Water sensitive urban design

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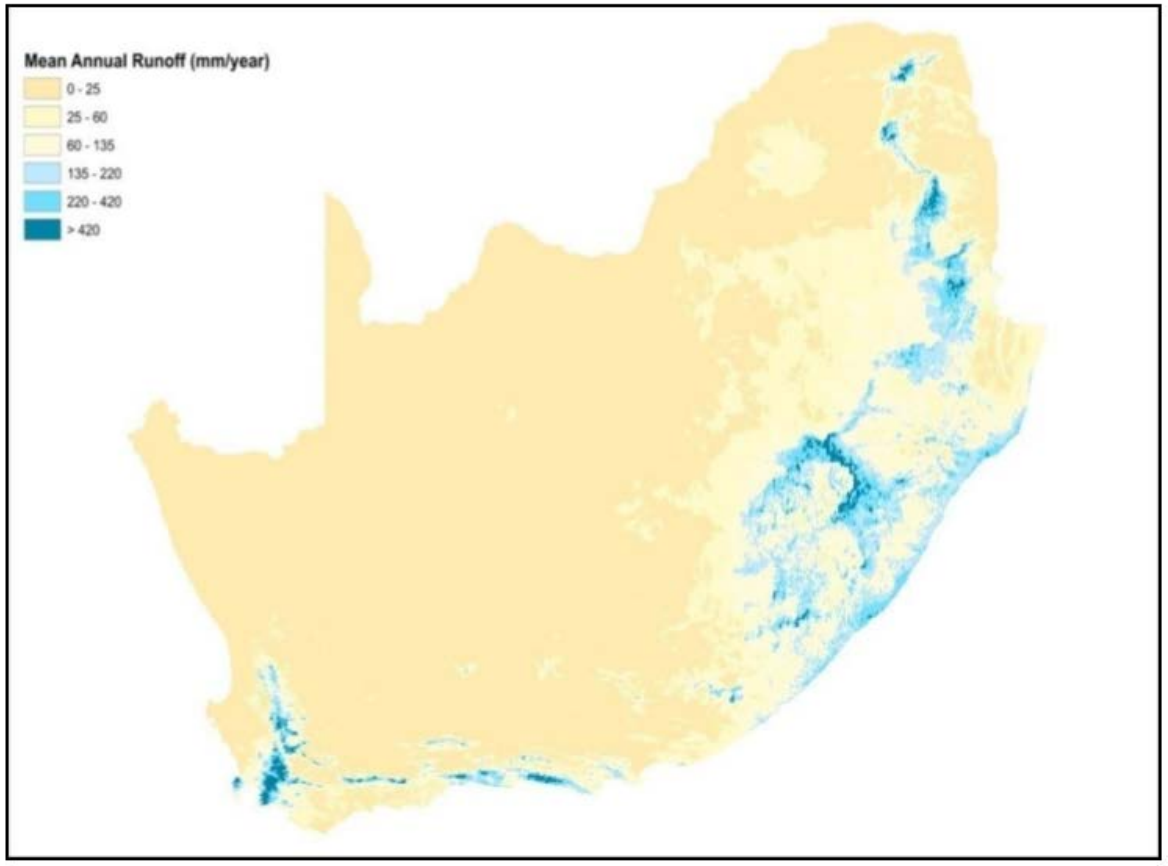
9th NRCS Annual Building Control Officers' Convention 2019
22 November 2019

The way we manage urban water influences almost every aspect of our urban environment and quality of life

Tony Wong

South African water resources



Mean annual runoff for South Africa (Nel *et al.*, 2013)

- Uneven spatial distribution and seasonality of rainfall
- Relatively low stream flow in rivers most of the time
- Location of major urban and industrial developments remote from the country's larger watercourses
- 70% of South Africa's water resources are trans-boundary in nature

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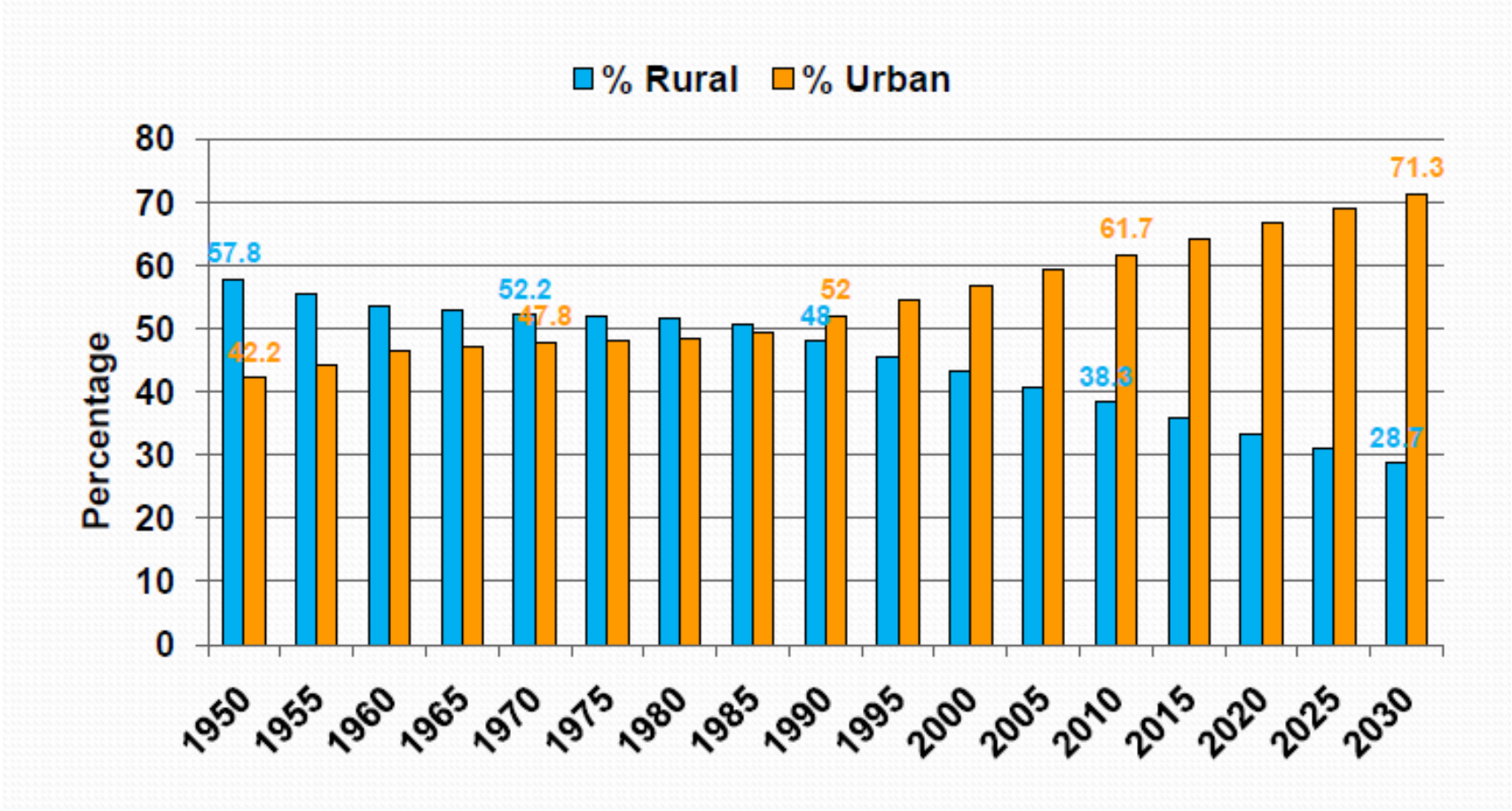
Urbanisation in SA: recognising risk



