Pathways to Water Resilient South African Cities

- The potential for repurposing existing water infrastructure in Cape Town

The PaWS project

PaWS project

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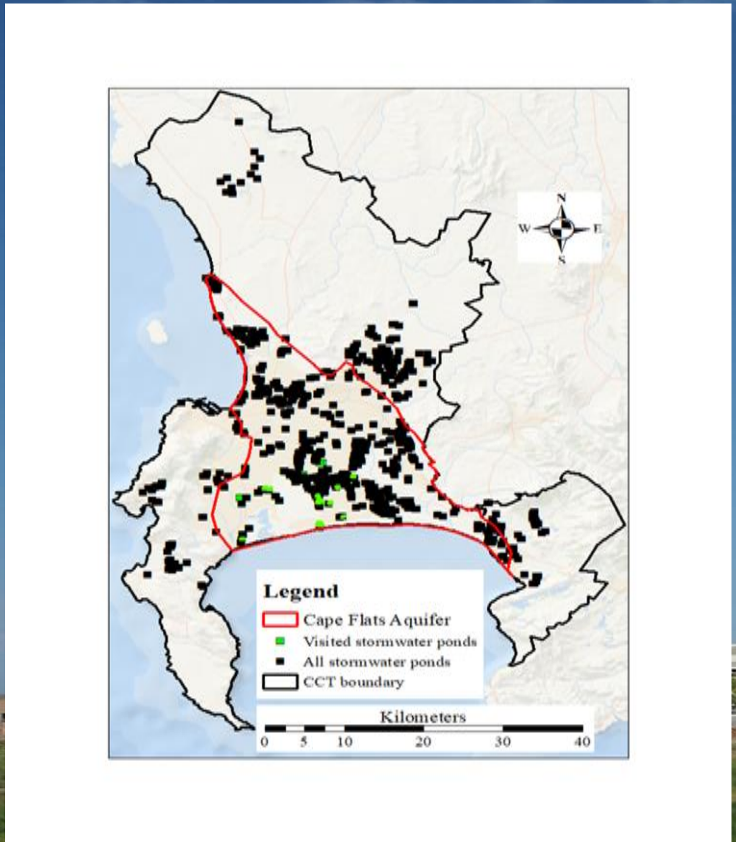
University of Cape Town, Future Water - Kirsty Carden, Neil Armitage, Amber Abrams, Craig Tanyanyiwa, Julia Mclachlan, Rachelle Schneuwly, John Okedi, Jessica Fell

FUTURE WATER

UNIVERSITY OF COPENHAGEN

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
DANIDA | INTERNATIONAL DEVELOPMENT COOPERATION


N
W
E
S
Legend
Cape Flats Aquifer
Visited stormwater ponds
All stormwater ponds
CCT boundary
Kilometers
0 5 10 20 30 40


M43
M171
M54
M28
Turfhall Rd
M24
M18
Edinburgh Dr
Wetton Rd
R300
Ottery Rd
M49
M9
R102
M68
M17
Cape Flats
Old Faure Rd
M41
M3
M38
Highlands Dr
Vanguard Dr
M45
Strandfontein Rd
Mitchells Plain
M44
Prince George Dr
M32
M7
Baden Powell Dr
M5
M4
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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Programme for presentation

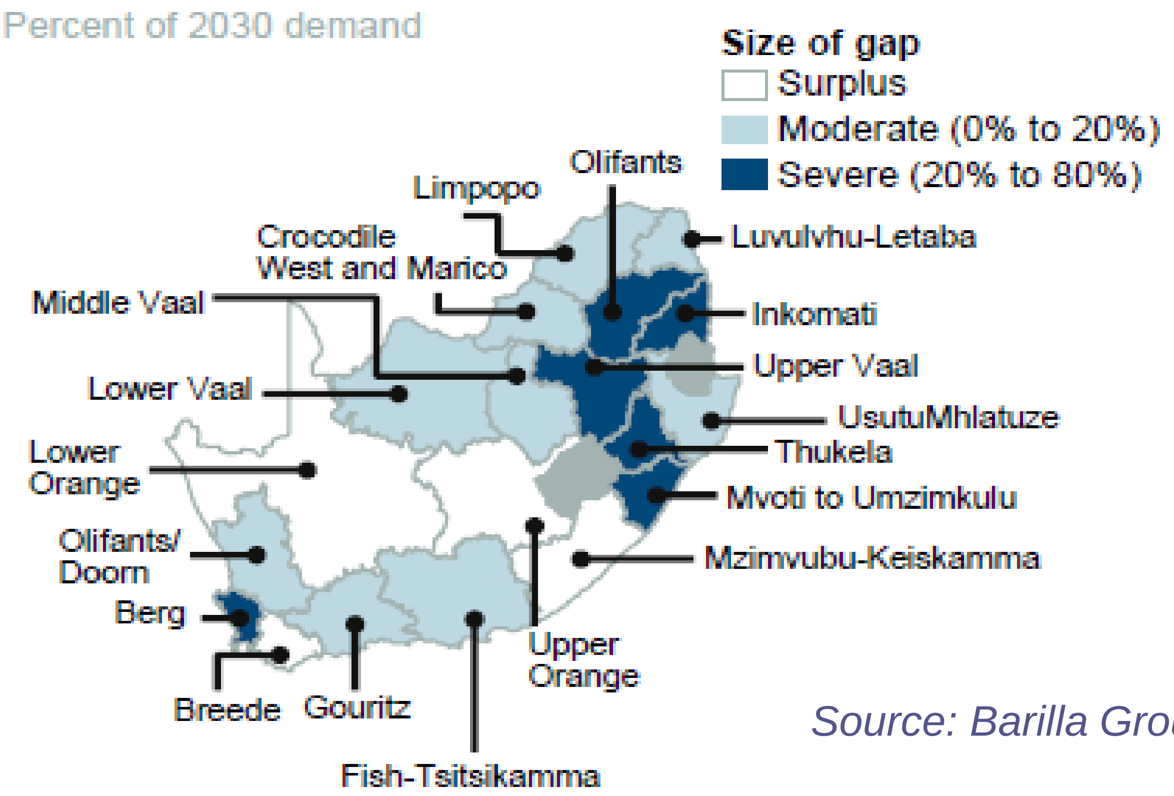
The South African water crisis

Repurposing a stormwater pond

Why also engaging local communities?

Is there an enabling governance environment for water resilience and the repurposing of stormwater ponds?

South Africa's impending water 'crisis'



Source: Barilla Group et al., 2009

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

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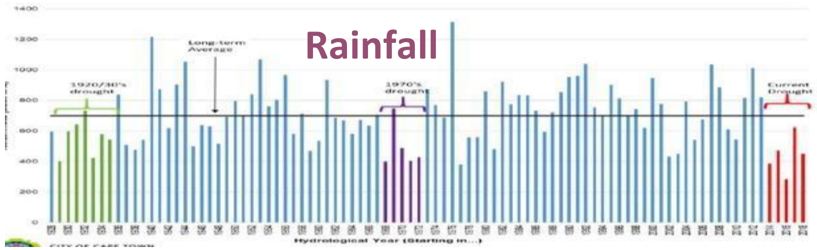
Cape Town example - Building resilience to respond to shocks

Source: M. Webster, CoCT

a wake up call

2017 & 2018 drought — *2019 water quality* — *2020 COVID-19*

System resilience & climate change



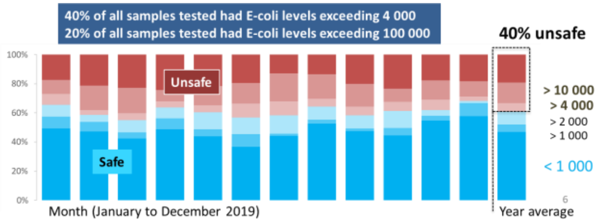
citizen action

Pollution from the Milnerton Estuary enters the sea – *Pic by Jean Tresfon*

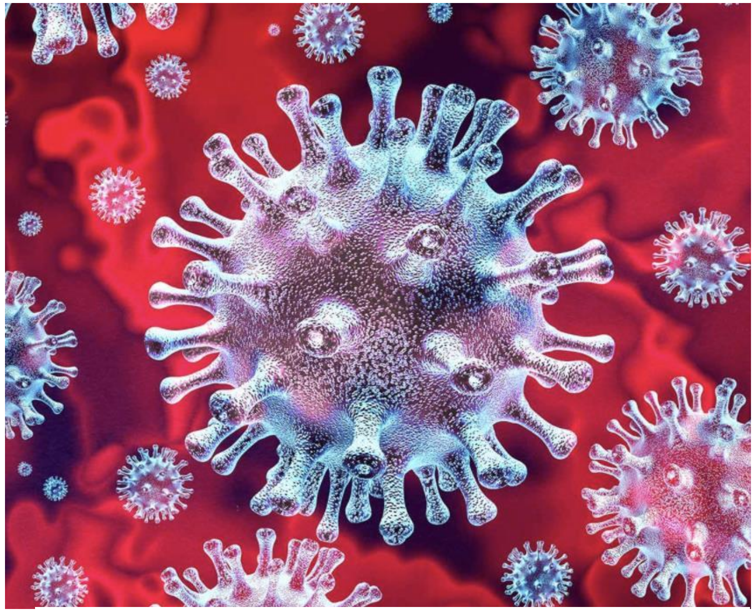
We won't take this sh!t anymore, says Milnerton

