Application and Implementation of Green Infrastructure in Parks.

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The **Green Infrastructure (GI)** is based on the understanding that **land is a crucial component of the built environment** and can be planned, **designed**, developed, and maintained to **avoid, mitigate, and even reverse detrimental impacts**.

- SA’s biggest crisis is the **scarcity of water**.
- **Increased population density** more flexible infrastructure is needed.
- Can not afford **efficient water runoff:**

“Shortest distance to big pipe straight to the river”

- Need to focus on improvement of **water quality**
- Reduce run off **velocity** and allow **filtering.**
- **Detention dams** are no longer the only mitigation measure
- **Stormwater treated as a resource – not waste**

Environmental Approach

Manage precipitation on site

Intent

Reduce negative impacts to aquatic ecosystems, channel morphology by **replicating natural hydrologic** conditions and retaining precipitation on site.

Re-integrate water into an ecological system

Intent

Conserve water resources and develop **strategies to integrate** water movement through the landscape in a **more ecological way**.

More **natural surface water and groundwater utilization**.

Manage precipitation beyond baseline

Intent

Maintain site water balance, **protect water quality**, and reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by **replicating natural hydrologic conditions**.

Providing **retention and treatment for precipitation on site**.

Restore aquatic ecosystems

Intent

Support healthy functioning of aquatic ecosystems for fish, other wildlife, and people

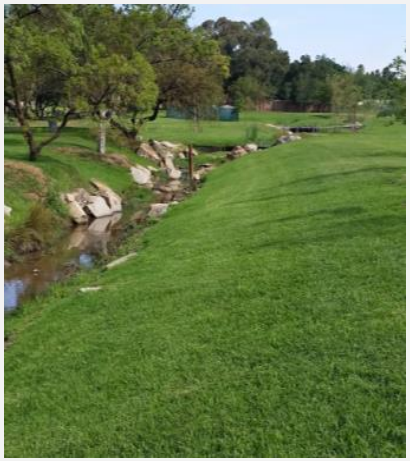
by **allowing ecological function**, integrity, and resiliency of those ecosystems that have been degraded, damaged, or destroyed.

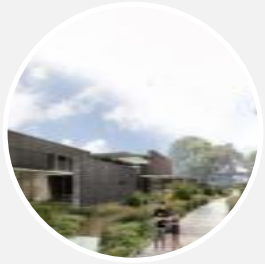
Design functional stormwater features as amenities

Intent

Provide a connection to the local climate and hydrology by **integrating aesthetically pleasing stormwater features** that are visually and physically accessible and **manage on-site stormwater.**

GI	Green Infrastructure
SUDS	Sustainable Urban Drainage Systems
BMPs	Best Management Practices
WSUD	Water Sensitive Urban Design
LIDS	Low Impact Drainage Systems
SQIDs	Storm water Quality Improvement Devices
RG	Rain Gardens

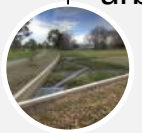




Productive Landscape for Humans

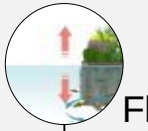
- Transportation network
- Green Infrastructure
- Identity. knowledge & understanding
- Urban agriculture
- Spatial and community cohesion
- Recreation and public space