Source: Haldenwang, 2010

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SA's water crisis - "*Too much, too little, too dirty*"

- Low rainfall / high evaporation
- Urbanisation
- Population growth
- Services backlogs
- Poor water quality
- Leakage / wastage
- Fragmented institutions
- Quality of life
- Poverty / inequality

…the availability of water of acceptable quality is predicted to be the single greatest and most urgent development constraint facing South Africa" (*Scholes, 2001)*

What South Africa must do to prevent a national water crisis

1 **Reduce water demand by 1.2 cubic km by 2035**

Enough water to fill
±500 000
Olympic-size swimming pools

2 **Fix water leaks, fix & improve existing water infrastructure**

36% of SA's municipal water is lost before it reaches consumers

3 **Increase treated & reused wastewater**

SA treats
<60%
of its wastewater

4 **Increase groundwater extraction especially for agricultural sector**

±63% of SA's water is allocated to agriculture

What can we learn from the CT crisis?

- Improve commitment to building a water sensitive city – multifunctional infrastructure
- Need to adapt much faster to water scarcity (drought as the new normal) – build resilience
- '*Conserve, Value and Enjoy Water*'
- Diversify water resources
- Blue-green corridors
- Water-energy-waste nexus
- Change behaviour

Design principle – "keep water in the town / city"

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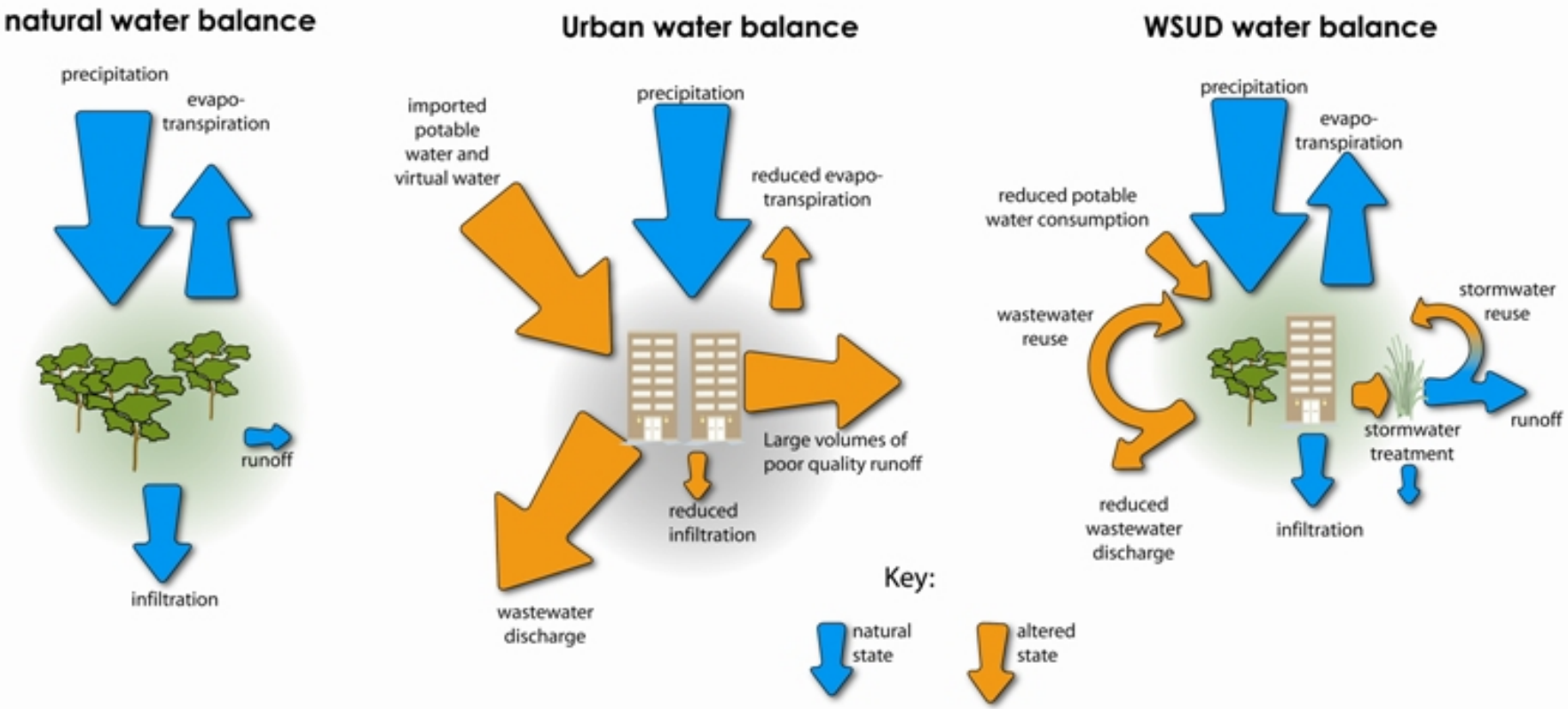
Water Sensitive Urban Design (WSUD)

WSUD integrates water cycle management with the built environment through planning and urban design, providing multiple benefits and opportunities in order to overcome challenges with water management.

"WSUD is not a set of solutions or measures, but a process and philosophy to optimise both water management and urban design objectives" (CIRIA, 2013)

Influence of Water Sensitive Design on urban water cycle



Source: Hoban & Wong (2006)

What can WSUD help with?

- Building flexibility & adaptability into water sources - including *"Cities as Water Supply Catchments"*
- Building flexibility & adaptability into sanitation ensuring healthy cities
- Blue-Green Infrastructure, *"Cities providing ecosystem services"*
- Building social and institutional capital, "*Cities supporting water-educated communities*"

Sophisticated, *equitable* and Water Smart City

Better urban water management provides the core for multi-value multifunctional urban spaces that are fit to cope with future challenges

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Water sensitive design and water sensitive cities

- Sustainable water supply
- Stormwater management
- Wastewater minimisation
- Design and planning

WSD is the process,
WSC is the destination

Cities as water supply catchments

Water diversity – key to resilience

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‘Closing the gap’ - many sources of water

Potable water (usually from surface water in RSA)

Water conservation / water demand management

Stormwater (from the local drainage system)

Rainwater (from roofs or similar)

Groundwater (including managed aquifer recharge)

Treated wastewater (from treatment works)

Light/dark greywater (from washbasins, showers, baths, kitchen sinks)

Acid mine drainage

Sea water

Simply a matter of relative costs and risk –the potential reuse of alternative water resources is as much a public health issue as it is a water conservation priority

Water conservation / demand management

- Pressure management
- Leak detection
- Tariffs
- Water efficient devices
- Water restrictions
- Awareness campaigns

