# Regenerative runoff

*Highlighting the value of  the city, while promoting biodiversity and water management in Nakuru*

Charlotte Blom
Urban Ecology

# Contents

1. Introduction

2. Analysis

3 Site visit & stakeholder input

4. Design Goal: Runoff-based spatial

5. Design Vision

6. Design
Zoom-ins

7. Conclusion & Reflection

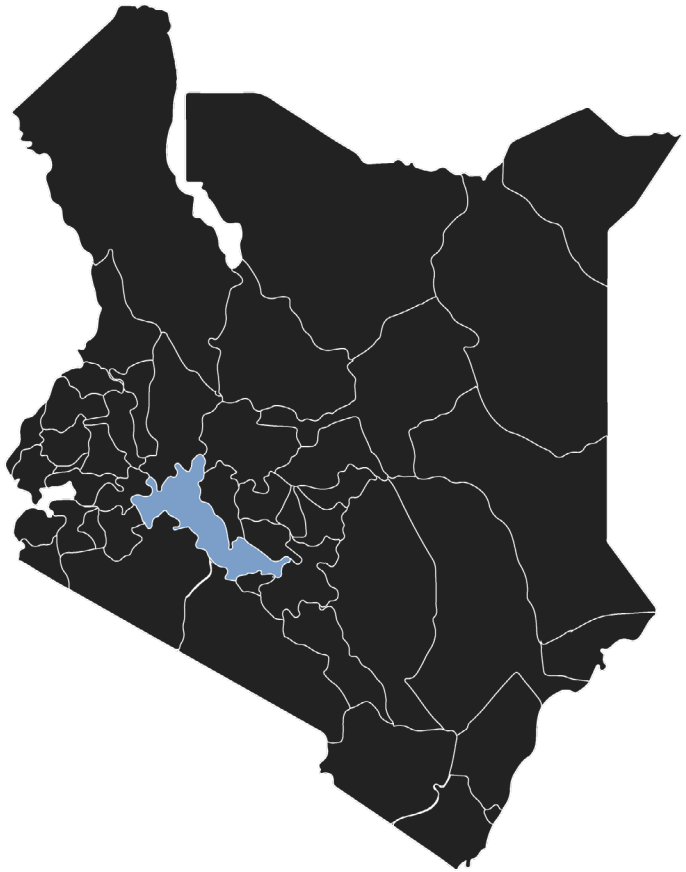
TOWER ONE
NCBA

ASCO PAINTS
KARIMI
KINYOZI

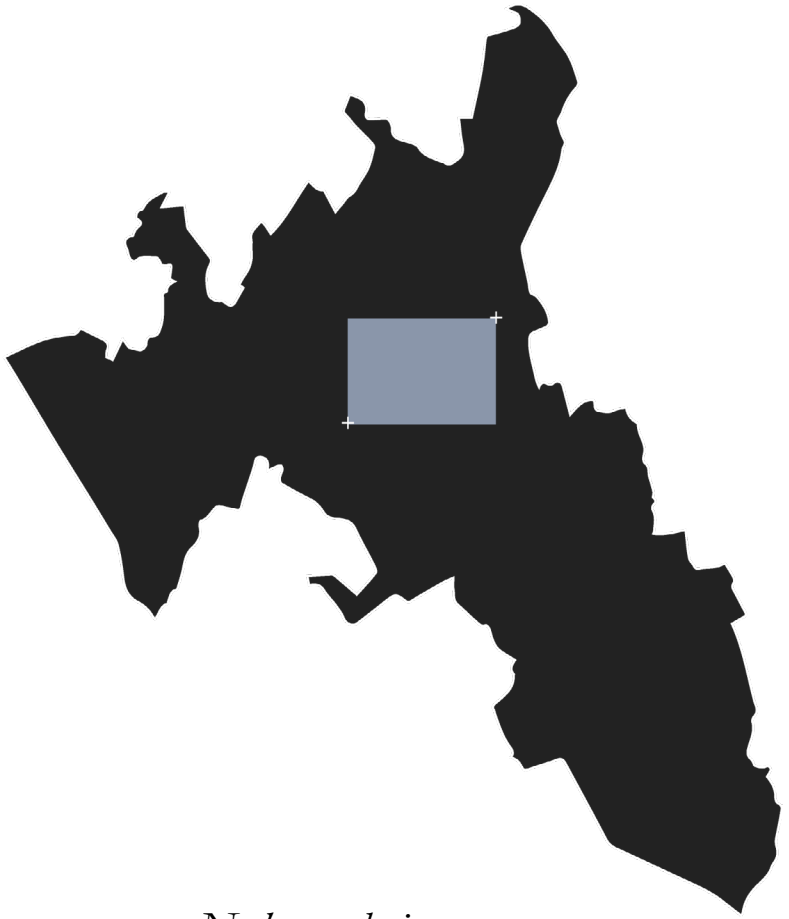
Fascination

# Location

*Kenya*



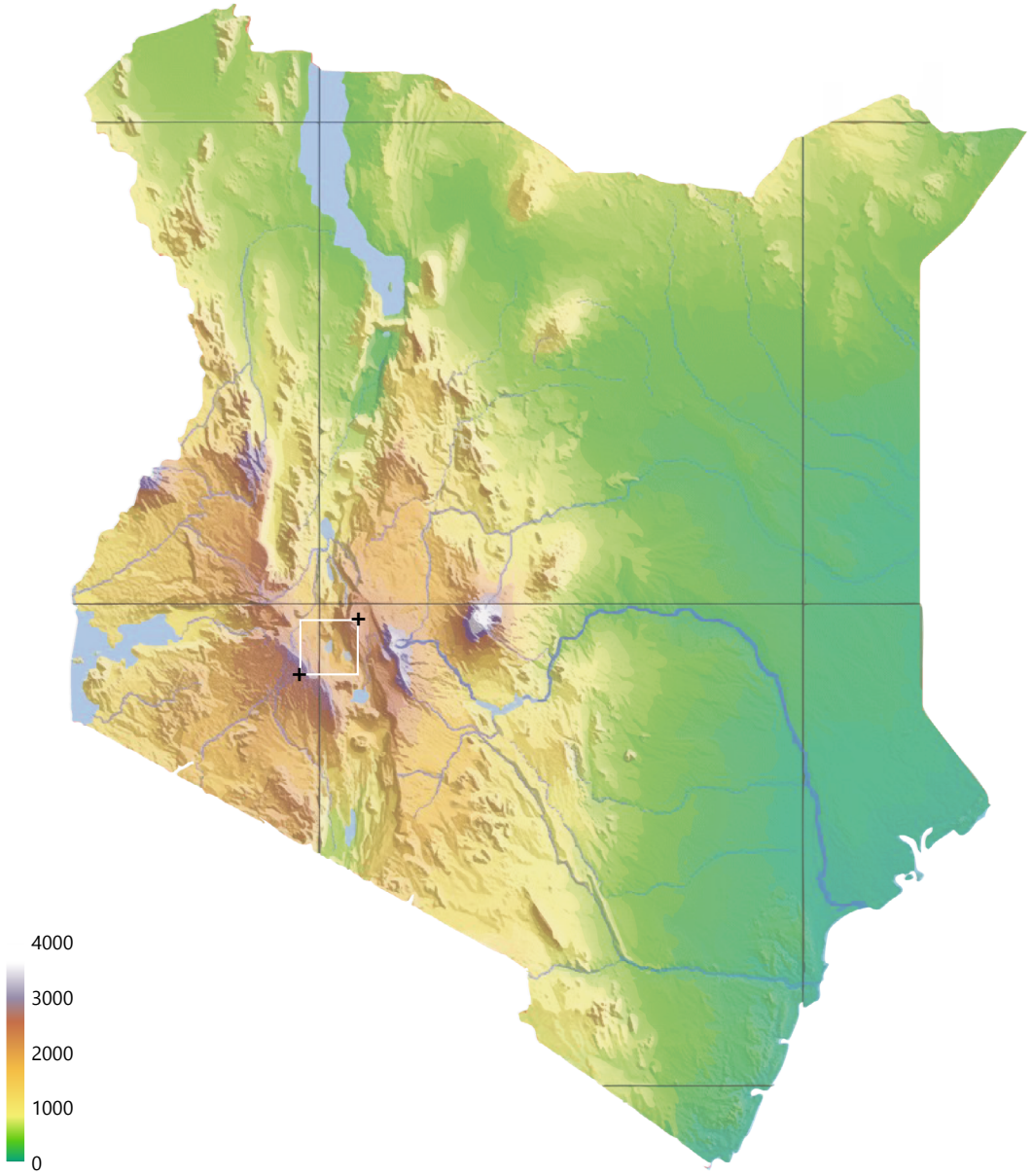