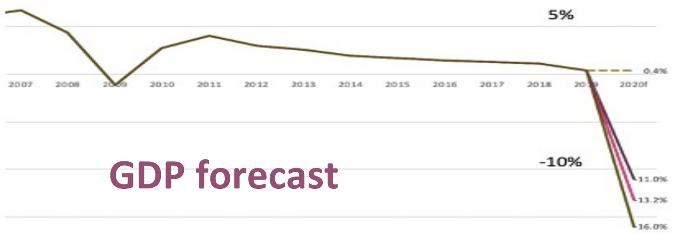
WHEN HE THINKS BACK 25 YEARS Richard Allen, chairman of the Milnerton Canoe Club, ... data, which they only received after putting up a fight and then, it was on a non-disclosure basis. "I'm convinced ... water warrior, is in the water "six times a week" either paddling, swimming, surfskiing, surfing or coaching.

River water quality



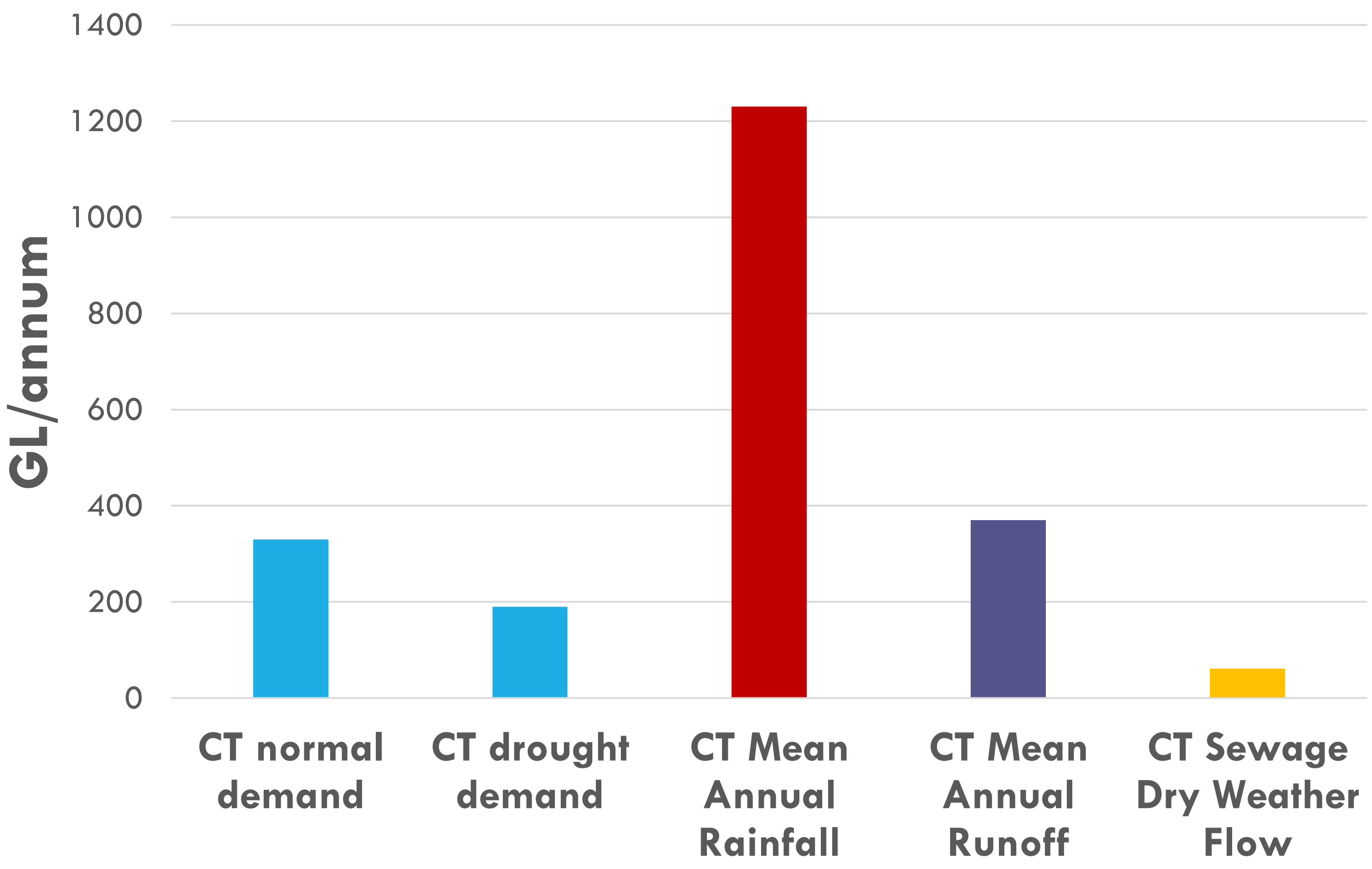
health and economy





Typical annual water flows in Cape Town (CT)

The annual water demand for Cape Town is of the same order of magnitude as the mean annual runoff – virtually all of which is currently drained to the sea.



1 GL = 1000 ML = 1 million kL (cubic metres)

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The two big challenges for SWH

Stormwater Harvesting (SWH) – the harvesting of water from stormwater systems for water supply.

1. **Storage** - it seldom rains when you want the water!

   Possible Solutions:

   a) Run-of-River (Use the water immediately and let the large conventional reservoirs recover)
   b) Real-time control (RTC) of stormwater ponds
   c) Managed Aquifer Recharge (MAR)

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

   Possible Solutions: 'Fitness-for-purpose' use; Treatment – to potable standard if necessary; use SuDS to reduce contamination