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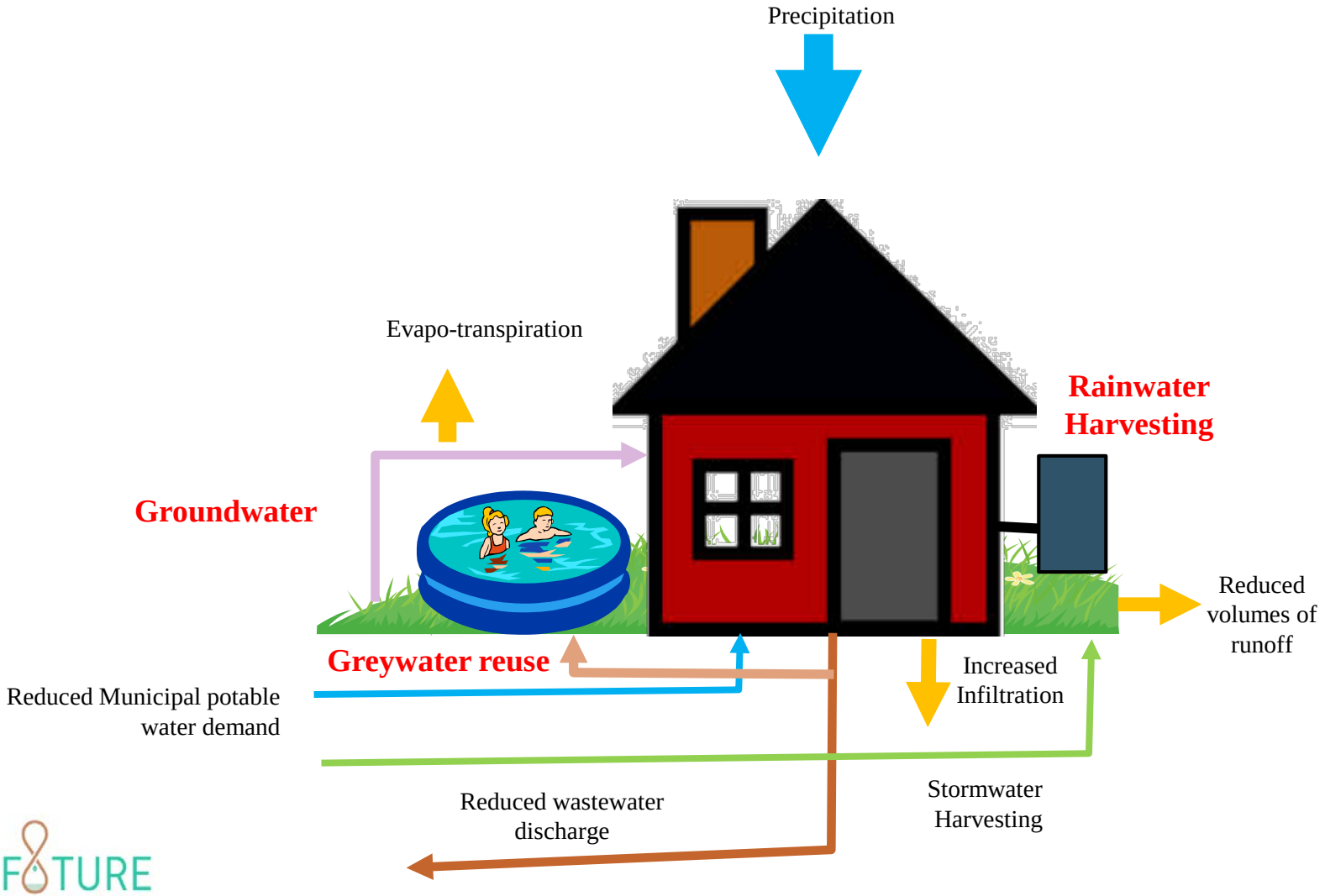
Treated wastewater use / reclamation

- schools, sports clubs
- golf courses, farms, irrigation
- industry, commercial developments
- direct potable reuse
- greywater harvesting

Diversifying household water sources



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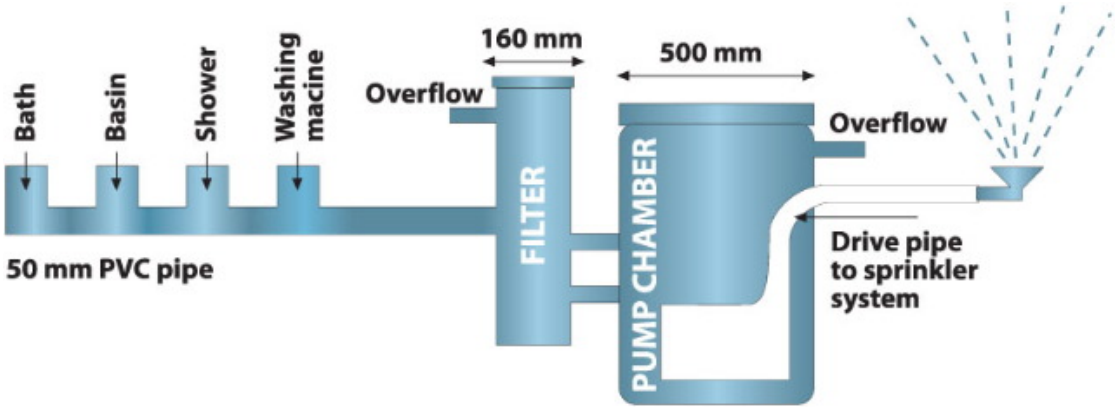
Greywater harvesting in serviced areas



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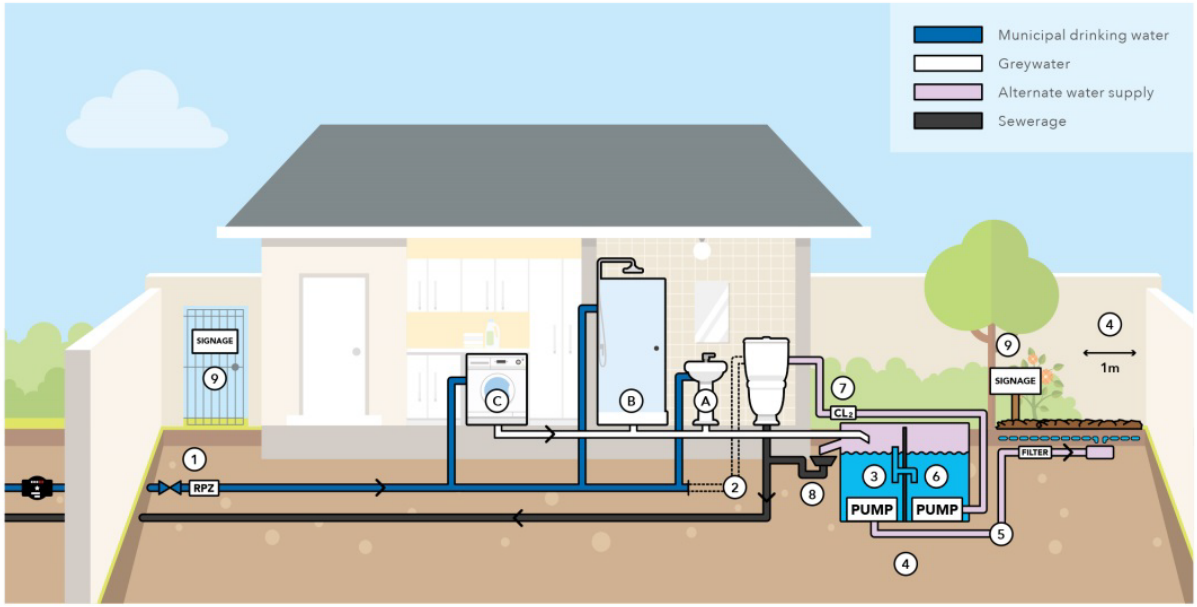
Greywater guidelines - CoCT

1. Municipal supply to be fitted with RPZ valve
2. Municipal supply to cistern to be disconnected
3. Collection and treatment in approved storage tanks
4. Underground tank to be at least 1m from boundary
5. Screen-filtered greywater for drip / subsurface irrigation
6. Collection, disinfection and distribution in second part of tank
7. Filtered and disinfected greywater for toilet flushing
8. Storage tank overflow to sewer, etc.