*Nakuru county*

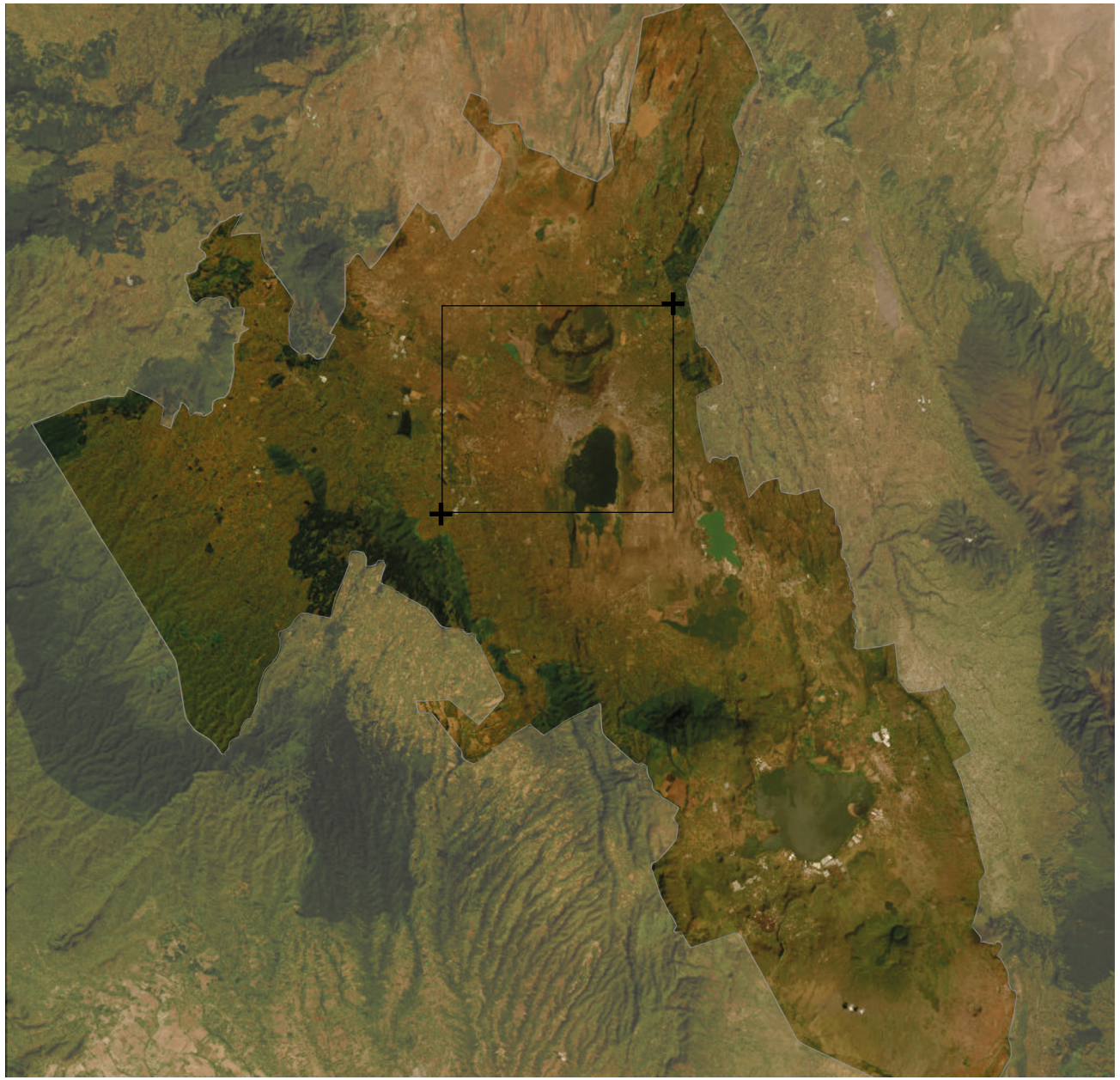


*Nakuru design area*

*Image by author*

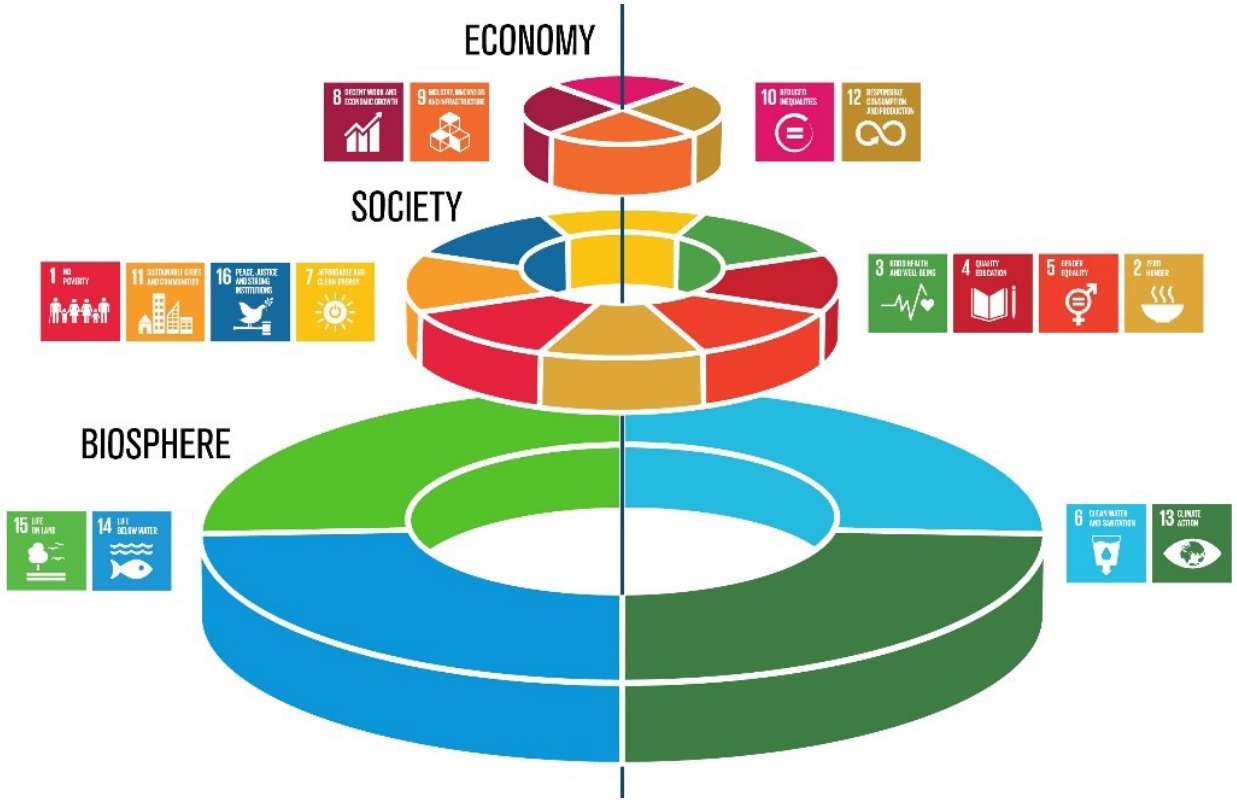
# *Rift valley*





*Nakuru design area*

# How the biosphere can guide a sustainable urban growth




*Source: The SDGs Wedding Cake, 2016*

# Problem statement

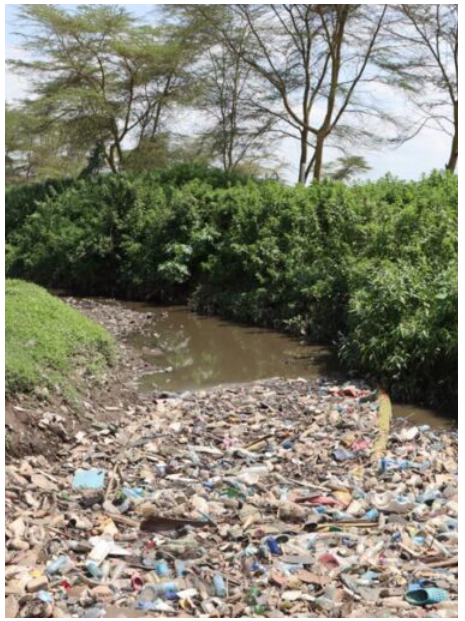
## *Nakuru's urban challenges*

*Crop failure caused by flooding*

*Purity Kinuthia/Mtaa Wangu*

*Rapid urbanization*

*By author*



*Polluted Njoro river*

*Nation.africa, 2020*

