restoration which means there is a nationwide lack of expertise in landscape rehydration. Farmers often also acquire ‘advice’ from chemical and fertiliser companies, which is biased towards more product sales.

Despite a growing understanding that current farming practice is not working, regenerative agricultural practice is not yet a mainstream concept. There is a great need to motivate

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5 The compliance cost for the first phase of the Mulloon Community Landscape Rehydration Project was ~$350,000. Approval for seven leaky weirs and related works on a single property took over 30 months, primarily due to the need to engage with various NSW government agencies. Once approval was granted, construction costs were ~$100,000 and installation took three weeks.

6 Including: Water Management (General) Regulations 2016 (NSW), State Environmental Planning Policy (Infrastructure) 2007 (NSW); Schedule 2 to the Water Supply (Critical Needs) Act 2019 (NSW); Local Land Services Act 2013 (NSW); Biodiversity Conservation Act 2016 (NSW); Fisheries Management Act 1994 (NSW); National Parks and Wildlife Act 1974 (NSW).
political will and change public perception. The economic value of a healthy landscape and its ecosystem services is generally not accounted for in current modelling. This is a huge gap and could be filled by a credible natural-capital accounting framework and environmental measurements.

**Recommendations to help rehydrate the land and build drought resilience**

1. Establishment of a Regenerative Agriculture Advisory Group to work with the NSW Minister for Agriculture and Western New South Wales.

2. Building on the innovative work of Southern Cross University, finance a Centre for Excellence in Regenerative Agriculture with a focus on working with farmer cluster groups on a catchment-by-catchment basis.

3. Train more rural Natural Resource Managers (NRMs) in regenerative farming practices to provide alternative solutions to those promoted by chemical and fertiliser companies.

4. Develop a credible natural-capital accounting framework and environmental measurements. Create a robust framework to monetise the economic value that water investments can contribute to the community.

5. Develop a soil carbon-trading credit scheme such as proposed by the Regenerative Agriculture Alliance in which regenerative practices to sequester soil carbon above a registered baseline receive saleable carbon credits.

**1.5 WIDER COMMUNITY INVOLVEMENT**

**From top down to meet in the middle**

Our current system of water and resource management is very top down. Collaboration, communication and coordination is necessary through multiple levels of government for building drought resilience, but it isn’t just government who should be involved.

At the DRF, Professor Cameron Holley warned that while planning needs to be integrated, authorities must soften top-down implementation to allow a diversity of self-determined local solutions. Ian McIntyre, independent industry analyst, believes stakeholder input must flow freely to create evidence-based solutions that are not crushed by inflexible regulatory regimes (DRF 2020).

This self-organisation principle is already evident in many NSW rural and urban community responses to drought or pollution in their waterways (See Appendix 3). When local people respond, they increase knowledge and participation through organic networks and innovation and can be powerful success factors for projects, particularly when supported by government agencies.

**Getting the community involved**

We must harness the love of the land that so many Australians exhibit. Tens of thousands of volunteers already work in environmentally caring organisations including Bush Care, Coast Care, Community Gardens Australia, Clean Up Australia day, Conservation Volunteers Australia, Cooks River Alliance, Greener Spaces - Better Places, Inland Waters Rejuvenation Association, Land Care, Nature Conservation Council, Organic Growers’ Assoc. (NSW), Revive Lake Cathie Inc, and Saving Sydney Trees.

There are significant benefits for local councils who engage with existing environmental conservation groups, supporting them either financially, with expert training, or by supplying resources. With council support these groups perform better, generate more members, make better decisions, and consult with authorities more freely. Volunteer organisations should be regarded as repositories of essential local information.

Across NSW, farmers are becoming environmental activists, with the Lock the Gate movements and Farmers Against Climate Change prime examples. This changing attitude amongst landholders must be encouraged and harnessed. Agricultural innovations such as regenerative agriculture, and the use of recycled water and solar power on farms are stimulated by a philosophy that farming must work with the land and not against it.