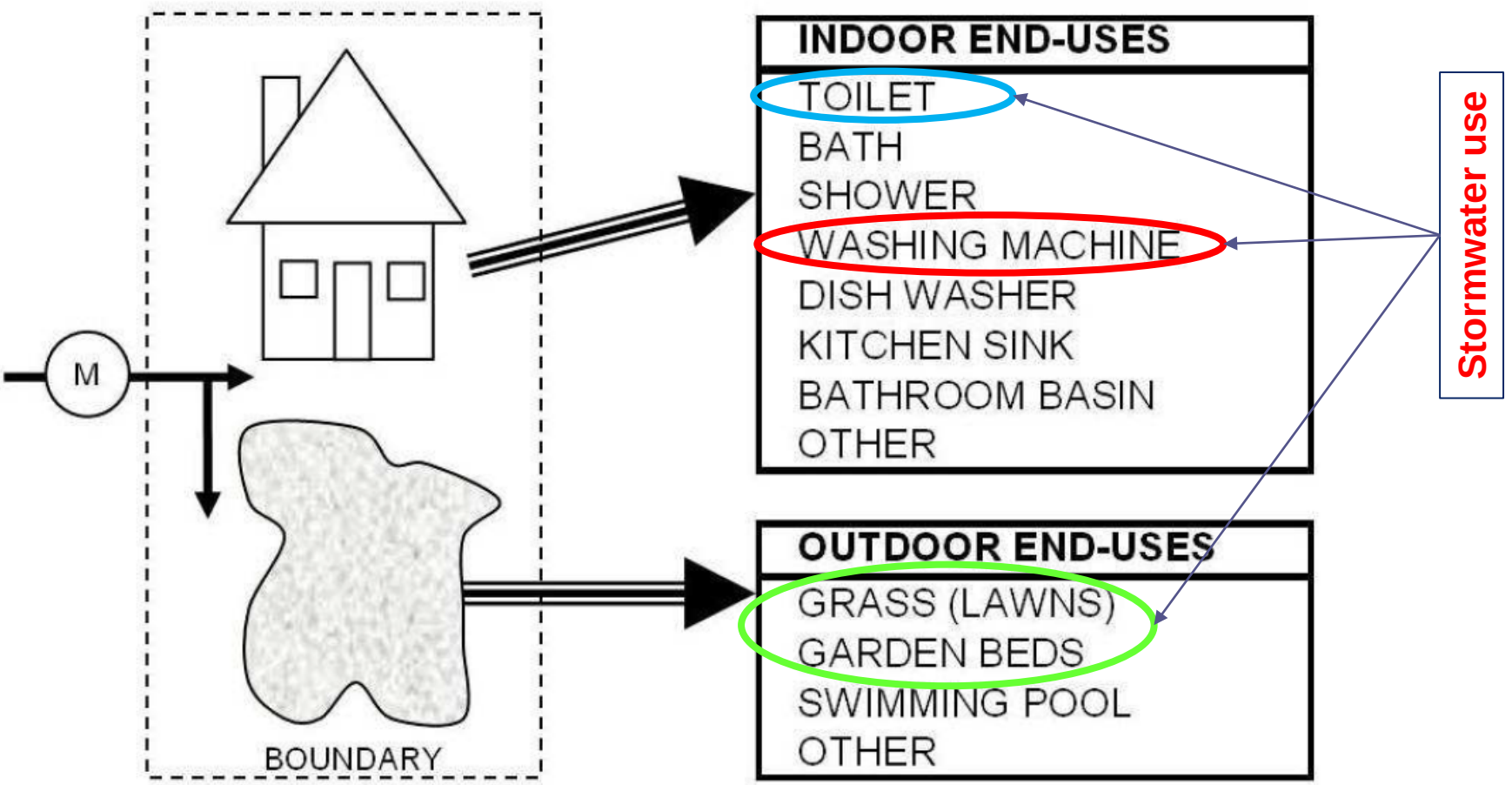


Rainwater and stormwater harvesting

Rainwater Harvesting – harvesting of water from roofs for water supply (private property owners)

Stormwater Harvesting – harvesting of water from stormwater systems for water supply (regional scale)

Rainwater use at the household level



(Jacobs and Haarhoff, 2007)

Positions on SWH

Position 1: SWH improves water security

An alternative source of water

Position 2: SWH reduces flooding

Stores and removes ‘surplus’ SW

Position 3: SWH provides additional benefits

e.g. amenity, ‘value capture’ by adjacent real estate, preservation of biodiversity, reduction of the ‘heat-island’ effect provides ‘sense of place’…

Two big challenges

Water Quality - SW can be highly contaminated (trash, pathogens, nutrients, heavy metals, sediment etc.)

Possible solutions: 'Fitness-for-purpose' use; treatment – to potable standard if necessary

Storage - it seldom rains when you want the water!

Possible solutions: Real-time control of stormwater ponds; Managed Aquifer Recharge

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Sustainable Drainage Systems (SuDS)

Mimic the pre-development situation both with regard to runoff quality, runoff quantity, and amenity and biodiversity by:

- treating the stormwater as close to its source as possible
- using a “treatment train” to successively treat increased post-development pollution and flows