Water Management



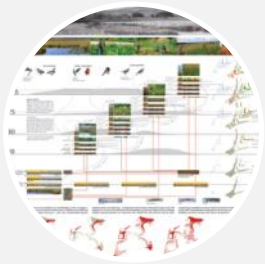
Water sensitive urban design

- Green belt
- Rain garden
- Porous pavements
- Riparian zone filter



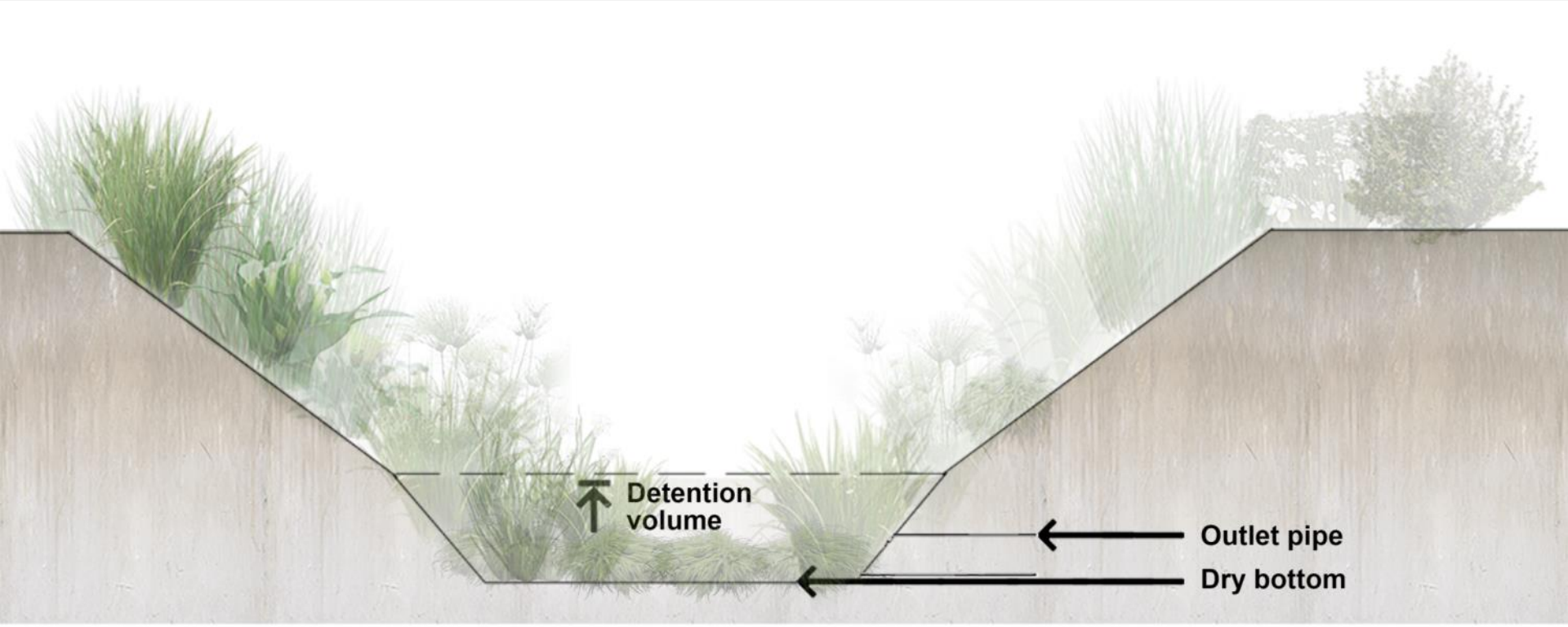
Flood water management

- SUDS
- Stream management
- Detention ponds
- Water harvesting



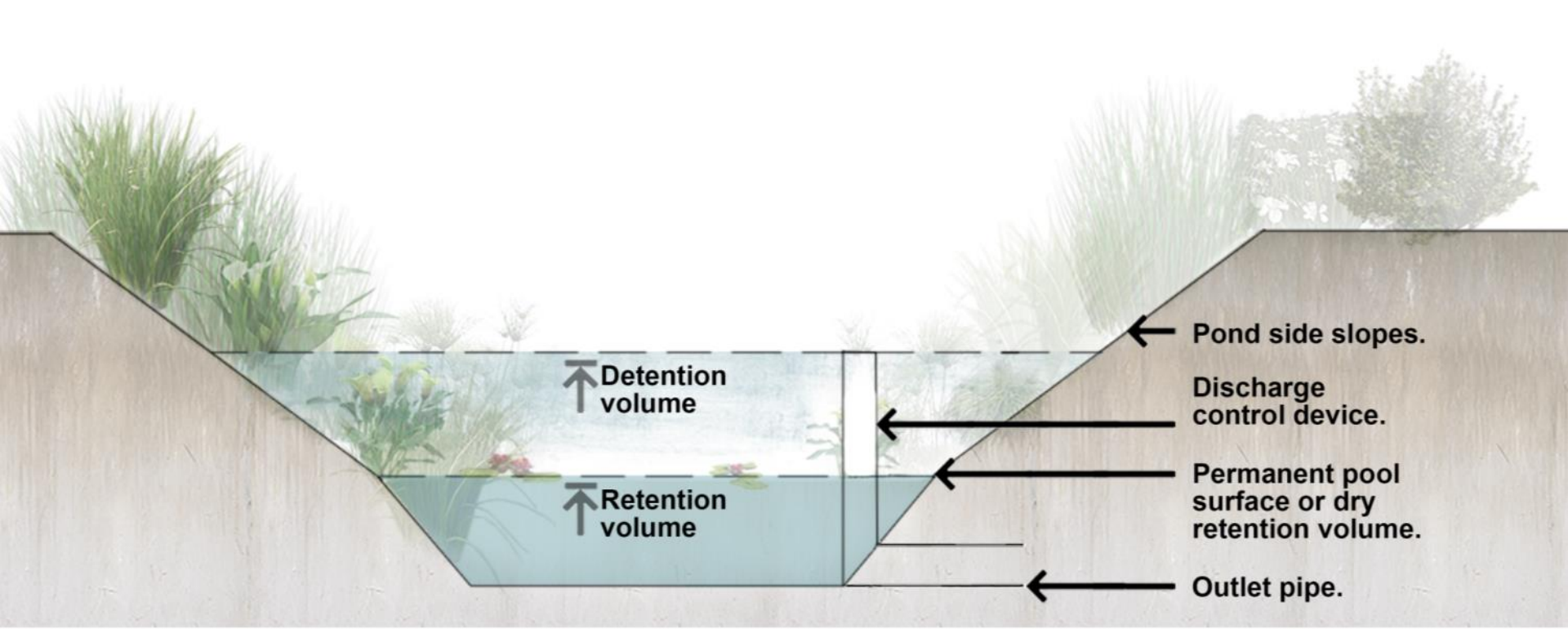
Ecological Biodiversity

- Constructed wetland
- Ecological corridor
- Habitat creation
- Enhancing natural habitat



Detention Ponds

- Increasingly stormwater ponds have systems of retention and detention.