**Recommendations to integrate community perspectives into water management**

1. Provide financial support and training to community groups who are involved in environmental practises that will build water resilience in NSW.

2. Increase stakeholder and community participation in catchment management and metropolitan water planning to allow greater community input.

3. Build engagement strategies and policies that support innovation to build water resilience in regional communities.

4. Achieve service levels that align with customer /community values, expectations and aspirations.
PART 2
WATER RESILIENCE IN TOWNS AND CITIES

2. INTEGRATED URBAN WATER CYCLE MANAGEMENT
Since the challenges of the Millennium Drought (1997–2009) integrated water cycle management (IWCM) has been proposed as a way to deliver urban water services more effectively. IWCM is a whole-of-system, multidisciplinary approach that aims to manage the urban water cycle by integrating potable water, wastewater and stormwater services and systems (PC, 2020, p.7). IWCM has a good track record for unlocking the potential of purified water recycling and Water Sensitive Urban Design (WSUD) to provide positive economic, social and environmental outcomes for the community.

Why do we need to reassess urban water management in NSW?
Sydney Water currently supplies over 1.5 billion litres of drinking water daily to over 1.8 million homes and businesses in Sydney, the Illawarra and the Blue Mountains. Every day Sydney Water collects more than 1.3 billion litres of wastewater, which is treated through 19 wastewater treatment plants before being re-used or discharged to rivers or the ocean (SW Website, 2020).

Australia is a highly urbanised country with over 65% of the population living in the five largest cities. Population projections by the ABS point to increasing urbanisation in all urban centres over the next 30 years, in particular Sydney and Melbourne. Sydney Water affirms that by 2056 the population of Sydney is expected to reach 8 million people “putting our existing water and wastewater services beyond capacity” (SWLPP).

The climate change/population increase nexus
Climate projections from the Bureau of Meteorology (BoM) and CSIRO in 2018 indicate that Australia is getting warmer and climate change will increase the frequency, duration and intensity of heat waves. The frequency of “hot days” (exceeding 35°C) is expected to rise, in some cases markedly (PC 2020, p.13). Increased temperatures not only increase urban water and power demand - they will decrease the amount of water stored in dams, through higher rates of evaporation.

According to the Greater Sydney Commission, most of the 725,000 new dwellings needed by 2036 to keep pace with population growth in Sydney will be built in the western suburbs, which are already warmer and drier than the rest of the city (ABC, 2018). For example, the proposed Western Parkland City in Sydney has roughly half the annual rainfall of the existing city centre, seven times the number of hot days and half the cooling tree canopy (PC2020,p15).
2.1 PURIFIED RECYCLED WATER FOR DRINKING

All water on Earth is reused in an endless natural cycle. It is also reused through our engineered water systems. The water industry in NSW has, however, struggled to talk about water recycling and reuse. Among the community, little is known about the realities of wastewater treatment (WSAA, 2019, p.4).

Research into Australians’ water literacy, published by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) in 2016, revealed that while 8 in 10 (80.92%) respondents were willing to use recycled water for non-drinking purposes, only 35.6% were either willing or somewhat willing to drink it. This unwillingness, however, can be overcome. The key message that is currently missing is that it is water treatment, and not the water source that protects public health. In fact, many recycled water schemes produce cleaner water than standard drinking water schemes (WSAA, 2019, p.4).

Purified recycled water for drinking has become an important water supply management strategy for a growing number of towns and cities around the world, including in Australia (WRA, 2019, p.5).

The Groundwater Replenishment Scheme in Perth has been operating at full-scale since 2017, with capacity to recharge the Leederville and Yarragadee aquifers with up to 40 megalitres per day (Khan, 2019, p.5). The capacity of this scheme was doubled in 2019. WA’s Water Corporation expect groundwater replenishment to provide 20% of Perth’s drinking supply by 2060 (WA, 2019).