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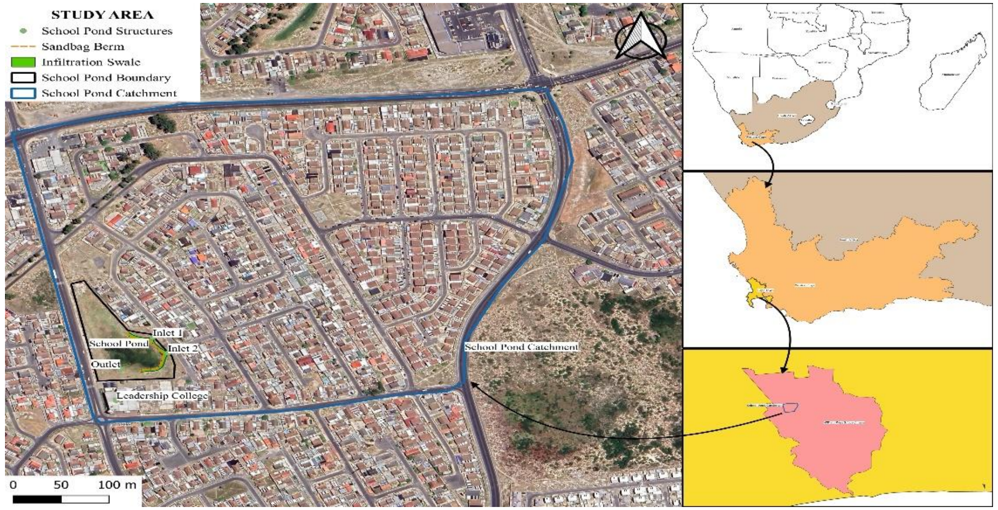
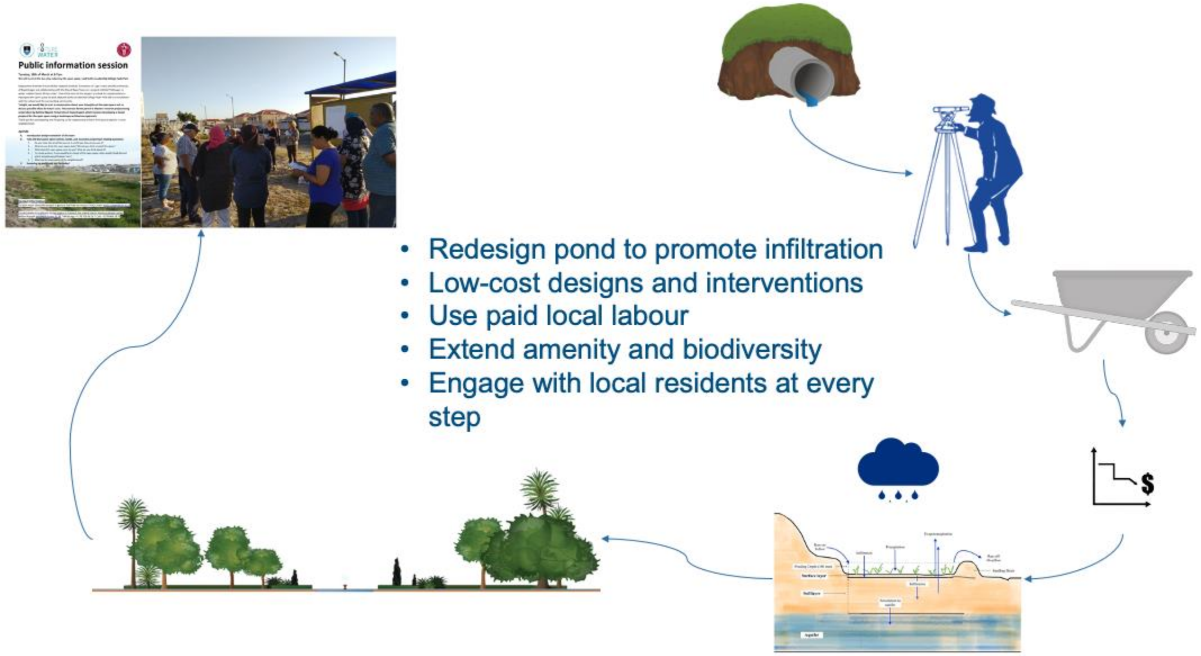
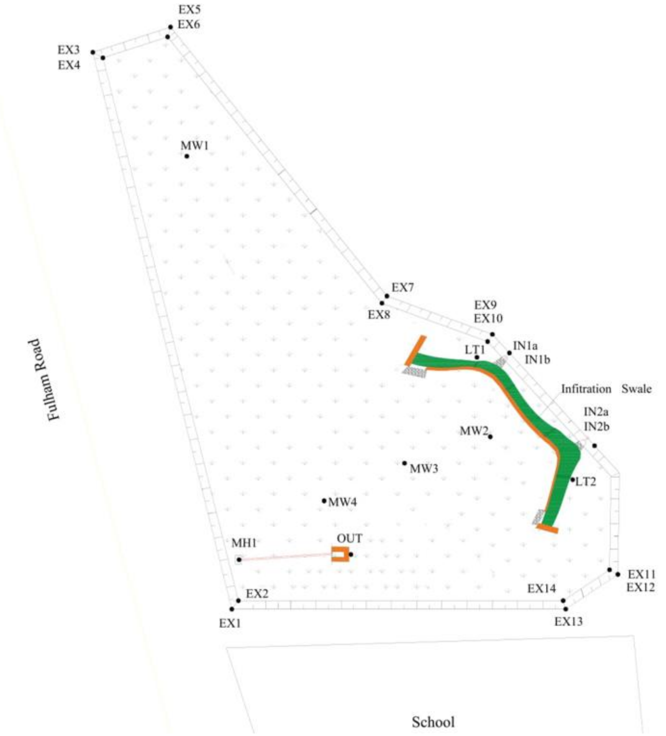
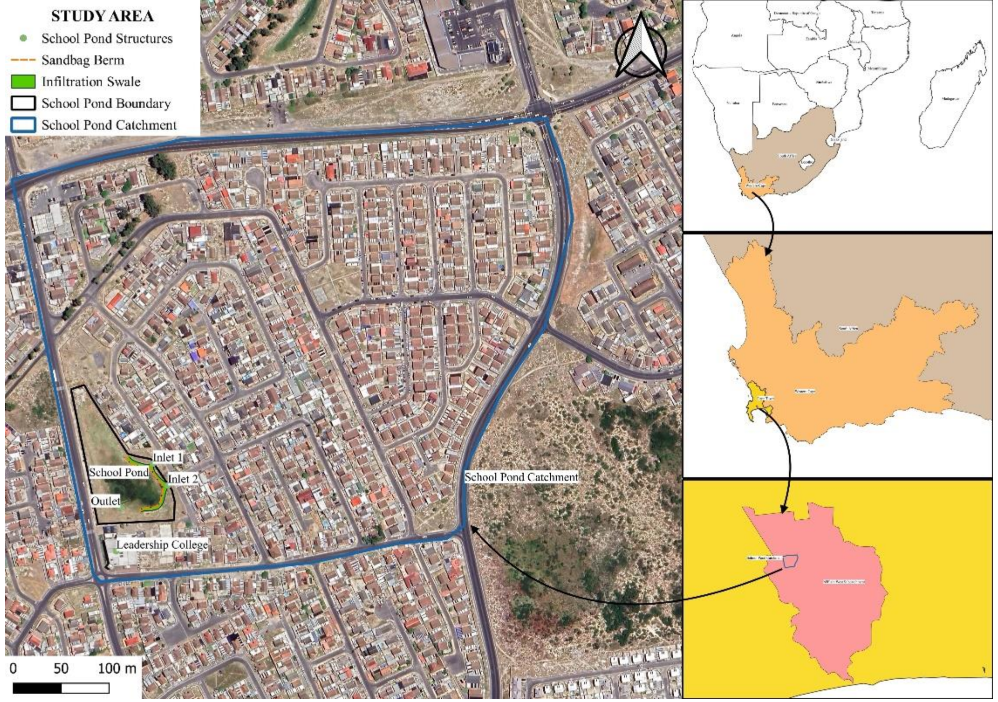
Urban MAR In Retrofitted Infiltration Basins – the experiment