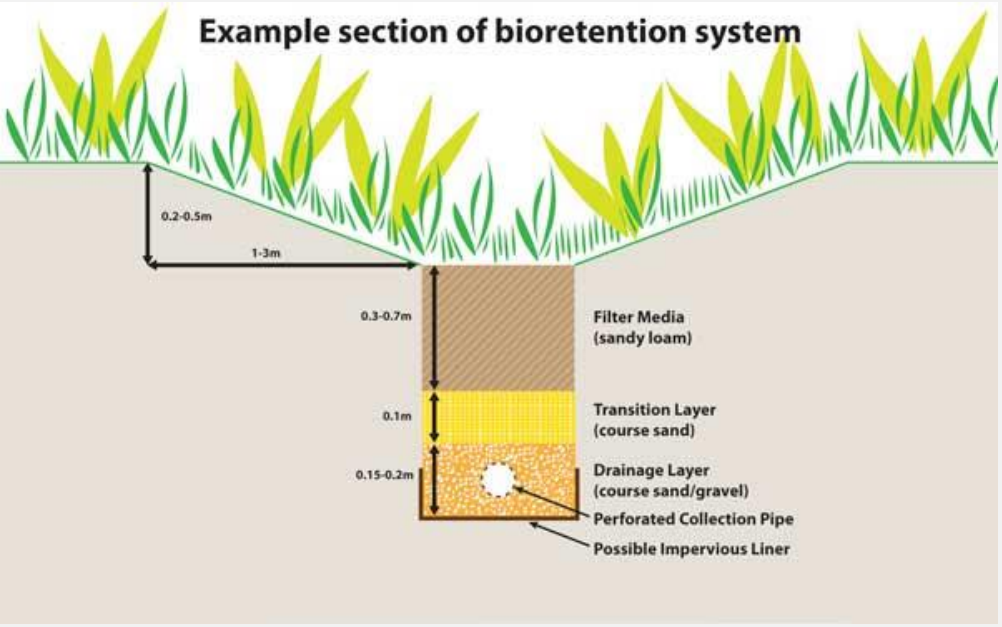
Retention Ponds

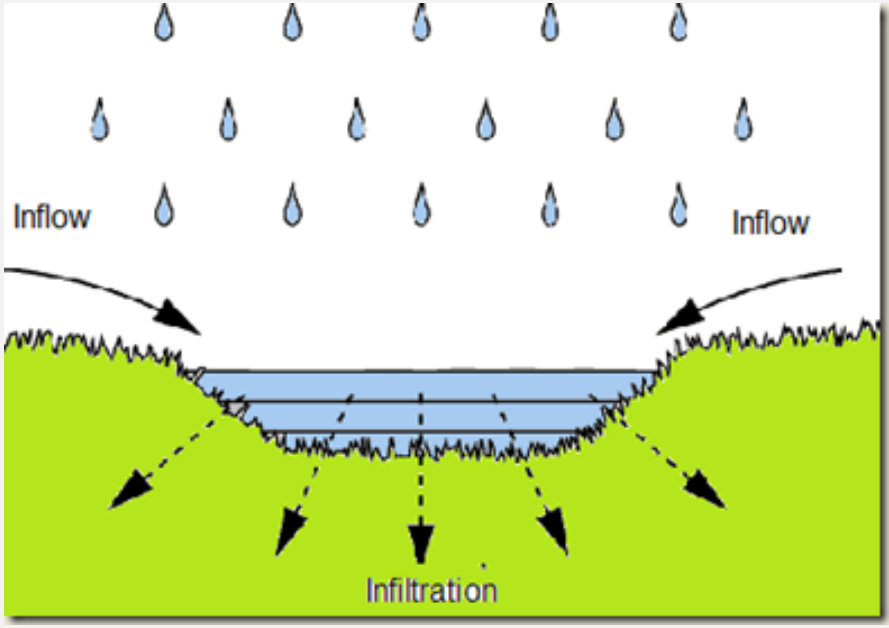
- Is an element in the landscape designed to remove silt and pollution from the runoff water before storing it in a system or releasing it in to the groundwater table.

Bioswales

- **Infiltration** is the process of which surface water enters the soil.

- **Filtration** is any operation that separated solids form fluids by passing through a medium that only the fluid can pass through.