*Seasonal flows Menegai crater*

*By author*

*Illegal logging Menegai forest*

*By author*

*Research question*

What **regenerative urban landscape framework** can guide rapidly growing Nakuru to balance **water management** and **biodiversity restoration**?

What **regenerative urban landscape framework** can guide rapidly growing Nakuru to balance **water management** and **biodiversity restoration**?

## REGENERATIVE LANDSCAPE

Restores, renews and enhances natural and urban systems to create more vibrant, inclusive, and ecologically functional cities.

## WATER MANAGEMENT

Water retention
Stormwater management (slow drainage)

## ECOLOGY

Connected green-blue
Biodiversity restoration

Ecosystem services:
cooling urban microclimates, providing food, improve air quality

What **regenerative urban landscape framework** can guide rapidly growing Nakuru to balance **water management** and **biodiversity restoration**?

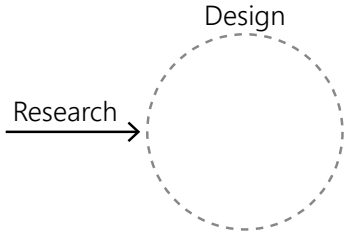
s-RQ1
What are the social and environmental impacts of rapid urban growth, particularly on water management, biodiversity?

s-RQ2
What regenerative design principles can enhance water resilience and biodiversity restoration?

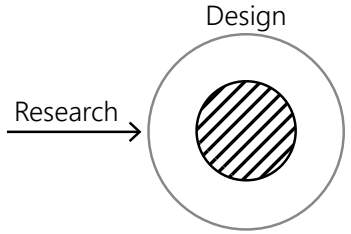
s-RQ3
Which spatial-ecological interventions are appropriate to restore ecological balance in this specific social-economic and environmental conditions/problem?

s-RQ4
How can the proposed regenerative urban framework translate into spatial strategies and design interventions for Nakuru, fostering ecological balance and sustainable urban expansion?