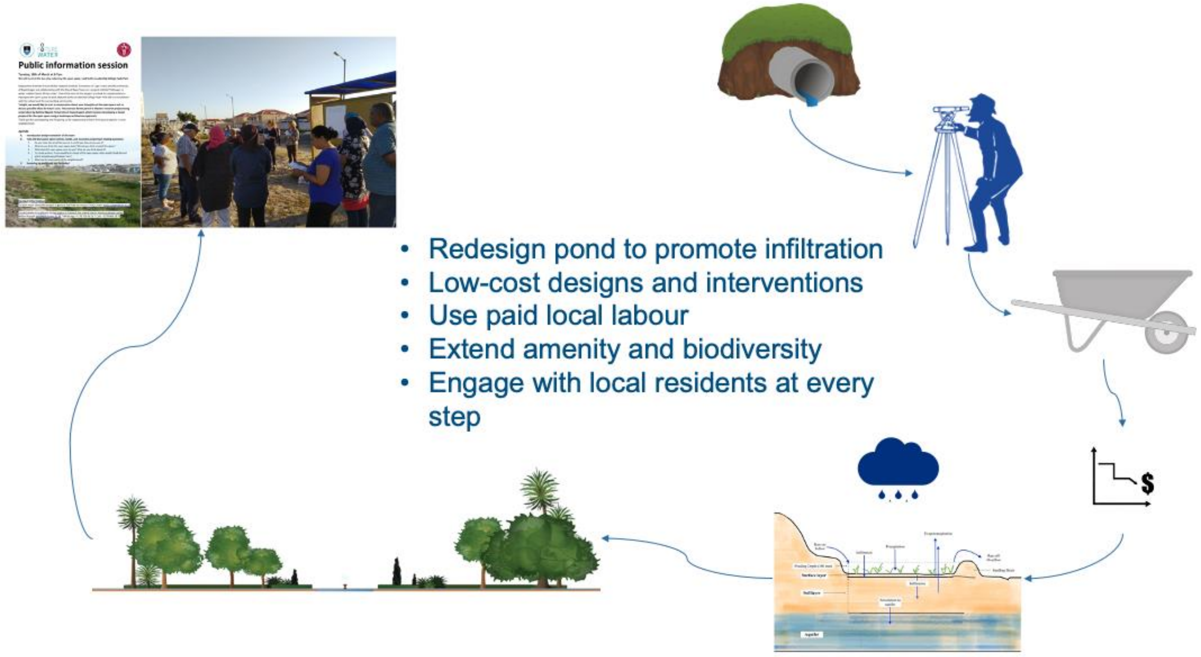




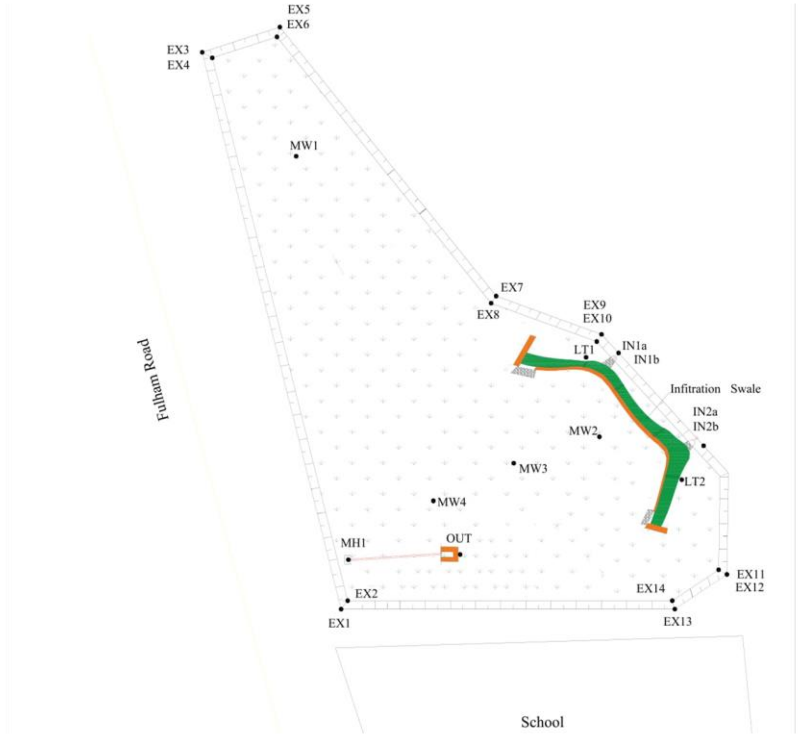
- Redesign pond to promote infiltration
- Low-cost designs and interventions
- Use paid local labour
- Extend amenity and biodiversity
- Engage with local residents at every step




STUDY AREA
School Pond Structures
Sandbag Berm
Infiltration Swale
School Pond Boundary
School Pond Catchment
Inlet 1
Inlet 2
School Pond
Outlet
Leadership College
School Pond Catchment
0 50 100 m


Public information session
Redesign pond to promote infiltration
Low-cost designs and interventions
Use paid local labour
Extend amenity and biodiversity
Engage with local residents at every step
$


The Leadership College - Hyde Park
The "School"
Inlet 1
Inlet 2
Outlet
Before


EX5
EX6
EX3
EX4
MW1
EX7
EX8
EX9
EX10
LT1
IN1a
IN1b
Infitration Swale
IN2a
IN2b
MW2
MW3
LT2
MW4
MH1
OUT
EX2
EX1
EX14
EX13
EX11
EX12
Fulham Road
School

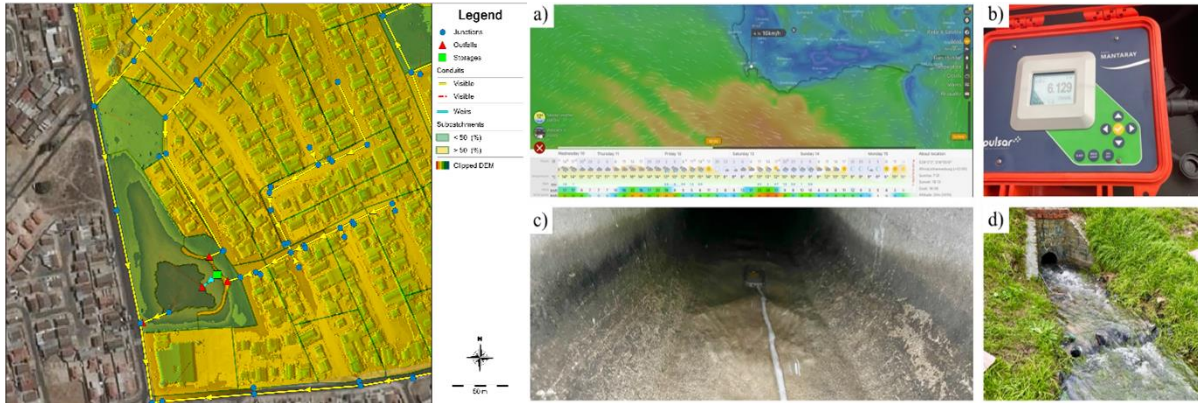




Total retrofit cost: ~ R300 000


Hydraulic Performance

The volume of water that can be harvested in the swale, was determined using a PCSWMM based hydraulic model.



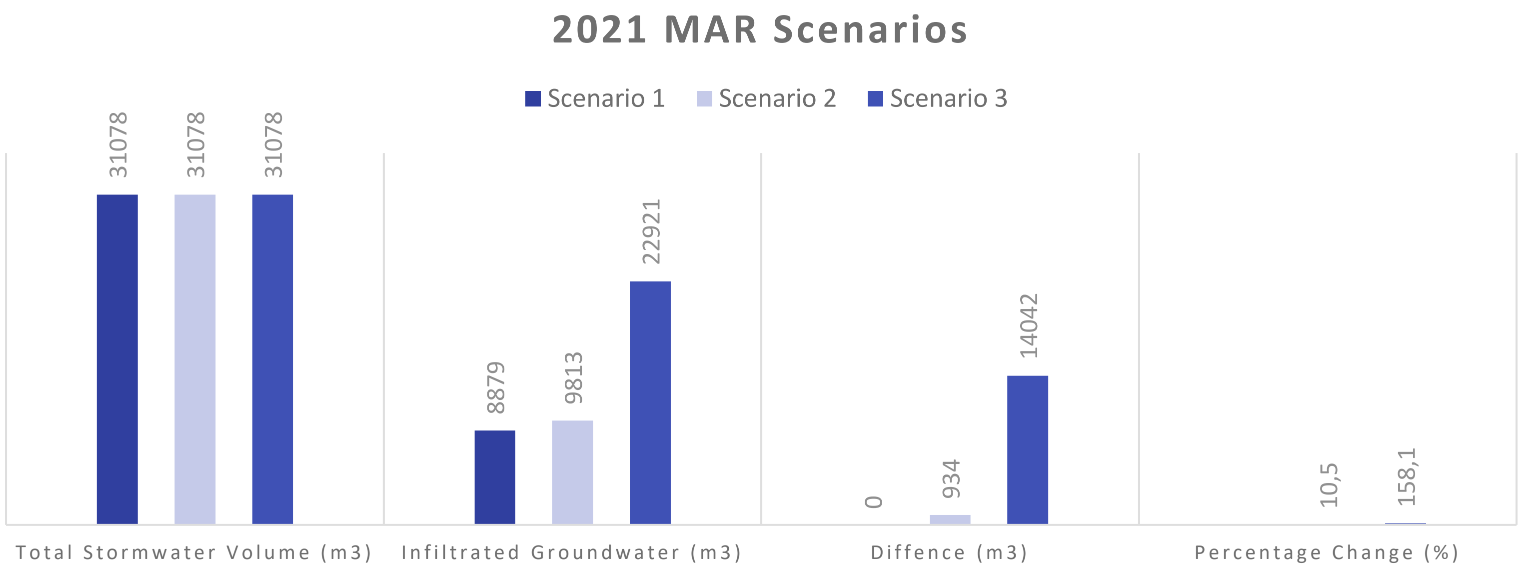
Treatment Performance

1. *Field monitoring* **-** Groundwater monitoring wells were installed across the site at various depths and monitored for 1 year.
2. **Column Experiments:** 6 PVC columns, 2 m tall, were packed with 1.5 m of soil and aquifer material from the site , while 2 were packed with silica sand .