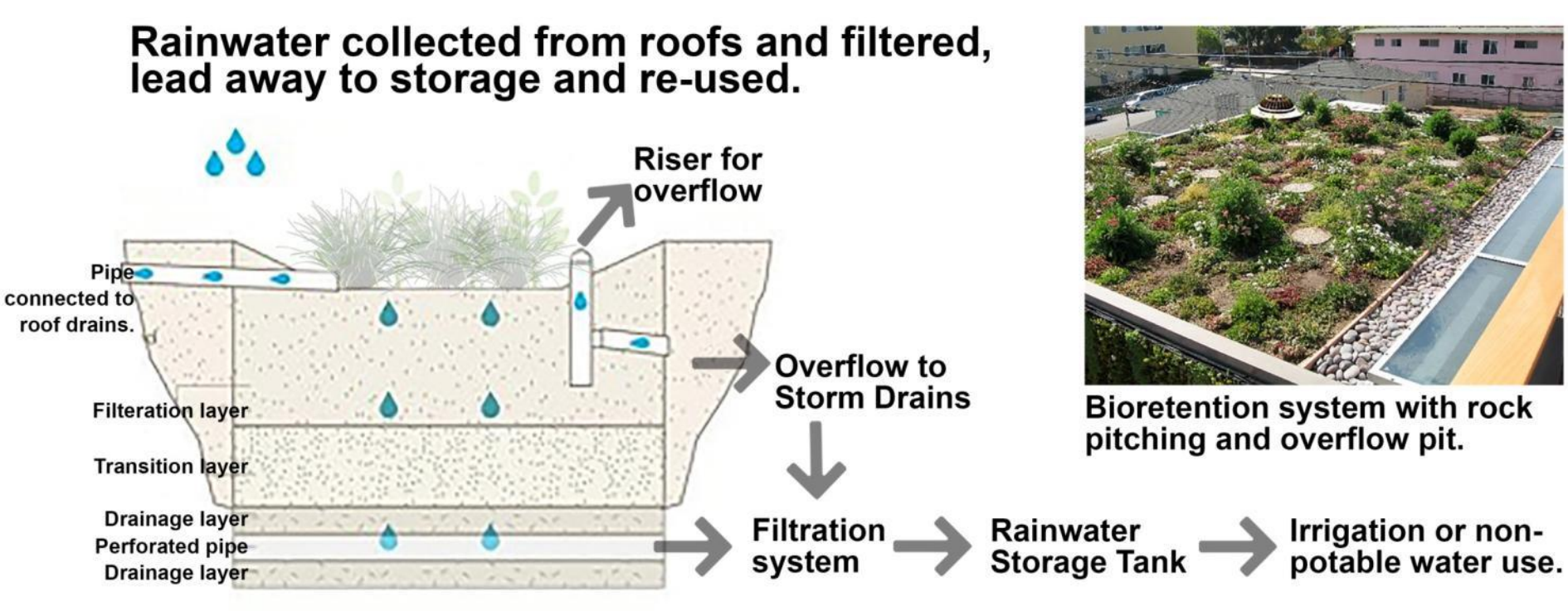




River Sands. 2010. *Bioretention Systems*. [ONLINE] Available at: http://www.riversands.com.au/bioretention-system.php/ [Accessed 25 July 2017].
Online Civil Engineering. 2012. *Estimation of Infiltration.* [ONLINE] Available at: http://civil-online2010.blogspot.co.za/2012/09/estimation-of-infiltration.html/ [Accessed 25 July 2017].

Infiltration vs Filtration

- **Rainwater Harvesting** is collection of rainwater from hard surfaces. Water is filtrated by plants and soil before it is then stored in reservoirs or tanks.



Rainwater harvesting

- Defined as **engineered wetlands** that utilize natural processes involving oxygen, wetland vegetation, soils and their associated microbial organisms to assist in treating an run-off and storm water.

G-Soil. 2012. *Can field wetlands trap eroding agricultural soil?*. [ONLINE] Available at: https://gsoil.wordpress.com/2012/10/08/can-field-wetlands-trap-eroding-agricultural-soil/ [Accessed 25 July 2017].

Constructed Wetlands

The area after replanting. Although some of the plants were dislodged, they established in other areas.

The area after rehabilitation was complete. None of the engineering is visible and the *T. capensis* is providing a variety of functions.

Rehabilitation – Planting Requirements

- Growth season of the wetland.