“Soft” engineering – minimise concrete conduits

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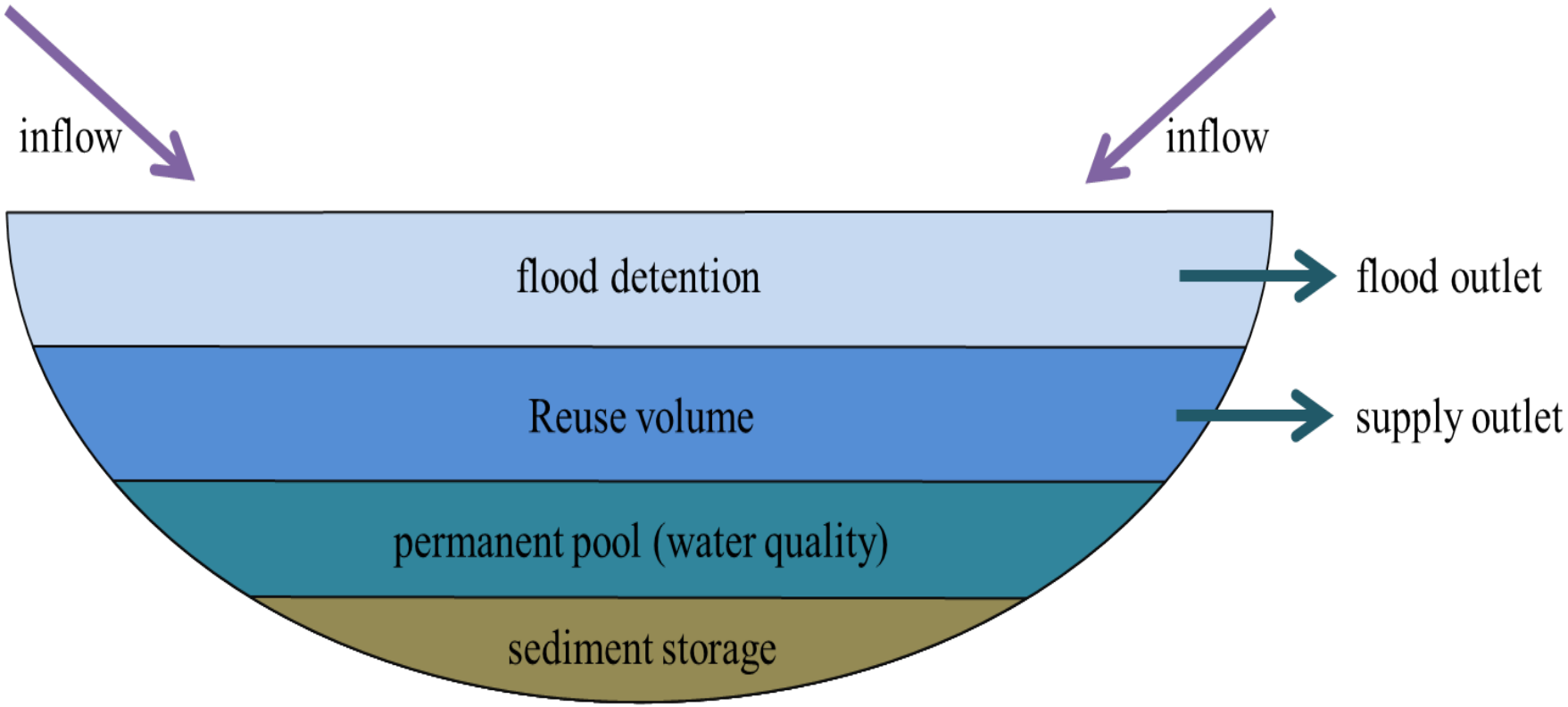
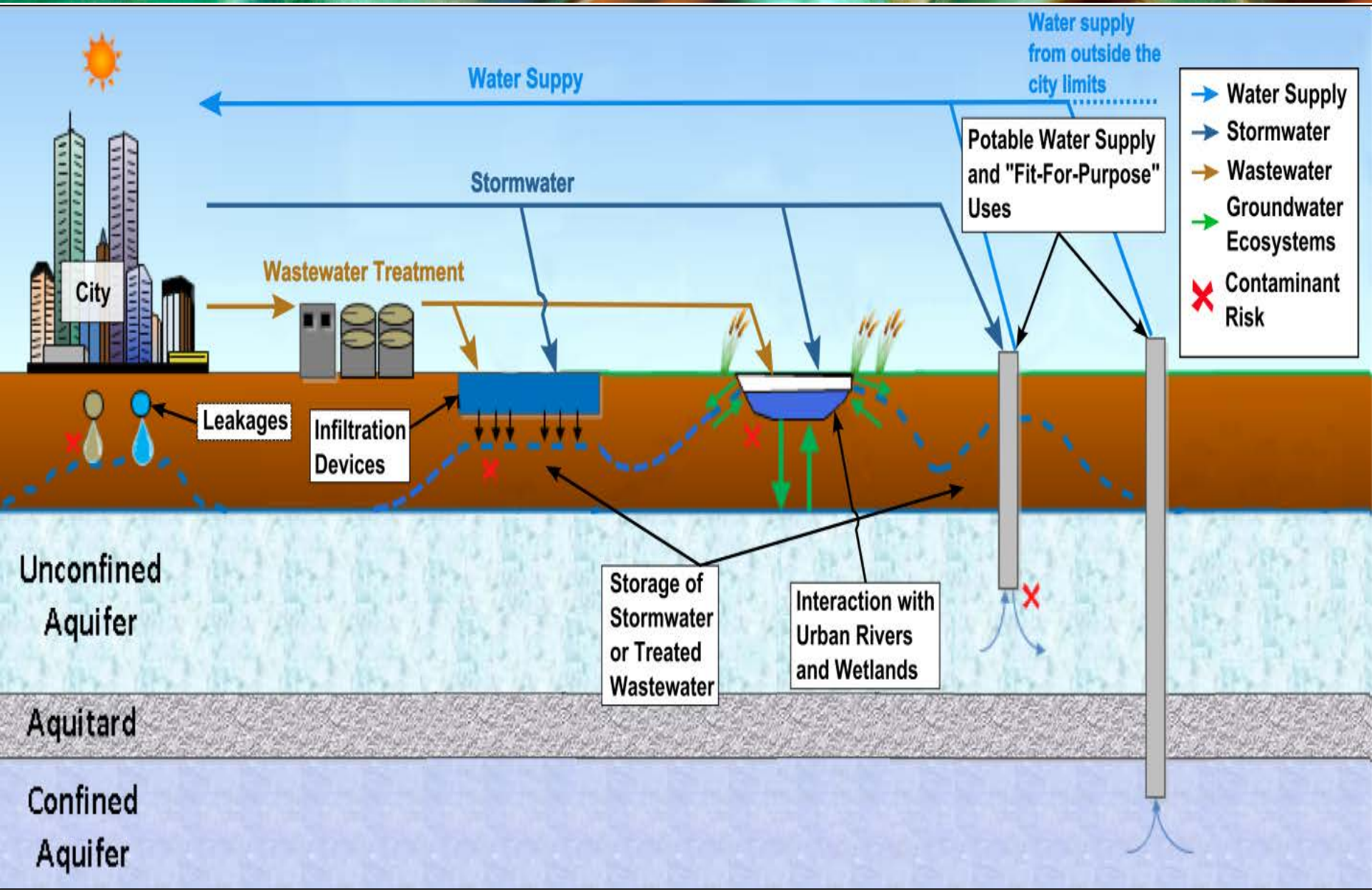
Open storage