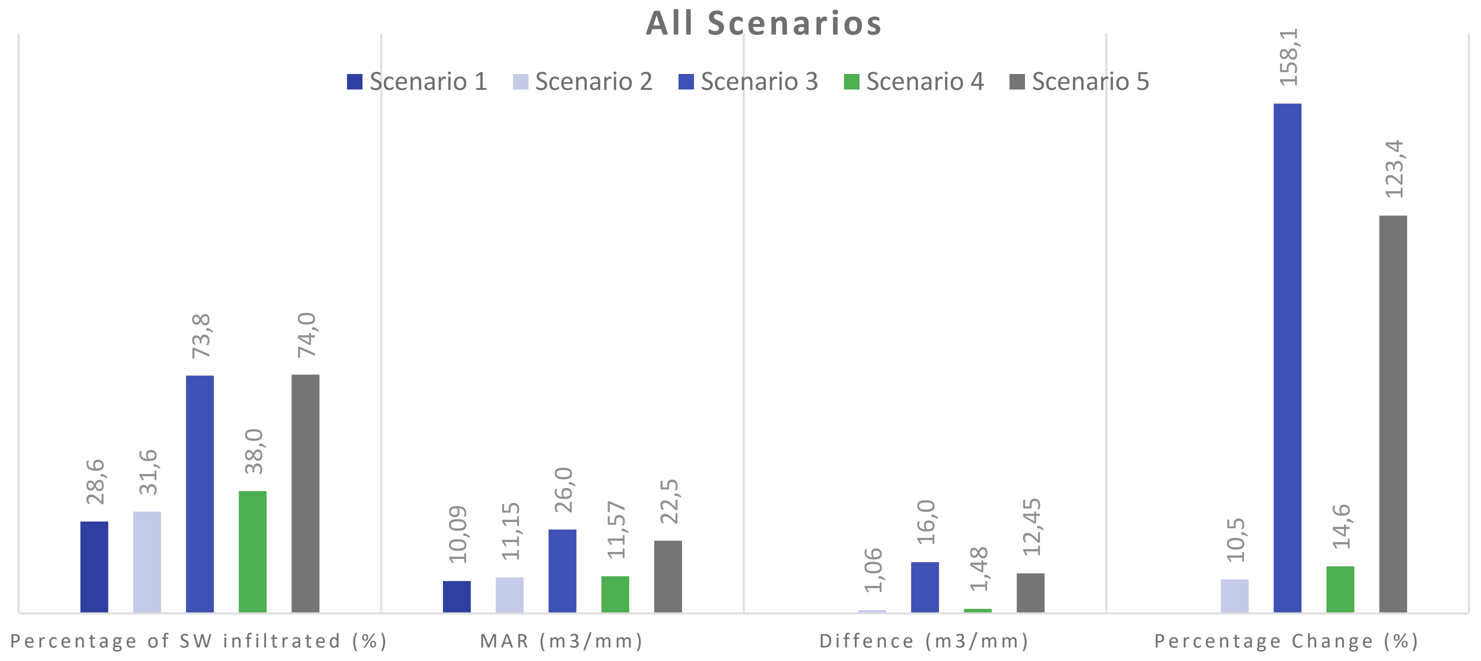
Hydraulic Performance

Scenarios

1) The pre-retrofit volume of infiltrated stormwater (2021 data).
2) The post-retrofit volume of infiltrated stormwater (2021 data).
3) Same as 2 but considering the effect of the CoCT's GW abstraction with MAR on the Cape Flats Aquifer (CFA).
4) Mean annual post retrofit infiltration volume using continuous long-term rainfall data (2005-2022).
5) Same as 4 but considering the effect of groundwater abstraction.



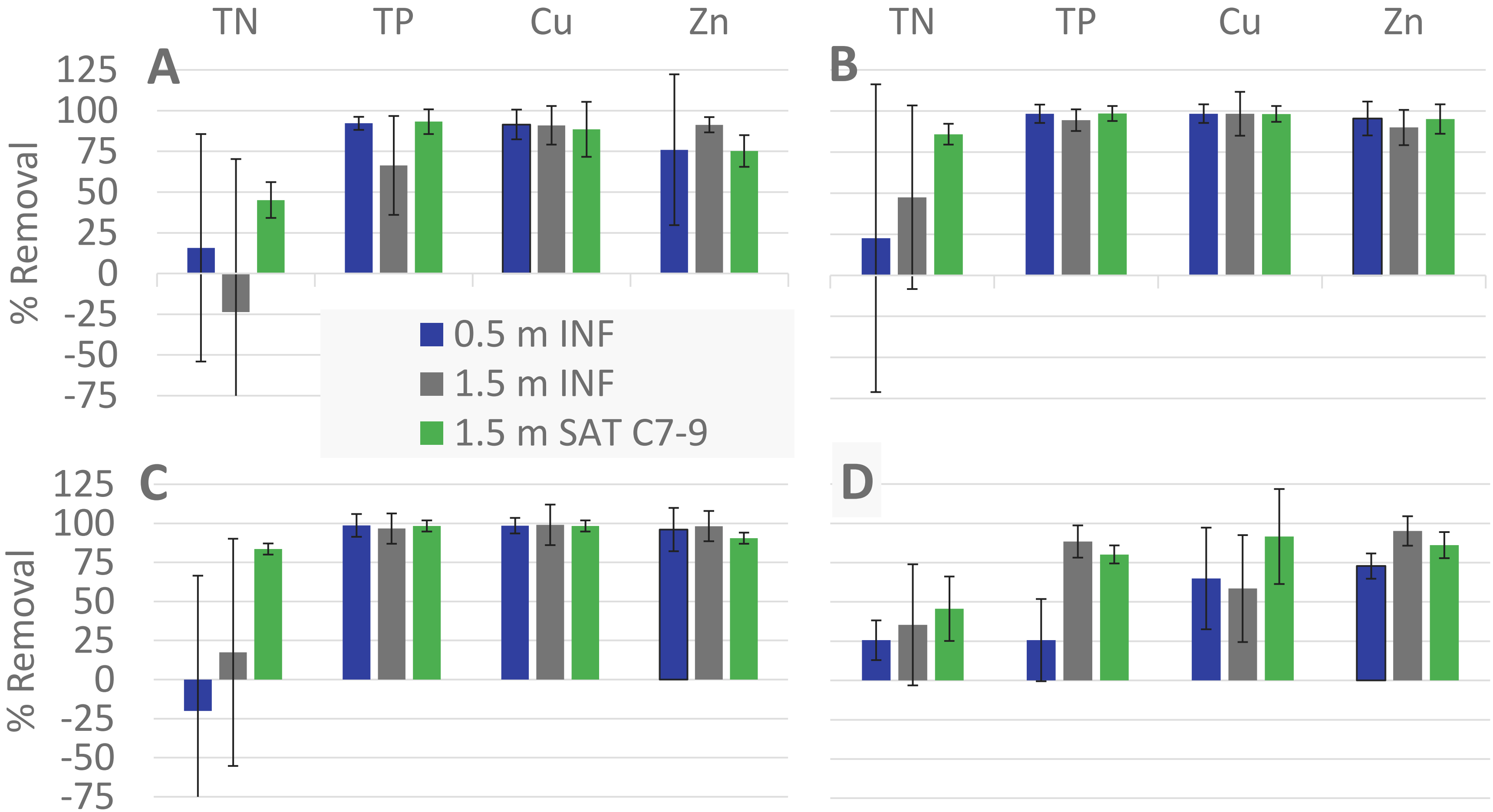
Site has high water table (2 m below ground level) therefore MAR is limited but the retrofit increases annual MAR by 14.6%. MAR significantly increases by 123% if the CoCT abstracts GW in the aquifer.