Plant selection

ZOLA WETLANDS

ZOLA WETLANDS – filter zone

ZOLA WETLANDS – erosion protection

ZOLA WETLANDS – Add of planting

ZOLA WETLANDS – Planted swale

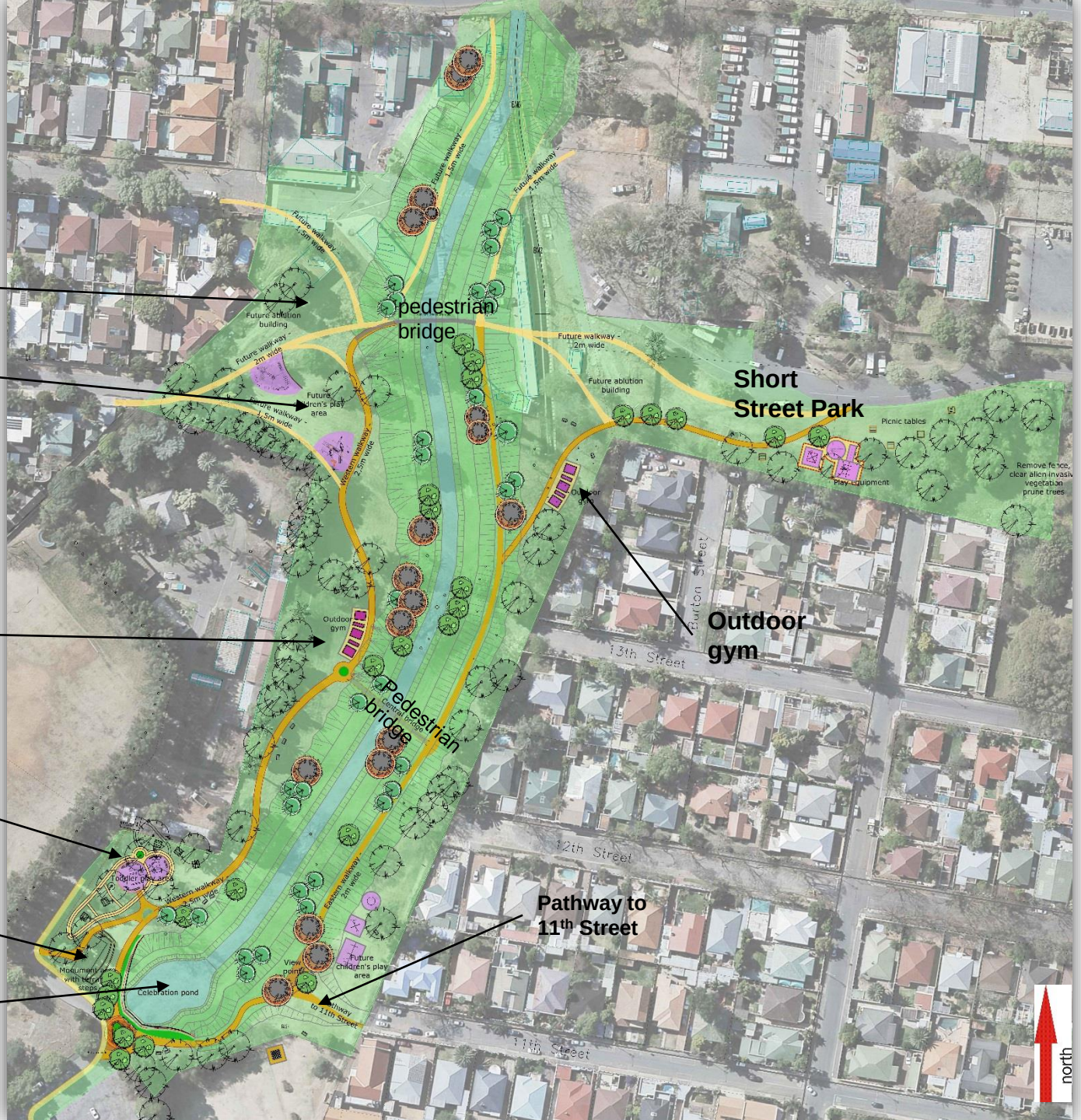
ZOLA WETLANDS - Rehabilitated swale

ZOLA WETLANDS – Swale maintenance

The site

PATERSON PARK

master plan

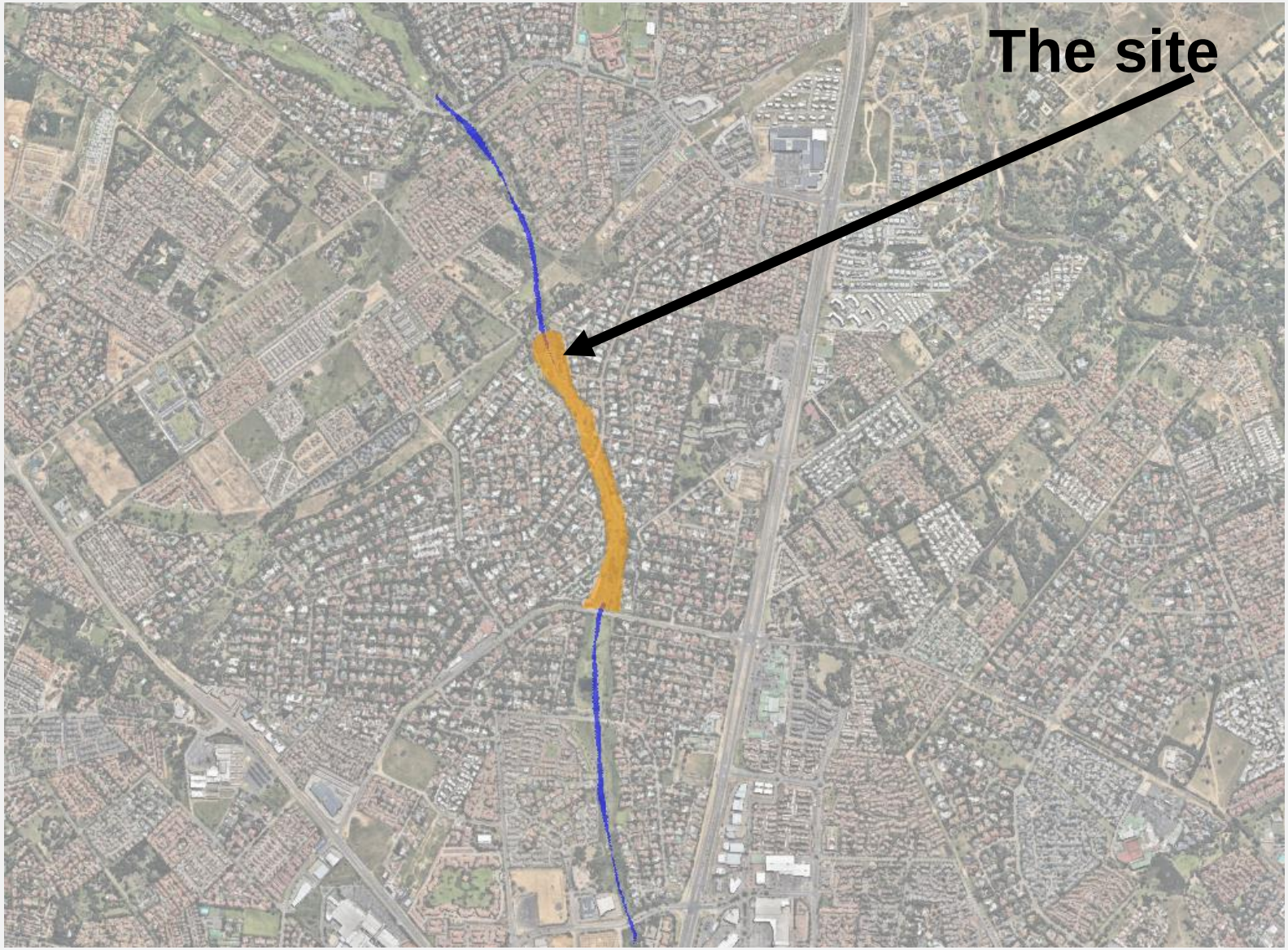

Future ablution building
Future children's Play area
Outdoor gym
Toddler play area
Monument area
Celebration pond
pedestrian bridge
Short Street Park
Outdoor gym
Pedestrian bridge
Pathway to 11th Street
Future walkway - 1.5m wide
Future walkway - 2m wide
Future ablution building
Future children's play area
Western walkway - 2.5m wide
Eastern walkway - 2m wide
Central bridge
Picnic tables
Play Equipment