The main drivers behind successful recycled water schemes around the world include:
- Improving resilience to climate change
- Rainfall independence
- Drought
- Reducing reliance on imported water
- Avoiding major water infrastructure cost
- Meeting increased demand through population increase, and
- Better managing wastewater nutrient disposal (WSAA, 2019, p.4).

Faced with the threat of drought as the new norm along with our expanding population, NSW has a huge opportunity to invest in proven purified recycled water systems and boost the community’s understanding about different approaches to water management. Purified recycled water is a large part of the solution that will help ensure urban water supplies are maintained into the future.

Increasing water availability as a result of ‘closing the loop’

As Professor Stuart Khan stated at the DRF “We need to stop thinking about wastewater as a waste disposal problem and start thinking about it as an opportunity.”

The ‘multiplier effect’ is a term used widely in macroeconomics to describe the disproportional economic stimulus that may follow from an injection of new demand to an economy. In the case of water recycling, an injection of ‘new’ water into a municipal system is made to meet new and growing demand. Some of that water (such as that used on gardens and other outdoor uses) will be lost from the system, but in a highly urbanised scenario, much of it will be returned to the sewage collection system and become available for retreatment and reinjection back into the system.

A city which is able to capture and recycle 50% of the drinking water it supplies will capture 50% again (thus a total of 75%) on the second time around. Capturing 50% on the third time around gives a total of 88%. This practice of 50% capture and recycle will ultimately lead to a doubling (an extra 100%) of the city’s available potable water supply. The impact of the multiplier effect becomes exponentially more effective as the percentage of water recapture and reuse increases (WRA 2019, p.27).

Increasing supply while avoiding major infrastructure costs

According to the WRA, potable reuse presents a huge opportunity to increase water supplies while avoiding major augmentations to water or wastewater conveyance, treatment, or disposal infrastructure; avoiding costs associated with marine disposal, or the costs of developing alternative new supplies, such as new dams (WSAA, 2019, p.28).

Community resistance to a purified recycled water scheme may be lessened by economic discussions. The decision to build a pipeline to augment drinking supplies in Toowoomba cost over $100 million more than it would have cost to implement recycled water options, which was the preferred option on the basis of cost, environmental impact and reliability (PC, 2020, p.53).

Major water infrastructure projects, such as constructing a new dam, can have even more significant upfront financial and environmental costs. The Guardian reported in October 2019 that Wyangala Dam in central west NSW will get a $650M upgrade and a new dam near Tamworth Dungowan would cost $480M.

Even the green/purple solutions can be costly. Installation of third pipe (purple pipe) networks which use recycled water for non-potable industrial and household uses can involve the expensive duplication of infrastructure.

Is seawater desalination a solution?

Theoretically, seawater desalination can provide a limitless and climate-change-independent supply to urban areas near the coast, but there are several downsides. According to a recent study by the Water Services Association of Australia (WSAA), desalinated water generally costs roughly the same as purified recycled water for drinking, and less than recycled water for non-drinking (third pipe) projects (WSAA, 2020).
Seawater desalination plants do discharge large volumes of hypersaline brine directly into the ocean, raising concerns about potential impacts to marine life. However, Australian studies have shown minimal impact subject to brine discharge outfalls being designed and located with careful assessment to achieve low impacts (WSAA All Options 2020, p37). In Sydney, desalination pipeline infrastructure is only in place to the CBD and eastern suburbs. To reach the expanding west, a whole new set of pipelines would need to be built, adding to the cost. As UNSW’s Professor Stuart Khan has noted, “The further you (pump desalinated water) inland, the more you’re working in a direction that is opposite to the way our water supply systems are designed and operate” (ABC, 2018).

The readiness of Australian water industry and regulatory frameworks to embrace purified recycled water for drinking

There are a number of well-developed frameworks from Australia, the US and the World Health Organization for managing risks from recycled water. Satisfactory regulatory frameworks for planned potable reuse are currently in place in Queensland and WA. Existing drinking water and recycled water legislation could be applied together, in lieu of creating new overarching laws. An example of such compatible existing legislation is the Safe Drinking Water Act, 2011 (SA), which could be applied to potable reuse without modification in NSW (WRA, 2019, p.6-7).