Groundwater storage through MAR



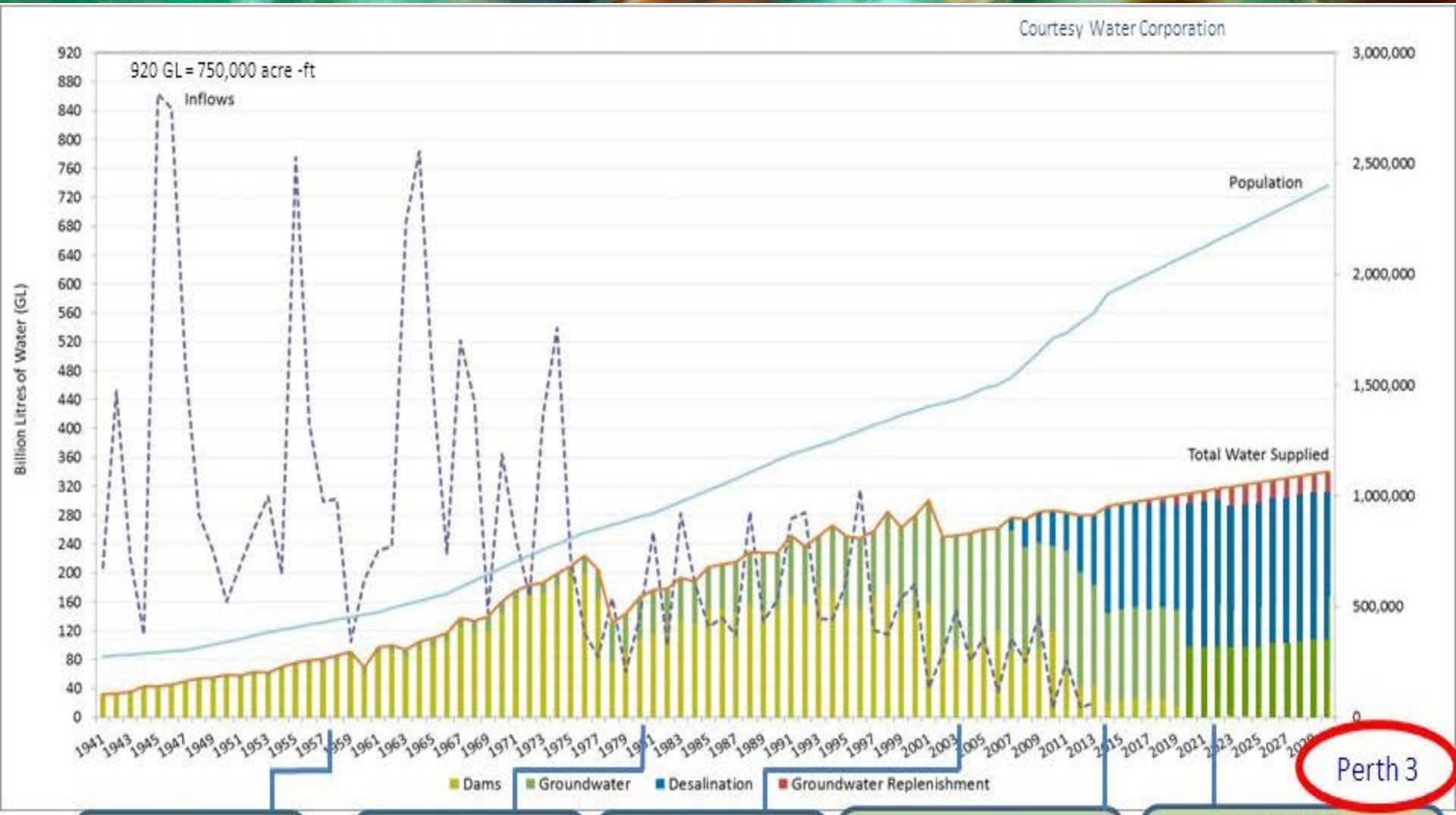
Links to groundwater - Sponge cities

34 ha urban stormwater park in Harbin, China provides multiple ecosystems services

- collects, cleanses and stores stormwater, infiltrates to aquifer
- protects/recovers natural habitats
- aesthetically appealing public space

Requires porous design interventions across the city, and contiguous open green / blue spaces

Reshaping water supply - Perth



1958
92% Dams
8% G/water

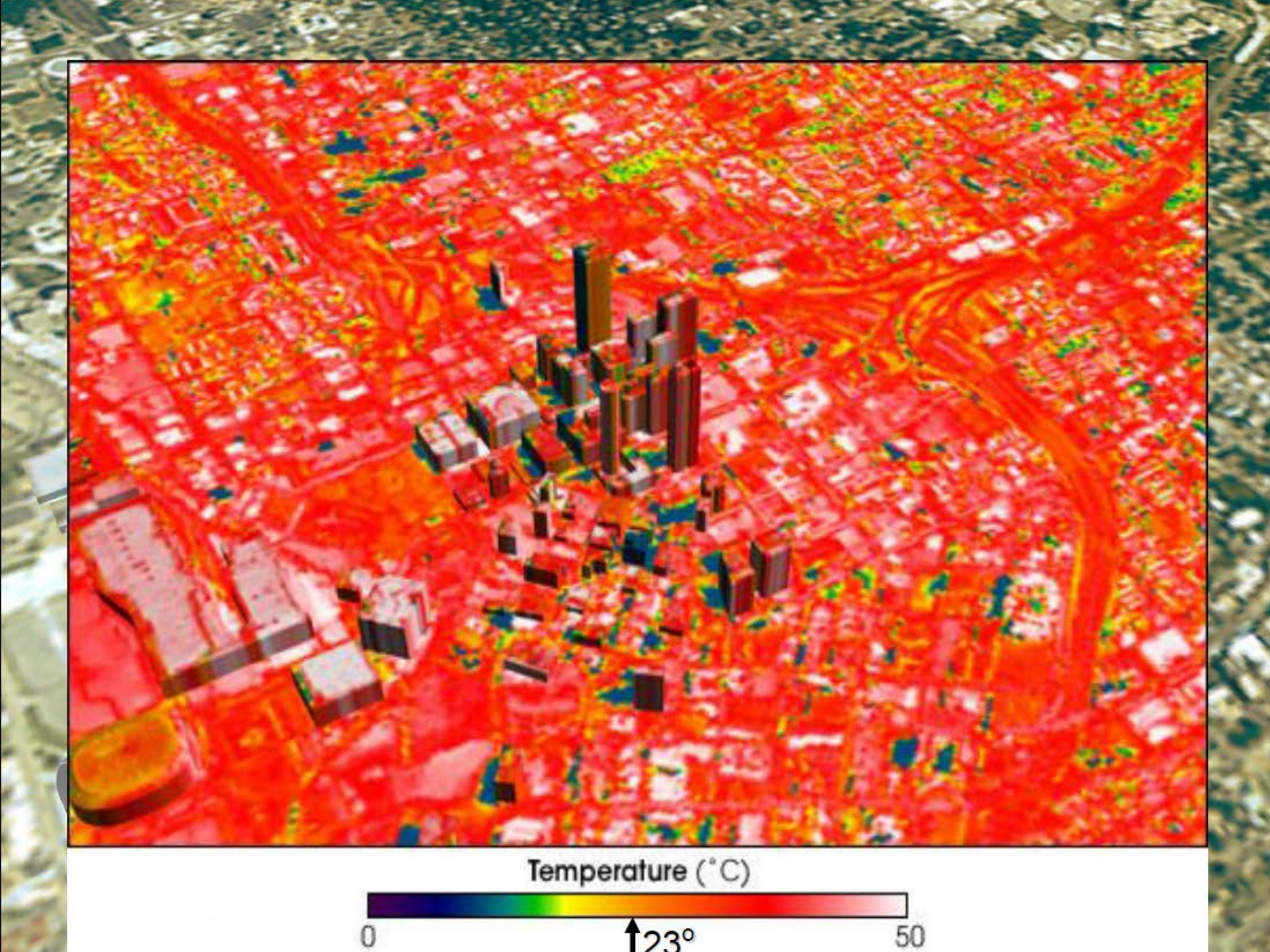
1980
65% Dams
35% G/water

2004
38% Dams
62% G/water

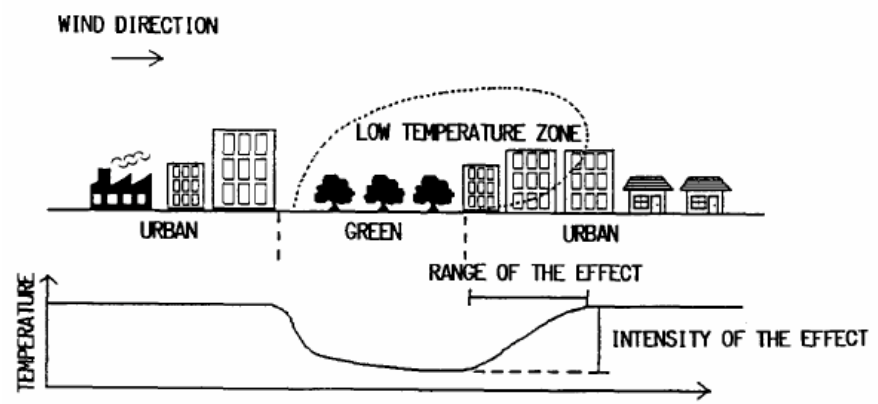
2014
7% Dams 51% Desal
42% G/water 1% GWR