Remove fence, clear alien invasive vegetation prune trees
Burton Street
13th Street
12th Street
11th Street
Toddler play area
Monument with heritage stones
Celebration pond
View point
Future children's play area
Pathway to 11th Street
north

PATERSON PARK

PATERSON PARK

PATERSON PARK

PATERSON PARK



FOURWAYS GARDENS STREAM

If streams are not maintained and left to erode during each storm

FOURWAYS GARDENS STREAM – before

FOURWAYS GARDENS STREAM

FOURWAYS GARDENS STREAM – construction

Single weir example.

FOURWAYS GARDENS STREAM – completion

Stepped weir example

FOURWAYS GARDENS STREAM

Embankment with & without rip-rap.

FOURWAYS GARDENS STREAM – completion

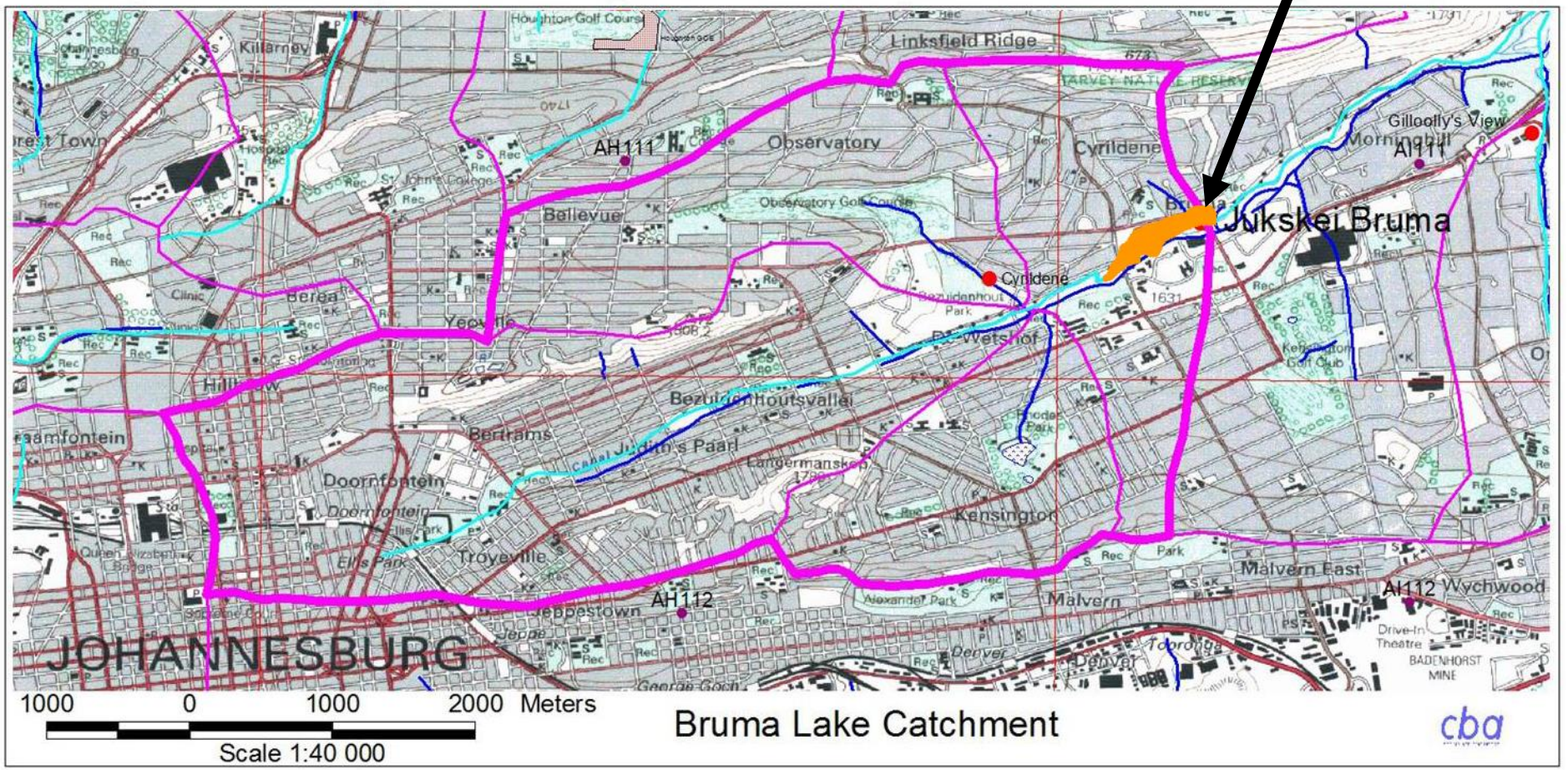
FOURWAYS GARDENS STREAM – completion

Stream in flood, flash flood control successful.