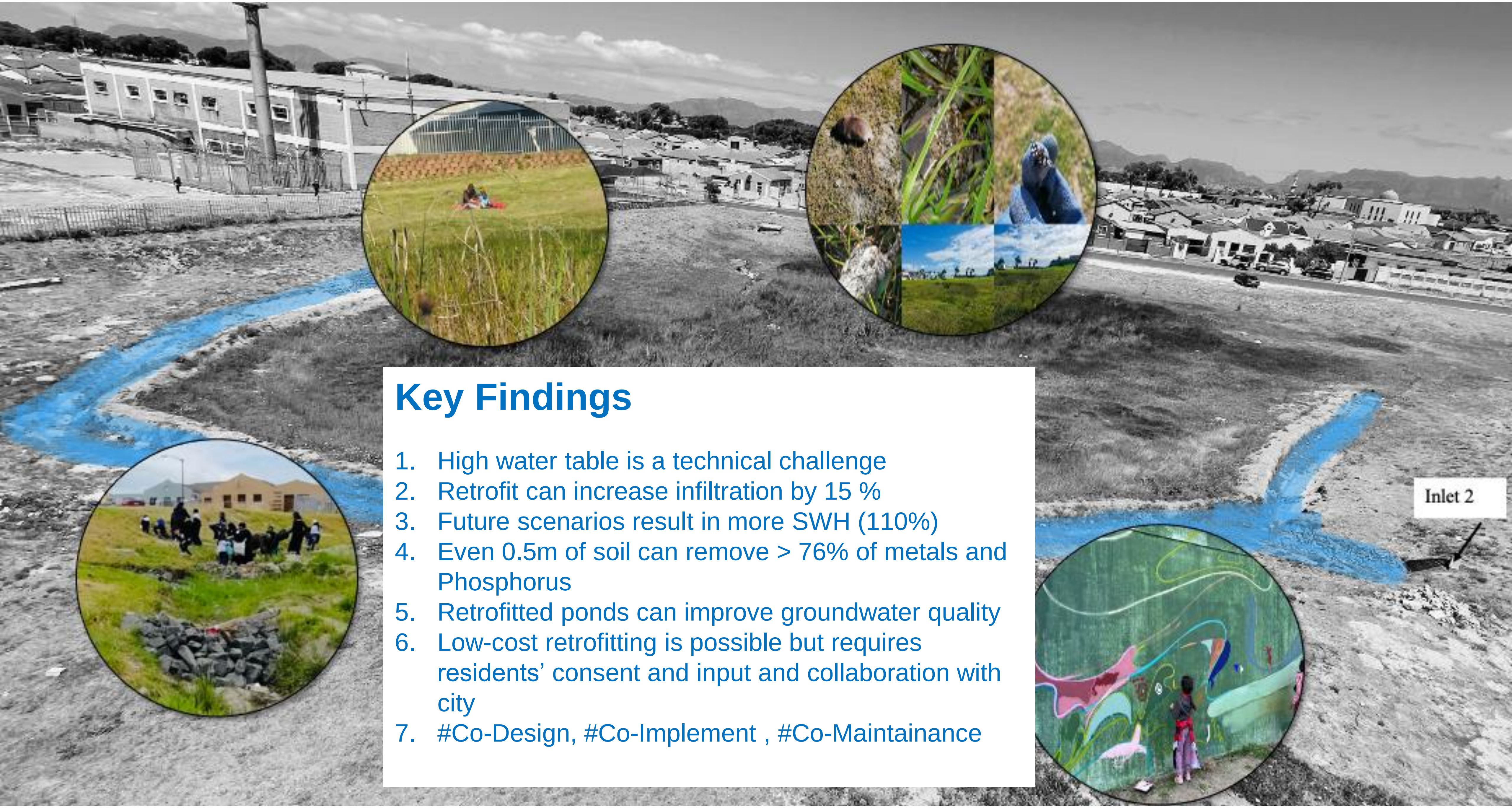
Treatment Performance

Field results: Background groundwater had elevated nitrate concentrations and denitrification was observed below the pond.

Laboratory columns: Metals and P were sufficiently removed in the top 0.5 m and removal of N in the saturated zone did not require input of organic carbon in the SSW.



Column results (above) - Percentage removal for selected contaminants in column experiments: A) Soil media, SSW based on formal residential catchment stormwater concentrations; B) Soil media, SSW 5X those in A; C) Soil media, SSW 5X those in A but no organic carbon; D) Sand media, SSW 5 X those in A. TN=total nitrogen; TP=total phosphorous



Key Findings

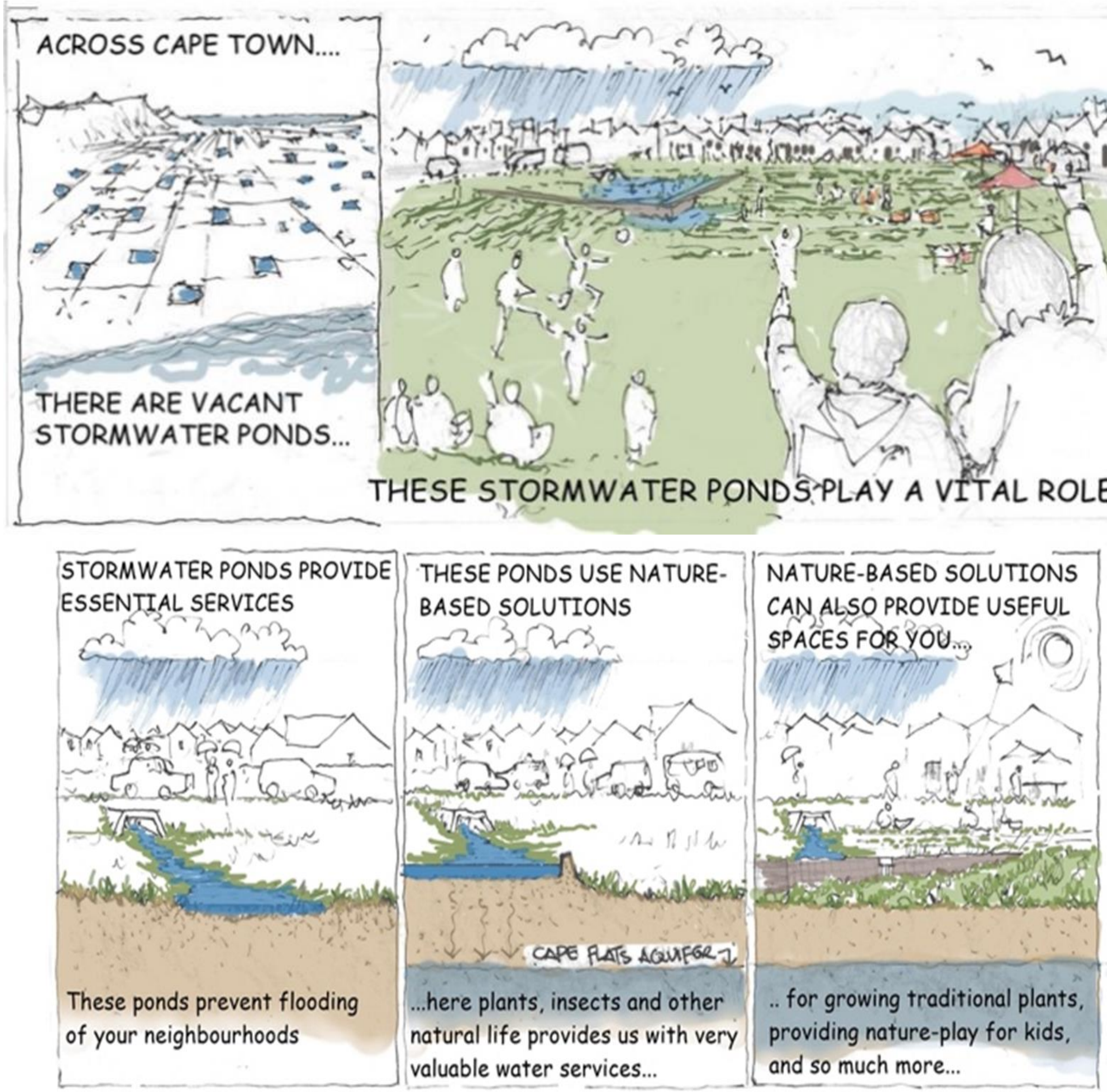
1. High water table is a technical challenge
2. Retrofit can increase infiltration by 15 %
3. Future scenarios result in more SWH (110%)
4. Even 0.5m of soil can remove > 76% of metals and Phosphorus
5. Retrofitted ponds can improve groundwater quality
6. Low-cost retrofitting is possible but requires residents’ consent and input and collaboration with city
7. #Co-Design, #Co-Implement , #Co-Maintainance

Why working with local communities

The city has limited resources – for implementation and maintenance

Ponds and green spaces prone to invasion – informal settlers

But city development characterised by past and present power struggles – so not straightforward



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So how to do it? Also deep engagement

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Public information session

Tuesday, 10th of March at 6-7pm

We will meet at the bus-stop adjoining the open space, next to the Leadership College Hyde Park

Researchers from the Future Water research institute (University of Cape Town) and the University of Copenhagen are collaborating with the City of Cape Town on a project entitled 'Pathways to water resilient South African cities'. One of the aims of this project is to look for opportunities to repurpose the open space located adjacent to the Leadership College Hyde Park site in consultation with the school and the surrounding community.