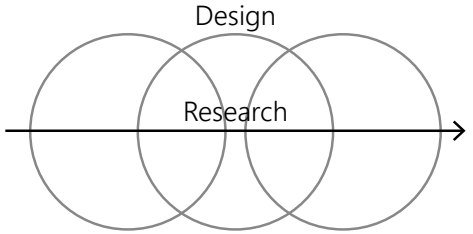
Research for design




Research about design




Research by design




Design strategy

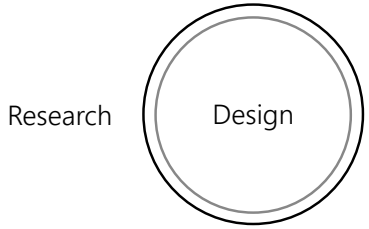


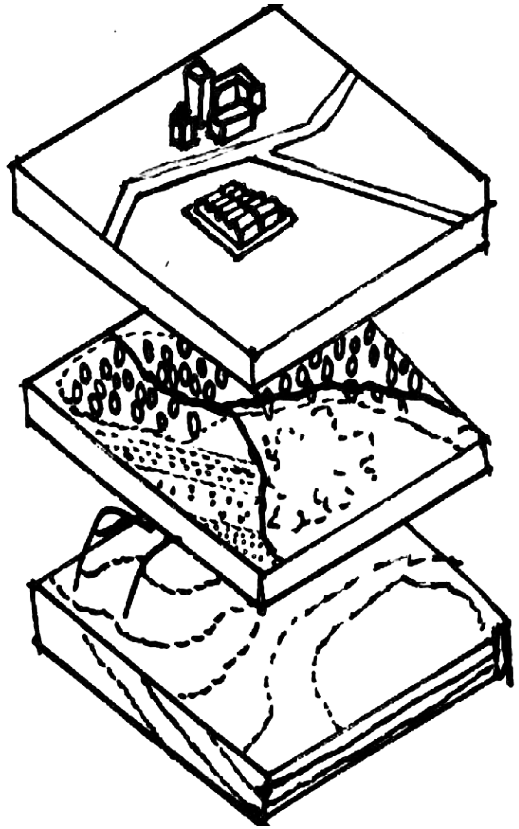

*Image by author, inspired by Manolakelli, 2023*

# Analysis

*Occupation layer*

*Green-blue network layer*

*Soil layer*



*The layer model*
*Image by author, inspired by (Frieling et al., 1998)*

# The Layers of Nakuru County

*Occupation layer*

Agriculture

*Green-blue network layer*

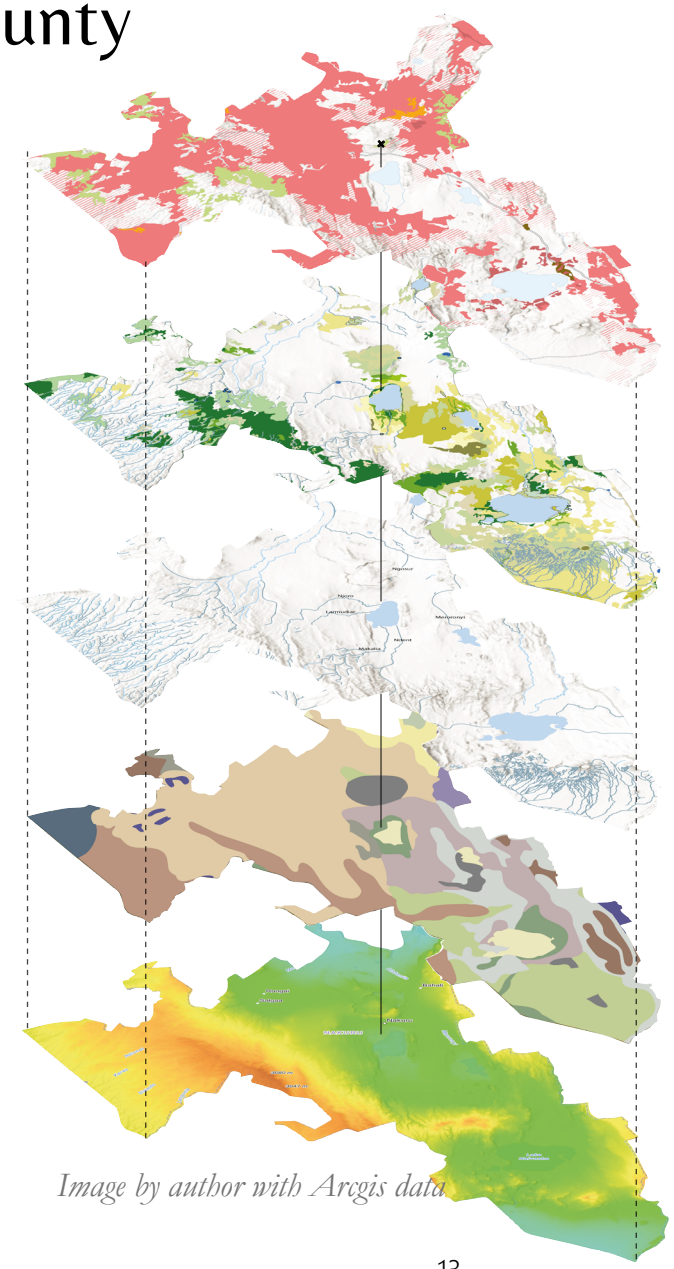
Nature

Water system

*Soil layer*

Soil classification

Topography



- Irrigated herbaceous crops
- Rainfed herbaceous crops
- Rainfed shrub crops
- Rainfed tree crops
- Irrigated herbaceous crops
- Rainfed herbaceous crops
- Rainfed shrub crops
- Rainfed tree crops

Vegetation
- Open shrubs (45-40%)
- Open low shrubs (65-40%)
- Very open trees (40-45%)
- Open trees (65-40%)
- Closed trees

Rangeland
- Trees and shrubs savannah
- Open to closed herbaceous vegetation
- Shrub savannah

Other
- Forest plantation
- Wetland

- Lava
- Andosols
- Regosols
- Solonetz
- Phaeozem and Cambisol
- Nitisols with Cambisols, Acrisols and Luvisols
- Regosols and Phaeozems

*Image by author with Arcgis data*

# The Layers of Nakuru County

*Occupation layer*

**Agriculture**

Main income source, but increasingly fragmented by urban sprawl.