FOURWAYS GARDENS STREAM – completion

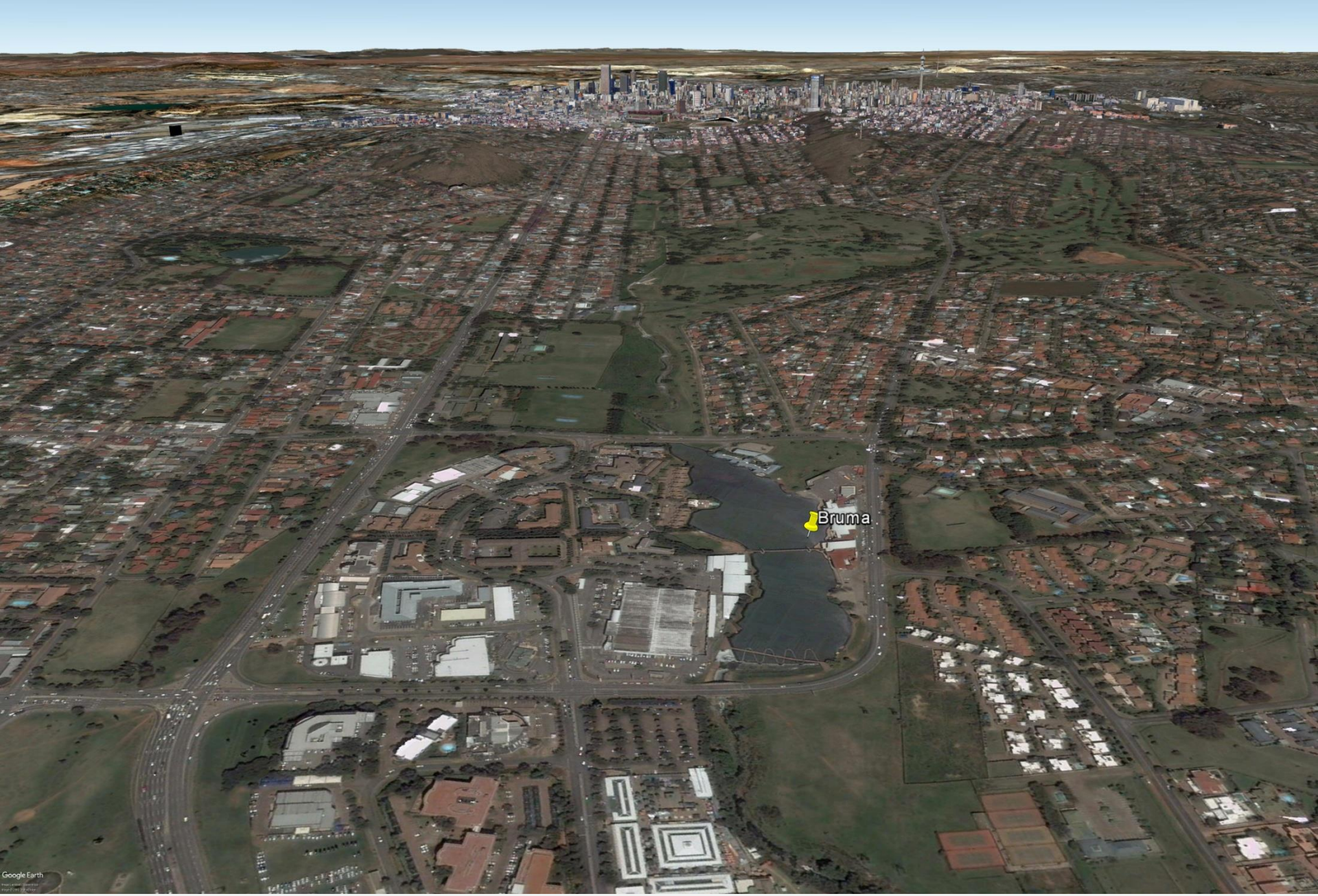
Stream after flood, flash flood control successful.

FOURWAYS GARDENS STREAM – completion


The site
Linksfield Ridge
Observatory
AH111
Cyrildene
Gilloolly's View
AH111
Bellevue
Bruma
Berea
Yeoville
Bezuidenhout Park
Wetshof
Houtsvallei
Bertrams
Judith's Paarl
Doornfontein
Troyeville
Kensington
Malvern East
AH112 Wychwood
AH112
Malvern
Jeppestown
JOHANNESBURG
Denver
1000 0 1000 2000 Meters
Scale 1:40 000
Bruma Lake Catchment
cba

BRUMA LAKE

BRUMA LAKE – original



BRUMA LAKE – before

BRUMA LAKE – completion

BRUMA LAKE – construction

BRUMA LAKE

BRUMA LAKE – construction of wetland

BRUMA LAKE – water quality after intervention

BRUMA LAKE – added recreation value

- **Water purification.**
- Green Infrastructure create natural sponge for the water, storing and slowly releasing the water.
- Allows for groundwater recharge.
- Water moves around the plants, allowing for more suspended sediment to drop and airation.
- Harmful nutrients are often absorbed by the plant roots and by the micro-organisms in the soil.
- Heavy metals are locked into soil deposits

Value of Green Infrastructure

- Water purification.
- **Flood protection.**
- Slows the water’s momentum and erosive potential.
- Holding excess runoff after a storm, then releasing it slowly.
- Size, shape, location and soil type determine the capacity.
- Lower flood peaks through delayed release.
- Wetland soils acts like a sponge, holding more water than any other soil type, but is also less erodible.