Tonight, we would like to start a conversation about your thoughts on the open space and to discuss possible ideas for future uses. This exercise forms part of a Masters research project being undertaken by Bettina Käppeli (University of Copenhagen) which involves developing a design proposal for the open space using a landscape architecture approach.

Thank you for participating and for giving us the opportunity to learn from you as experts in your neighborhood.

Agenda

A. Introduction and presentation of the team
B. Talk and discussion about wishes, needs, and issues by answering 5 leading questions
   1. Do you know this area? Do you use it, and if yes, how do you use it?
   2. What do you think this open space does? Who do you think created this space?
   3. What does this open space mean to you? What do you think about it?
   4. To create a vision; if you would be in charge of this open space, what would it look like and which activities would happen here?
   5. What are the main needs of the neighborhood?
C. Summing up and thank you for today!

Contact information

To learn more about the project in general feel free to contact Kirsty Carden kirsty.carden@uct.ac.za

To participate or to discuss further topics in frame of the master thesis research please contact Bettina Käppeli

Local community pushing for deeper involvement – taking part in construction - for livelihoods

The participants got a feeling of ownership but also ecological literacy

I saw the leopard toad and butterflies and learned about all the different species here. Frogs are singing day and night (Cayman)

So how to generate stewardship?

Water resilience also has to look the part!

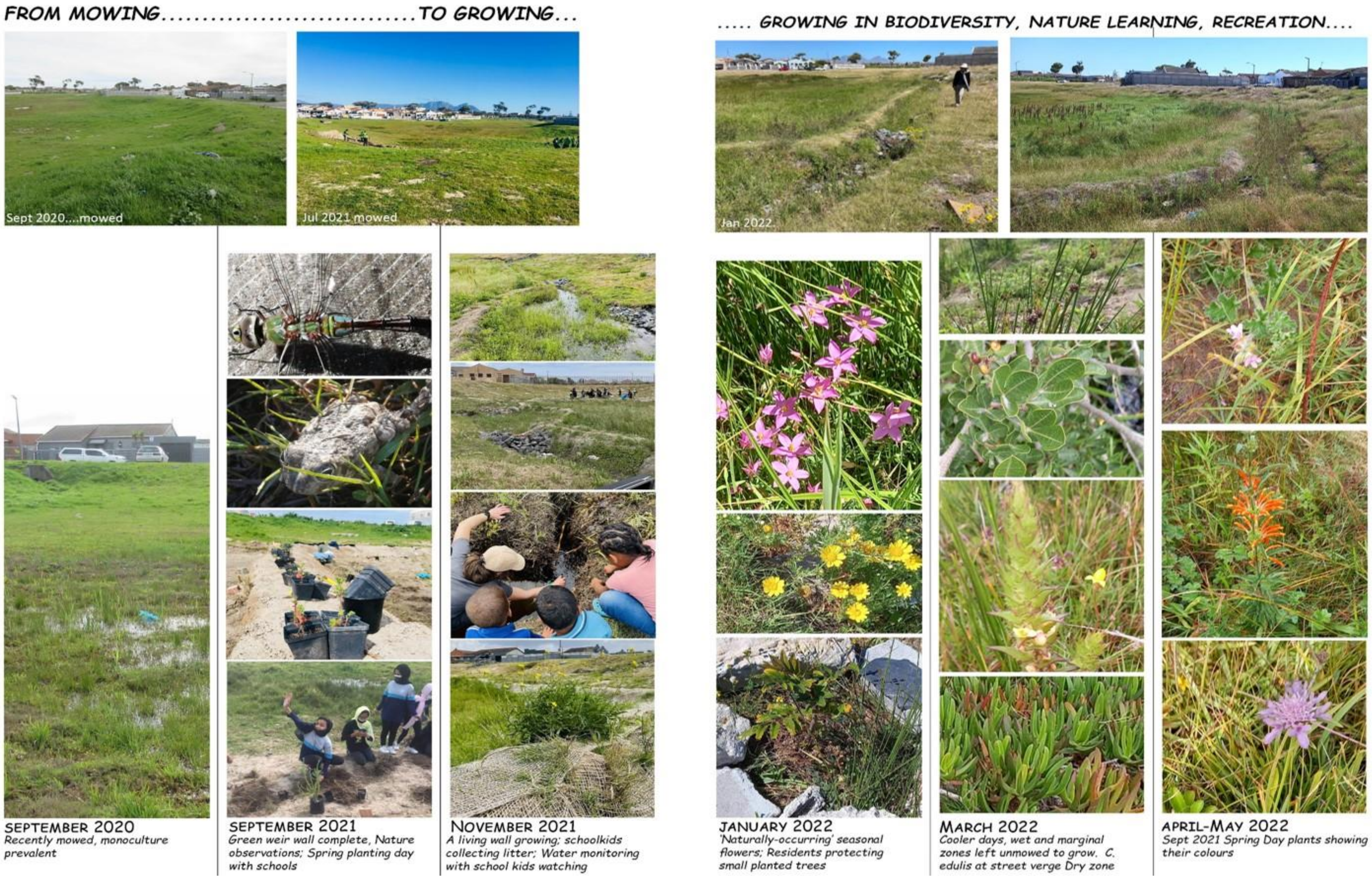
The community can see that the pond is more green

The community can hear the place – the frogs are singing

The mural as a place making device

Giving the landscape center stage

Through multiple engagements, realising that the pond is an actor



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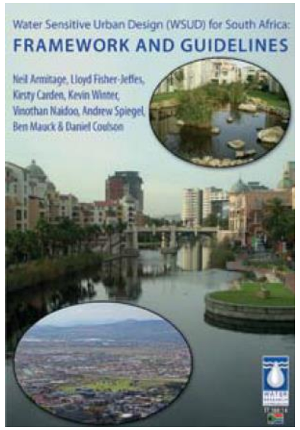
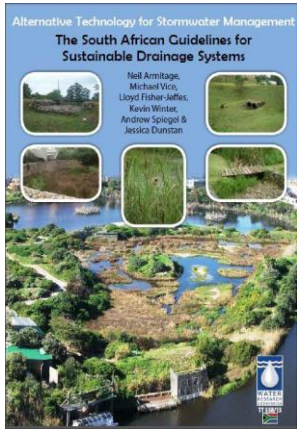
The proposed planting and signage area for the site