The module of the Australian Guidelines for Water Recycling (ADWG) which deals with the use of recycled water to augment drinking water supplies (AGWPR Phase 2), could be revised to become a stand-alone module of the Australian Drinking Water Guidelines.

Urban water planning should always be conducted in line with point five of the Australian Government’s National Urban Water Planning Principles (NUWPP): “Consider the full portfolio of water supply and demand options” - without recourse to politically determined policy bans on recycled water. The Productivity Commission’s Draft Report on National Water Reform reiterates the need to “consider all options” and states that policy bans are rarely appropriate. (PC NWR, p143)

Recommendations for the use of purified recycled water in NSW

1. Develop a renewed state-wide strategy for urban water management supported by an appropriate state body responsible for overseeing implementation with appropriate funding.
2. Consider all water supply options when selecting urban water sources.
3. Prepare a transition strategy for moving from existing forms of recycling wastewater to purifying recycled water for drinking.
4. Develop long-term community engagement strategies that identify champions and include community education campaigns about purified recycled water and other supply options.
5. Commission a purified recycled water for drinking demonstration plant and visitor centre in Sydney that can help build public confidence and trust in processes. The centre could be a collaboration between universities, industry and Sydney Water.

2.2 WATER SENSITIVE URBAN DESIGN

When it rains in our urban centres the majority of stormwater runoff is directed down drains, where pollutants and high flows can damage waterways. Water Sensitive Urban Design (WSUD) provides an opportunity to harness stormwater as a valuable community resource. WSUD provides environmental and social benefits including an alternative and re-usable water supply, urban greenery, decreased pollution, better air and water quality, enhanced urban biodiversity, reduced artificial heat, and cooler cities (Vandermeulen et al., 2011, Demuzere et al., 2014).

WSUD technologies harness natural processes within engineered systems to remove, transform and attenuate pollutants in water within the urban environment (Fowdar et al., 2018, p.14). This usually involves the use of plants and soils to treat water before it can pollute and degrade receiving waterways such as rivers and creeks.

WSUD also involves replacing impervious surfaces with nature-based technologies such as swales, rain gardens, green walls and wetlands. This slows stormwater runoff, enhances the absorption of stormwater into the ground and reduces the risk of small floods (Sydney Water, 2018). It has been estimated that installing household rain tanks in small catchments can reduce flood damage, saving up to $3 million per year.

As these are nature-based systems working with different climates, soils and water conditions, WSUD solutions and systems cannot be mass-produced. To ensure optimal performance, WSUD systems must be tailored to local conditions and must also address public health and environmental concerns.

Planning and regulations in NSW

Widespread adoption of WSUD is dependent on its acceptance by local government and industry, and the community understanding its benefits. To achieve full acceptance, it is necessary to have policy frameworks in place which would sanction proper construction, maintenance and operation of different WSUD technologies.

As highlighted in the PC 2020 report, statutory land and water planning are not well linked, creating a barrier to the “ongoing collaboration needed between the land-use planning and local government sectors and the water sector, in both policy and planning at a range of different scales” (PC, 2020, p.1). Furthermore, local councils often do not have the tools or resources to undertake water planning. This lack of clear policy objectives has caused confusion around the roles and responsibilities of different agencies with regards to implementation and maintenance of WSUD systems (see Appendix 3).
NSW does not yet have an overarching statutory WSUD policy that applies generally across the State. Nor does it have a clearly legislated policy on urban stormwater quality and flow objectives (Choi and McIlrath, 2017, pp69-70). The Sydney Growth Centre Commission published a number of potential WSUD initiatives that could be incorporated into any new development plans in their GCD Code 2006 (Growth Centre Commission, 2006), however, the WSUD measures were non-binding. Most areas of NSW are not covered by the GCD Code 2006 and do not have any planning controls or guidelines for WSUD (Choi and McIlrath, 2017, p.72).