Value of Green Infrastructure

- Water purification.
- Flood protection.
- **Shoreline stabilisation.**
- Marginal planting help protect the banks from erosive forces.
- Wetland acts as buffer zone by dissipating the water’s energy.
- Planting providing stability by binding the soils with their extensive root system.

Value of Green Infrastructure

- Water purification.
- Flood protection.
- Shoreline stabilisation.
- **Groundwater recharge & stream-flow maintenance.**
- Aquifers and groundwater is recharged or replenished.
- Groundwater provides water for drinking etc.
- During periods of drought or low stream-flow, the slow discharge of groundwater often helps maintain the minimum water levels.
- Wetlands located near rivers or streams may release water into these systems.

Value of Green Infrastructure

- **Water purification.**
- **Flood protection.**
- **Shoreline stabilisation.**
- **Groundwater recharge & stream-flow maintenance.**
- **Provides habitats.**
- Wetlands are some the most biologically productive natural eco-systems.
- Many of species are endangered and rely on wetland habitat for breeding, foraging and cover.
- These small animals and insects are an essential link in the greater environment.

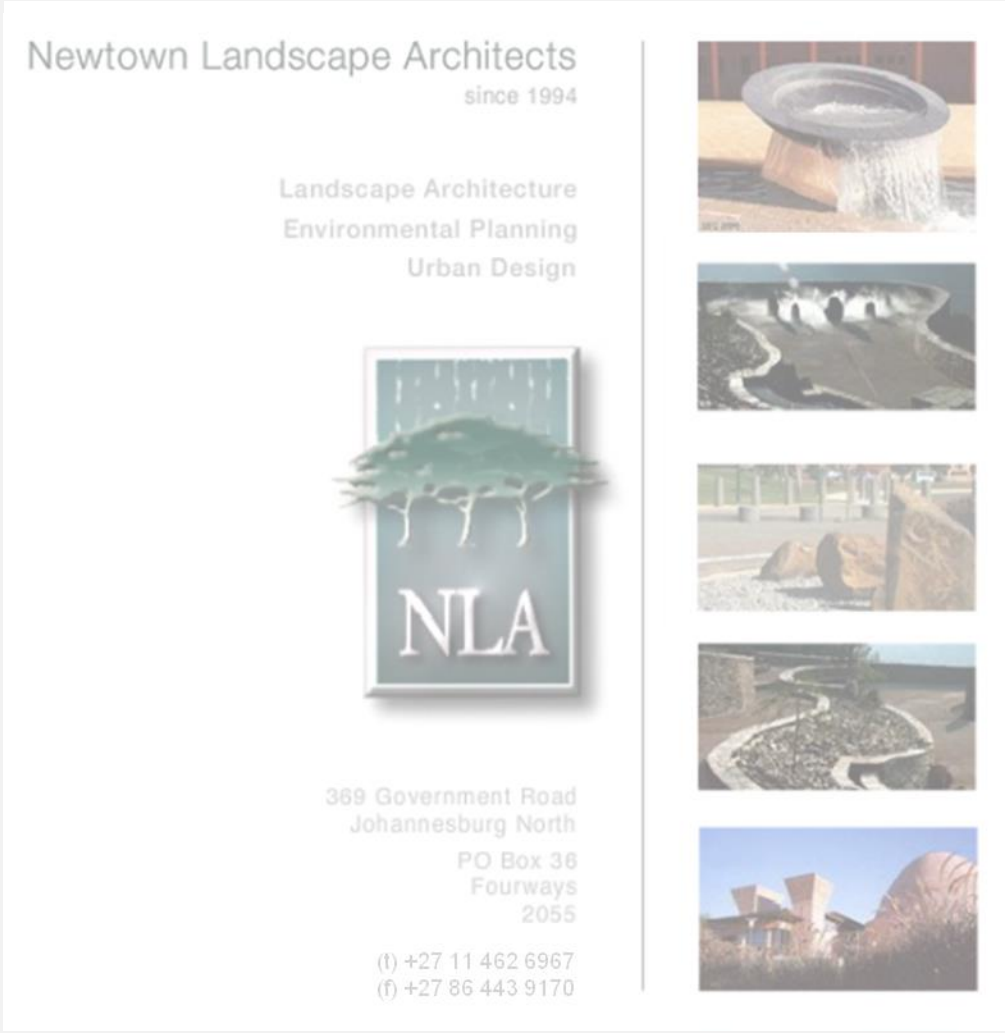
Value of Green Infrastructure

- Water purification.
- Flood protection.
- Shoreline stabilisation.
- Groundwater recharge & stream-flow maintenance.
- Provides habitats.
- **Economic Benefits.**
- Green Infrastructure provide flood control and water treatment at a fraction of the cost of conventional infrastructure and increase land value.

Value of Green Infrastructure

IMPROVED AMENITY: “Parks working harder”

Thank-you...



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