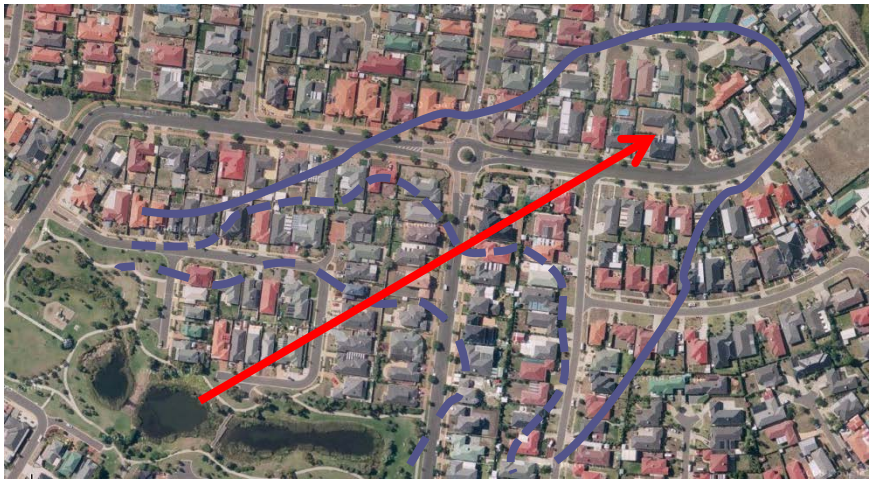
2022 Likely
0% Dams 65% Desal
24% G/water 11% GWR

Cities providing ecosystem services

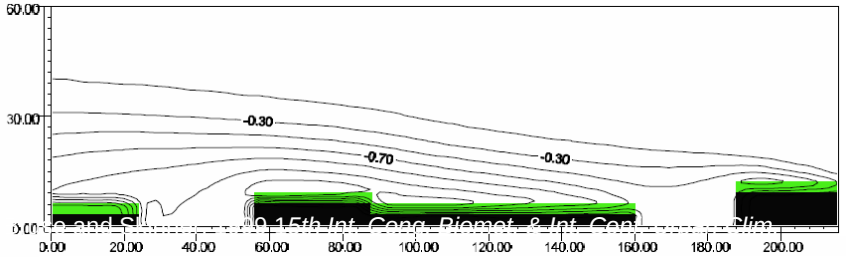

Temperature (˚C)
0
23°
50

Park ‘cool’ islands





- Influence of WSUD features is controlled by its size and location, and local meteorological conditions. As much as 1km downwind…
- WSUD needs to be distributed throughout the landscape… and where people actually are!
- Stream ecology benefits from distributed systems



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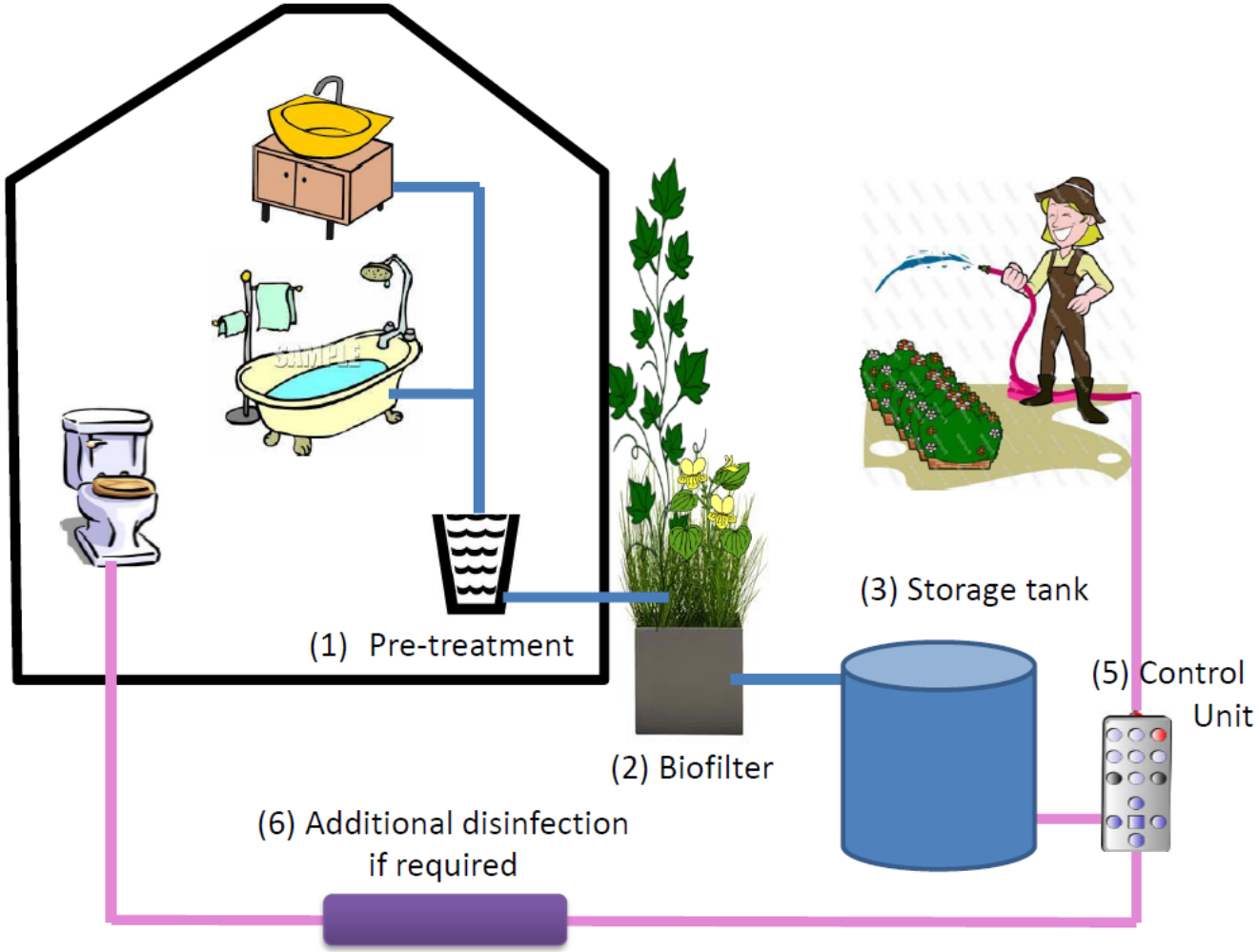
Green Walls

Living wall for greywater recycling



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Cities building capacity and supporting water educated communities

Presenting the benefits of WSUD

Stakeholder	Area of interest
Politicians	Provision of basic services; job creation
City officials	Costs / ease of maintenance
Private developers	Increased profit / public image
Community groups	Job creation; public health / safety
Environmental groups	Protection of environment
Individuals	Additional costs / benefits per household

Social – institutional barriers / enablers

- Lack of common vision / Champions
- Institutional fragmentation / Bridging organisations
- Undefined organisational responsibilities / Accountability
- Political incentives and/or disincentives / Market receptivity
- Poor organisational commitment / Strategic funding
- Technological path dependency / Trusted science
- Community capacity to participate / Socio-political capital
- Lack of experience with facilitating integrated management processes / Binding targets

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The Singapore story

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The four ‘taps’

In a bid to ensure water security, water supply in Singapore is now being diversified. In 2013:

1. Imported water from Malaysia (40%)
2. Water harvesting from the local catchments (35%)
3. Treated effluent (NEWater) (15%)
4. Desalinated water from the sea (10%)

The objective is to minimise / eliminate 1. – so as not to be reliant on Malaysia for this critical resource

gallerySIX

Clean water, clean air and clean, green land – these are the components that make Singapore a livable, dynamic city, with an environment all can enjoy.