NSW could look to Victoria and SA to help inform WSUD best practice. SA’s Parafield stormwater-harvesting wetlands in Adelaide produce 1.3 GL of water per year, while Melbourne Water has established WSUD guidelines for councils (Melbourne Water 2013).

Stormwater management is a local government issue, and while it can present as a big challenge it can also be viewed as an opportunity for policy makers to work towards integrated water cycle management. Several Sydney councils such as Blacktown, City of Sydney and Randwick Council have embraced stormwater reuse projects (See Appendix 2 for WSUD case study Blacktown Council).

Recommendations for WSUD in NSW
1. Develop an overarching statutory WSUD policy to support the implementation and ongoing maintenance of WSUD systems and encourage wider uptake by developers and councils.
2. Financially support and incentivise local government and developer schemes to harness and recycle stormwater as a valuable community resource.
3. Technology and governance need to advance in tandem to ensure robust controls and standards around implementation and maintenance. A ‘toolbox’ approach of case study solutions could help guide industry implementation of WSUD.
4. Plan for ongoing operational project funding to support maintenance as well as implementation. Community engagement and education on the benefits of WSUD is important, particularly to gauge preparedness to pay.
5. Support the development of more efficient, cost-effective and low maintenance WSUD solutions to retrofit ageing infrastructure.

2.3 IMPROVING CURRENT PRACTICE IN CITIES AND TOWNS
There are several high-impact opportunities to improve water resilience in NSW by working with existing systems.

Consider water earlier for liveable cities and towns
Liveable, sustainable and productive cities and regions are critical to our economic wellbeing, quality of life, and health. Erin Cini, Manager Liveable Communities, Water Services Association of Australia, advocated at the DRF for significant increases in green and blue infrastructure as ways to promote the liveability of our cities. She believes they should be “funded in similar ways as other essential services and social infrastructure, such as health and education.”

The water industry has a strong reputation for contributing to the liveability of Australian cities by providing safe, secure and affordable drinking water, wastewater and drainage services. But water is often considered late in the project planning process. This results in missed opportunities to enhance community outcomes through ‘blue’ and ‘green’ infrastructure (such as rivers and parks).

Investing in green and blue infrastructure can deliver benefits to physical and mental health by making our communities cooler, healthier and more attractive (WSAA Blue + Green, p1). Green infrastructure also plays a role in building drought resilience, by rehydrating soils, storing carbon, and increasing river health.

Green supports blue - See gardens as producers not consumers
Water restrictions can be a blunt instrument. During droughts, urban green areas – including parks, community gardens and home gardens are often subject to severe water restrictions. This has negative implications for the health and wellbeing of urban dwellers, as well as impacting on urban food security.
As the editor of Gardening Australia magazine noted in February 2020, in response to the image of someone watering their garden as an illustration of water wastage:

“Most gardeners are judicious about watering, and this demonisation of gardeners is frustrating and counterproductive. Doesn’t the planet need more greenery, not less?” (Gardening Australia, Feb 2020, p.3).

The answer is, of course, yes. Apart from their myriad other benefits, plants and trees are evaporative coolers for our planet. One moderately sized tree has the equivalent of the cooling capacity of two residential air conditioners (GA, Feb 2020, p39). Encouraging urban food producers has several benefits:

- Energy, water and transport cost savings
- Rich soils hold more water in the landscape and help lower urban temperatures
- Encourage a healthy lifestyle and food for gardeners, particularly the elderly

Financial support for local councils taking direct action

There are opportunities for the State to provide more support to local government in achieving their water management aims. Stormwater harvesting, for example, can be undertaken at the local council level with many existing case studies across the state. Local councils need consistent funding and grant opportunities as well as policies, processes and illustrated case studies to get their projects underway. Current and past funding schemes include:

- The Stormwater Trust
- Urban Sustainability Fund
- Environmental Restoration and Rehabilitation

At the DRF, Dr David Reid from Georges Riverkeeper stressed the central role of local councils in educating the community through the implementation of water saving policies, creating infrastructure for stormwater harvesting, and implementing other water efficiencies on council property. Councils can also help their constituents through:

- Explaining new regulations for local water plans
- Providing water saving incentives to households, such as reduced cost water tanks
- Producing educational materials
- Managing community volunteers to rebuild riparian habitat for healthier waterways

Recommendations for building water resilience in cities and towns through green & blue infrastructure

1. Clearly state outcomes for liveability in planning and health policy. For example, clear policies on access to irrigated open space and tree canopy cover. Develop governance principles and water plans that reflect the importance of water to liveability.

2. Establish clear roles and responsibilities and early interface between urban land use planning and water service planning.

3. Allocate funding, resources and accountability to green-blue infrastructure liveability outcomes in the same way as other social infrastructure such as health and education.

4. Investigate funding options for increasing green and blue infrastructure via public and private partnership models, contributions from beneficiary stakeholders such as local government, developers and industry, and direct government funding.

5. Implement water restriction exemptions for home gardeners and some parks, particularly those producing food.

6. Increase financial and technical support for councils involved in urban land repair, regeneration and nourishment.
ADWG - Australian Drinking Water Guidelines

AGWWR - Australian Guidelines for Water Recycling, (AGWWR Phase 2), deals specifically with the use of recycled water for the augmentation of drinking water supplies

Advanced water treatment plant (AWTP) - A plant that applies additional treatment to the effluents produced by a WWTP in order to further remove contaminants (typically by treatment processes which may involve activated carbon, membrane filtration, UV disinfection, advanced oxidation and others).

Blue infrastructure - Beaches and waterways, such as harbours and rivers, and the facilities that support them, including foreshores, surf lifesaving and water recreation clubs, jetties and wharves.

Catchment - A physical area where water is collected by the natural landscape. The outside edge of a catchment is usually the highest point. Gravity causes all rain and run-off in the catchment to run downhill where it naturally collects in creeks, rivers, lakes or oceans. https://www.dpi.nsw.gov.au/fishing/habitat/your-catchment/sydney-metro

Direct potable reuse (DPR) - Highly treated recycled water is delivered to a drinking water supply system after first being subjected to some significant residence time in an environmental water storage such as an aquifer, lake or large river system. DPR is currently successfully practised in Namibia and Texas.

Environmental buffer - A natural water system (a river, lake or aquifer) in which reclaimed water is stored before being recovered for indirect potable reuse (IPR), such as:

Groundwater replenishment: A process of engineered replenishment of a groundwater aquifer with recycled water. Aquifers may be replenished by the use of infiltration basins or pressurised injection wells.

Surface water augmentation - process of engineered replenishment of a surface water system with recycled water.

Gigalitre (GL) - One billion litres, 1,000,000,000L. To get some idea of quantities, Sydney Water supplies Greater Sydney with 1.4 gigalitres daily.

Green infrastructure - The range of natural and built landscape assets which incorporate natural vegetation. It includes areas of public and private land such as parks, fields, verges, gardens, green facades, walking and cycling tracks, streets and backyards.

Indirect potable reuse (IPR) - Highly treated recycled water is delivered to a drinking water supply system after first being subjected to some significant residence time in an environmental water storage such as an aquifer, lake or large river system. IPR has been successfully used in WA and Queensland.

Non-potable reuse - The reuse of recycled wastewater for a purpose other than adding it to a drinking water supply. Common examples include agricultural irrigation and industrial applications. Often referred to as the purple pipe.

Wastewater treatment plant (WWTP) - A plant used to treat municipal (and/or industrial) wastewaters, usually to a quality considered suitable for environmental discharge.