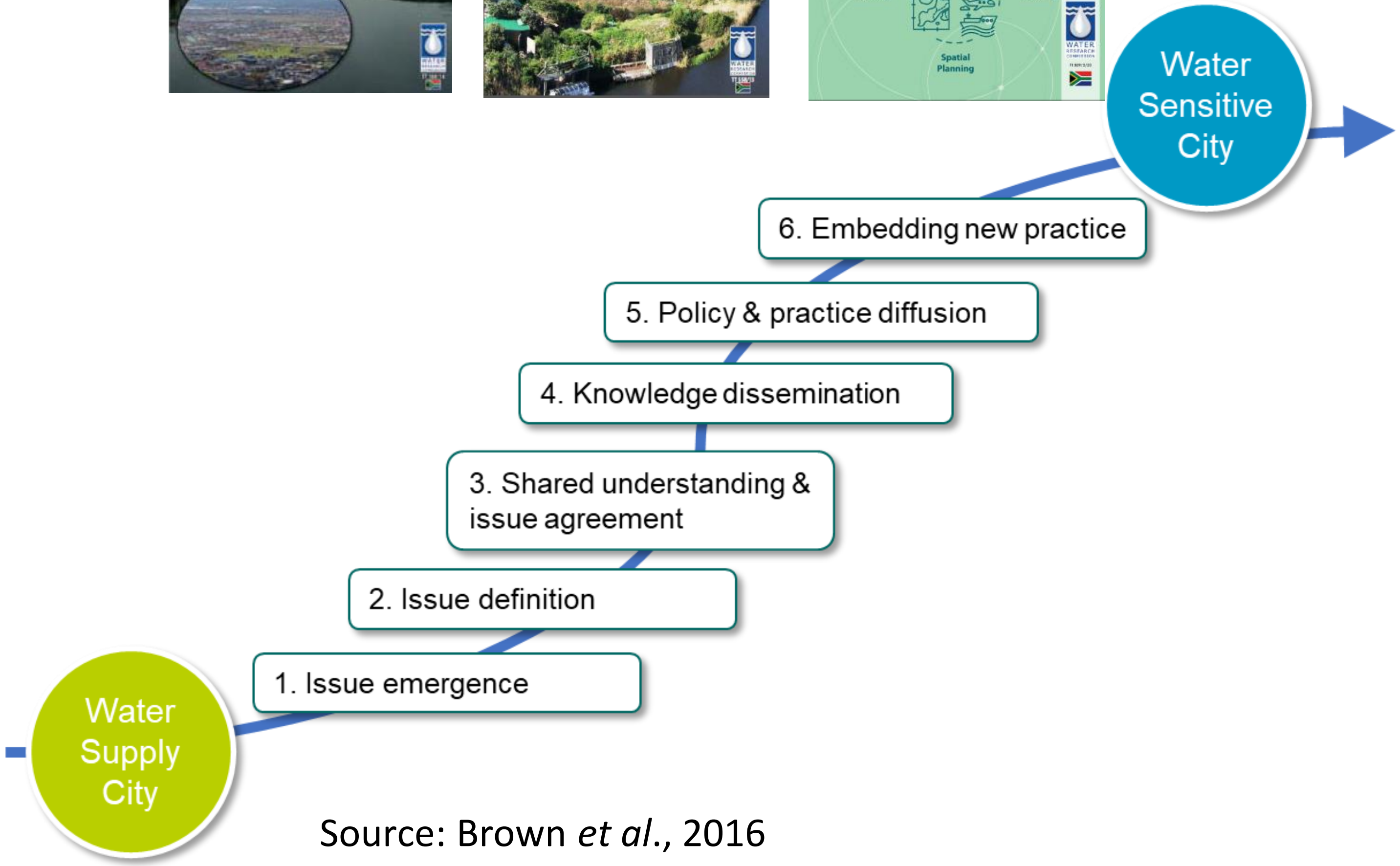
Is there an enabling environment?
- For water resilience and repurposing of ponds?

Grounding WSD/WSC concept in SA

- Incorporation into policy
- Consolidation of knowledge
- Identification and support for champions to drive this space
- Creation of knowledge and data sharing platforms
- Demonstration projects at scale
- Learning alliances







Source: Brown *et al.*, 2016

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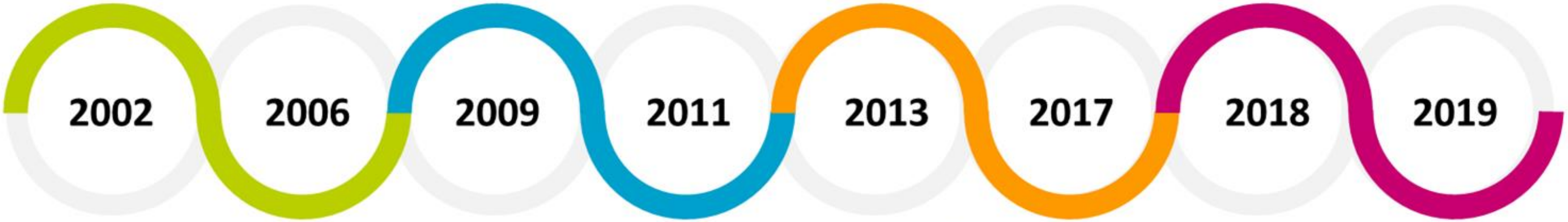
Policy landscape – barriers and enablers



2002
- City of Cape Town Catchment, Stormwater and River Management Strategy 2002-2007

2006
- Cape Town Energy and Climate Change Strategy

2009
- Floodplain and River Corridor Management Policy*
- City Cape Town Management of Urban Stormwater Impacts Policy*

2011
- Cape Town's Action Plan for Energy and Climate Change

2013
- City of Cape Town Urban Design Policy*

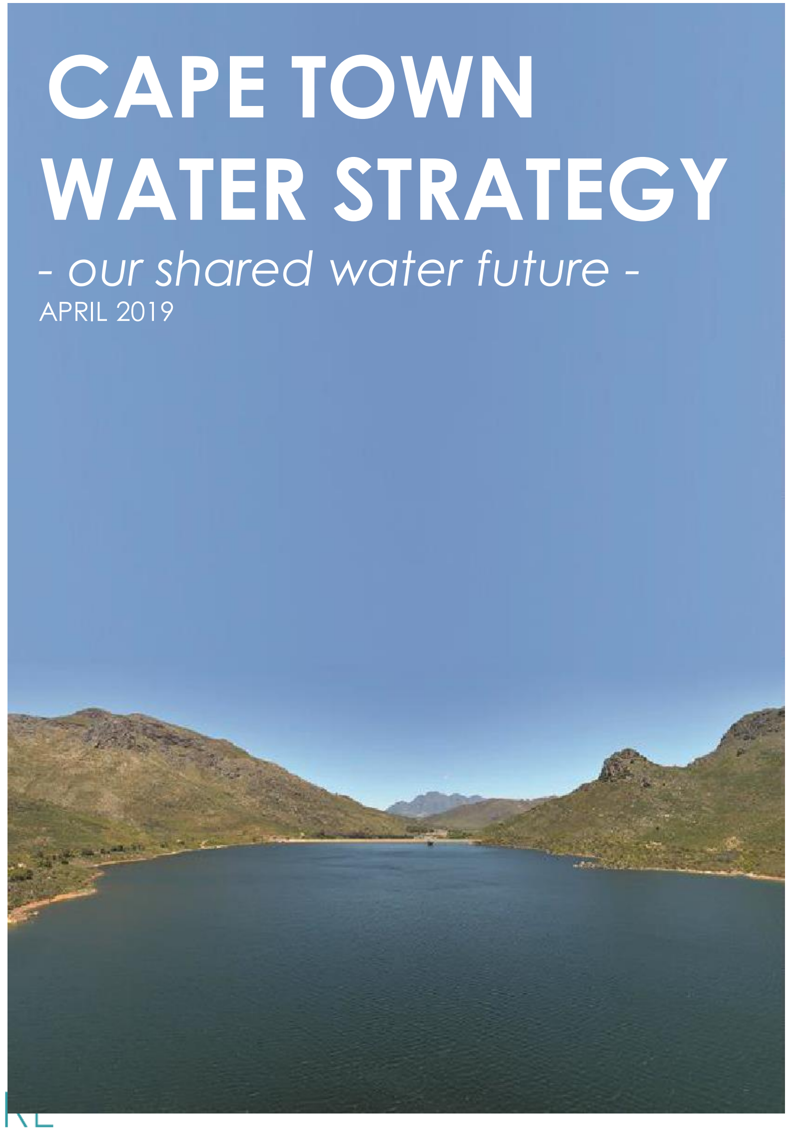
2017
- City of Cape Town Climate Change Policy*
- Environmental Strategy for the City of Cape Town*
- Western Cape Sustainable Water Management Plan 2017-2022*
- Water Services Development Plan - IDP Water Sector Input Report 2017/18-2021/22*
- Five-year IDP 07/2017-06/2022
- Municipal Spatial Development Framework 2017-2022*

2018
- National Water and Sanitation Master Plan*

2019
- Cape Town Water Strategy*
- Cape Town Resilience Strategy*

*References 'Water Sensitive'

Water resilience embedded in policy



Commitment 5: A Water Sensitive City

*The City will actively facilitate the transition of Cape Town over time into a **water sensitive city** with **diverse water resources**, diversified infrastructure and one that makes **optimal use of stormwater** and urban waterways for the purposes of flood control, aquifer recharge, water reuse and recreation, and that is based on sound ecological principles This will be done through new **incentives and regulatory mechanisms** as well as through the way the City makes **investments in new infrastructure**.*

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Enabling governance for water resilience?

- Integrated water management approach needed with practical/actionable roadmap for operationalising WSD; Coordination and network building; WSD not only a stormwater function
- Water and sanitation deficits remain a priority – context-specific understanding of WSD required – OUR EXPERIMENT
- WSD-specific skills and proof of concept case studies – increased confidence
- Multi-functionality of WSD evidenced by water quality improvements, amenity and environmental protection benefits
- Guidance on practical implementation – asset management and maintenance

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Thank you for your attendance

Questions and discussion