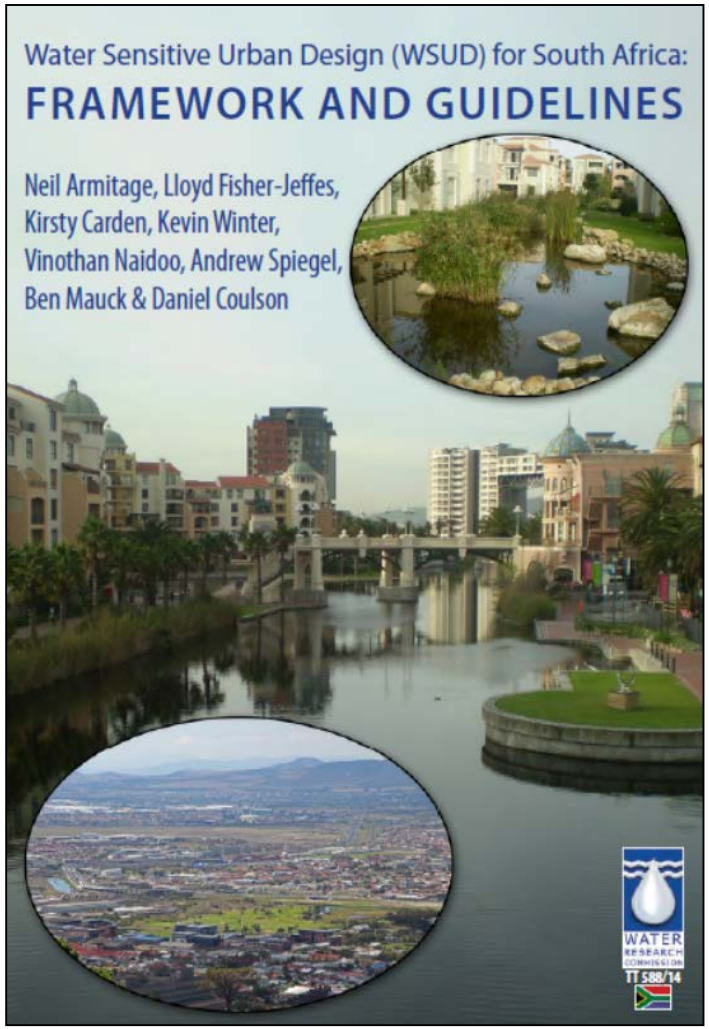
In 2004, PUB launched the 3P Partnership to engage key stakeholders in caring for Singapore's waterways: Public (Government), Private (Businesses) and People (Communities).

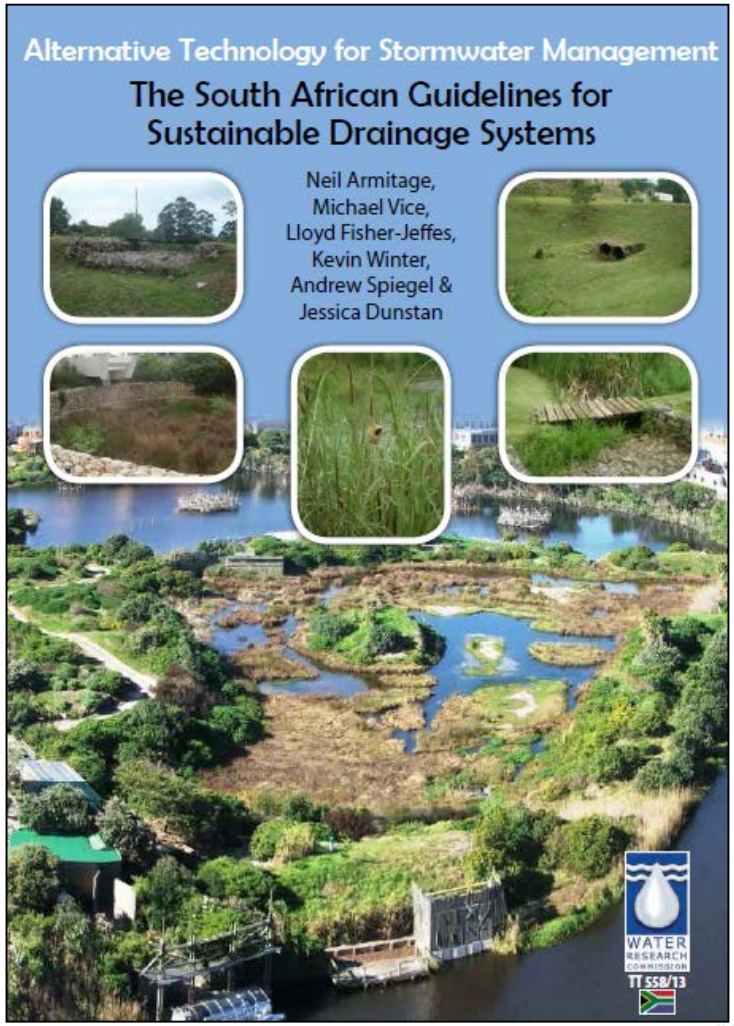
Today, public agencies, households, businesses and industries are adopting responsible environmental practices in energy use, water conservation and waste management. With more people and organizations caring for Singapore's environment, this drive has become a joint effort that includes people from all walks of life.

People who enjoy and care for the environment are the same people who transform and sustain it

And it all begins with a single individual You.

WSUD / SuDS for South Africa





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What are the challenges?

- Equity
  - Dignity; ownership; respect
  - Talking of greening cities is ludicrous when basic services do not exist
  - Give people basic skills at all levels
- Creating systems that can be adapted for the future
  - Not maladaptation or technologically locked-into regrettable solutions
- Mitigating climate change
  - Reducing energy and carbon use
- Increasing uncertainty
  - Population growth, demographics and lifestyles (standards of living)
- Enabling legislation
  - **Urban stormwater design to be addressed in building regulations, water policy, by-laws etc.**

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Future water outlook – water sensitivity

- Optimise and integrate the management of all available water resources – surface, ground, wastewater and stormwater – to improve resilience
- Create liveable urban areas that place high value on water and strive to increase water use efficiency through water sensitive urban design

Thank you

For more information:

www.futurewater.uct.ac.za

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Green infrastructure in the Gauteng City Region

https://www.gcro.ac.za/outputs/photo-essays/detail/video-green-infrastructure-in-the-gauteng-city-region/