Water treatment plant (WTP) - A plant that is used to treat conventional water supplies for drinking water production (typically by treatment processes which may include coagulation, flocculation, media filtration, chlorine disinfection and others).

UNSW WRC - WATER RESILIENCE IN NSW WHITE PAPER

EXPERT CONTRIBUTORS TO THE DROUGHT RESILIENCE FORUM AND WHITE PAPER

Catchment Management

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Rehydrating the landscape

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Improving water resilience in cities and towns

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GLOSSARY OF ORGANISATIONS REFERENCED IN THIS REPORT

ABS. Australian Bureau of Statistics: www.abs.gov.au


BoM. Bureau of Meteorology: http://www.bom.gov.au

CRCWSC. Cooperative Research Centre for Water Sensitive Cities: https://watersenslivecities.org.au

CWI. Connected Waters Initiative UNSW: http://www.connectedwaters.unsw.edu.au


Georges Riverkeeper: https://georgesriverkeeper.org.au/about-us

GWI. Global Water Institute UNSW: https://www.globalwaterinstitute.unsw.edu.au

LLS. Local Land Services: https://www.lls.nsw.gov.au


WaterNSW: www.water.nsw.gov.au

WRA. Water Research Australia: www.waterra.com.au

WRD. Water Research Centre, UNSW Sydney: /www.wrc.unsw.edu.au

WRL. Water Research Laboratory, UNSW Sydney: www.wrl.unsw.edu.au

WSAA. Water Services Association of Australia: www.wsaa.asn.au

Yuwaya Ngarra-li partnership between UNSW Engineering, Global Water Institute (GWI) and Dharriwaa Elders Group from Walgett, NSW: https://www.wrl.unsw.edu.au/news/YUWAYA-NGARRA-LI
Case Study – Restoring a large acidic landscape into a new tidal wetland

Big Swamp is the local name for a series of drained agricultural floodplains located on the Manning River estuary on the mid-north coast of NSW. The floodplain was historically a large brackish backswamp known for abundant bird populations, but over the course of 110 years underwent major hydrologic modifications due to the installation of an extensive floodplain drainage network system. The entire site is approximately 2,000 hectares and below 2 m AHD (Australian Height Datum).

The combination of extensive drainage for agriculture and sulfidic subsoils had greatly acidified the soil (pH<4.0), and adjacent waters, and it became known as one of the worst acid hotspots in the country. Acidic rainfall events increased acid discharges sending large acid plumes throughout the lower estuary. These plumes severely impacted the once thriving oyster industry.

In 2011, with a $2 million Federal Government grant, Greater Taree City Council initiated the Big Swamp Restoration Project alongside UNSW’s Water Research Laboratory and WetlandCare Australia. The aim was to determine priority areas for wetland creation, detail innovative on-ground methods, model flooding impacts and undertake large scale on-ground works to restore/create new wetlands.

First, a detailed surface and groundwater study identified acid hotspots, transport pathways, flooding issues and nominated high priority areas for remediation. In January-February 2013, a significant flooding event occurred in the lower Manning River estuary forming large acidic plumes (pH<2.7). The acid plume dynamics within the estuary were extensively monitored to assess acid impacts and saline dynamics. The final report from the study outlined key areas to restore, monitoring strategies and detailed on-ground works including drain infilling, land reshaping and wetland creation.

In late 2013, approximately 670 hectares of private property located within prioritised zones was acquired by Council through Caring for our Country funding. Between July and December 2013, the on-ground works were implemented onsite and post-remediation monitoring got underway.

Based on Council monitoring, the water quality has significantly improved and the wetland vegetation is recovering. The on-ground works were designed to support natural evolution towards a dynamic saltwater/freshwater wetland. Further land acquisition and on-ground works were undertaken in 2014 through funding secured by Council and WRL. This has expanded the remediated area to the north-east of the site and targeted additional high priority acid contributing drains.

To date, the Big Swamp project has transformed over 700 hectares of degraded landscapes.
APPENDIX 2 - SUCCESSFUL WSUD PROJECT IN SYDNEY

WSUD Case Study: Angus Creek stormwater harvesting and reuse scheme

In this scheme, excess stormwater is extracted from Angus Creek and, together with stormwater runoff from the hard surfaces of nearby Blacktown International Sportspark, is used to irrigate both the sportspark and neighbouring reserves. It supplies up to 200 megalitres of high-quality water per year for spray irrigation with no access restrictions and incorporates natural treatment processes (via storage ponds, floating wetland rafts and a large wetland) with mechanical/chemical treatment (via screen filters, chlorination and UV disinfection). The project cost a total of $6.2 million, including aquifer investigation, design and modelling, mechanical components, solar system, civil construction, wetland construction and water quality monitoring.

The main project drivers were:

- Irrigation water for sports facilities
- Reduction of stormwater flows to Angus Creek
- Financial sustainability through a reuse water charge
- Carbon neutrality

The project resulted in a number of positive outcomes, including reduction of nutrients and pollutants in the downstream waterway, reduction in peak flows, a successful environmental monitoring campaign and reduced reliance on mains water with fit-for-purpose water supply. Importantly, there was significant community involvement in decision-making process allowing for community acceptance and support of the project. The project is transferable to other high end open space and recreation facilities where irrigation demands are high.
APPENDIX 4 – COMMUNITY IS CRUCIAL IN BUILDING WATER RESILIENCE – SOME CASE STUDIES

Reviving Lake Cathie, Northern Rivers
A keen sense of duty and exasperation at government inaction led to the formation of the powerful Revive Lake Cathie Inc (RLC), a grassroots community-driven initiative that works to restore the lake and its surroundings. Lake Cathie is 12 kilometres south of Port Macquarie and is the second largest estuarine salt marsh area in NSW. The group’s vision is to “achieve the sustainable health and amenity of the Lake Cathie/Lake Innes Estuarine System” and their intervention came about after locals got tired of endless government reports which “led to no visible action.”

According to the group, millions of dollars have been spent on research and reports specifically relating to the Lake Cathie, Lake Innes and the Lake Cathie/Lake Innes Estuarine System without any effective resultant implementation. It was locals who felt that “Our environment and inter-generational equity requires that we address the damages caused by man-made impacts to future proof the estuary.” (Revive Lake Cathie, 2020).

Cooks River Alliance, Sydney
The Cooks River Alliance is a partnership of four councils – Bayside, Canterbury-Bankstown, Inner West, and Strathfield – who are working together with communities for a healthy Cooks River Catchment. The Cooks River is an urban waterway located in the inner South West of Sydney. It runs through some of the most heavily urbanised and industrialised areas in Australia, but many parts of the river and its foreshores offer beautiful riverside walkways and cycle paths, wonderful parks and facilities and an abundance of native flora and fauna. Over recent years, the condition of the river has improved considerably, due in large part to the efforts of stakeholders and the local community (Cooks River Alliance, 2020). http://cooksriver.org.au/about-us/

Inland Water Rejuvenation Association (IWRA), Dubbo
The IWRA is a non-profit organisation of Dubbo community members and businesspeople keen to promote and improve recreational localities, services and sustainable fishing potential within the district. Matt Hansen, president of the IWRA has been working to restore the health of the Macquarie River for 10 years. A keen fisherman since a child, he was spurred into action when he learnt Australia’s native fish stocks have depleted by 70-90%. Much of this is due to loss of habitat along the riverbanks.

Up to 40% of a fish’s diet can come from the riparian zone - the plants on the riverbank. The plants also supply food, cover and shade for other animals.

Some of the group’s main objectives are:
- Rejuvenation of riverbank habitats and waterways
- Educational programs to promote sustainable best fishing practices with community groups and local schools
- Work in conjunction with government authorities and fishing club organisations to provide constructive results
- Promote the region and provide improvements to local waterway and resources
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