- Irrigated herbaceous crops
- Rainfed herbaceous crops
- Rainfed shrub crops
- Rainfed tree crops
- Irrigated herbaceous crops
- Rainfed herbaceous crops
- Rainfed shrub crops
- Rainfed tree crops

*Green-blue network layer*

**Nature**

Closed trees in the north-west, in the south more shrubs

Vegetation
- Open shrubs (45-40%)
- Open low shrubs (65-40%)
- Very open trees (40-45%)
- Open trees (65-40%)
- Closed trees

Rangeland
- Trees and shrubs savannah
- Open to closed herbaceous vegetation
- Shrub savannah

Other
- Forest plantation
- Wetland

**Water system**

Rivers are seasonal with high runoff. Lake Nakuru is the lowest part, no outlet

*Soil layer*

**Soil classification**

Vulcanic soils that have a high infiltration capacity and fissures

- Lava
- Andosols
- Regosols
- Solonetz
- Phaeozem and Cambisol
- Nitisols with Cambisols, Acrisols and Luvisols
- Regosols and Phaeozems

**Topography**

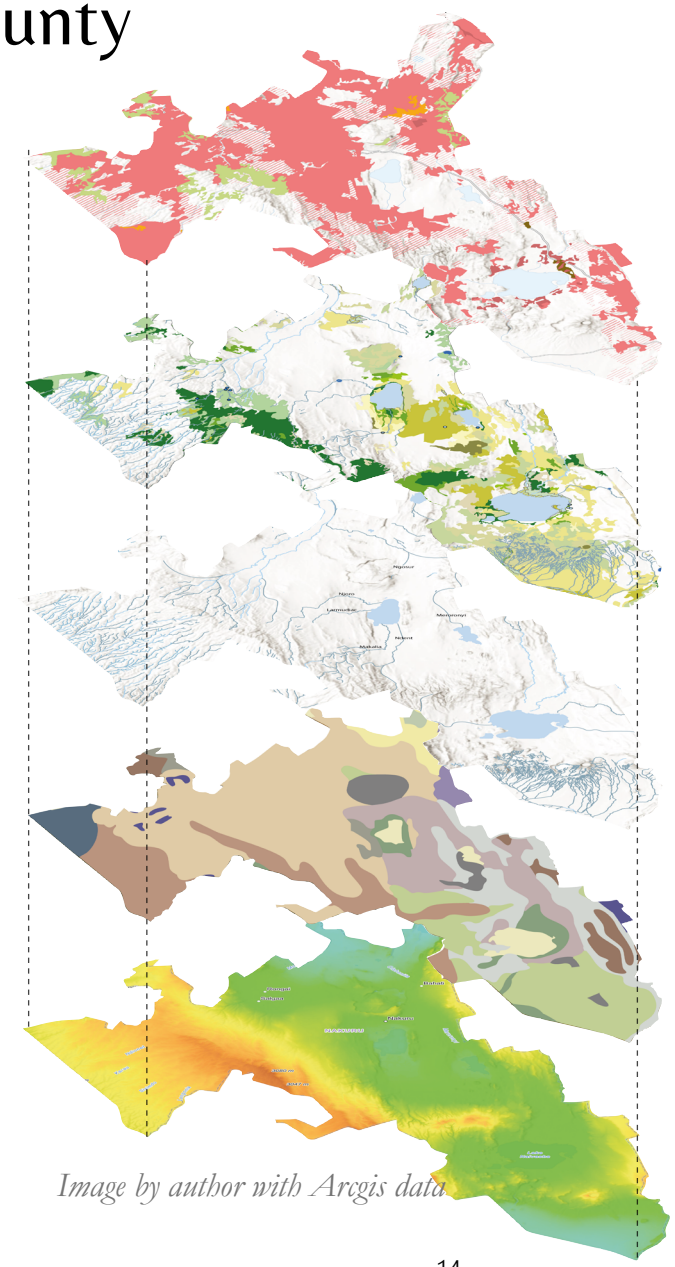
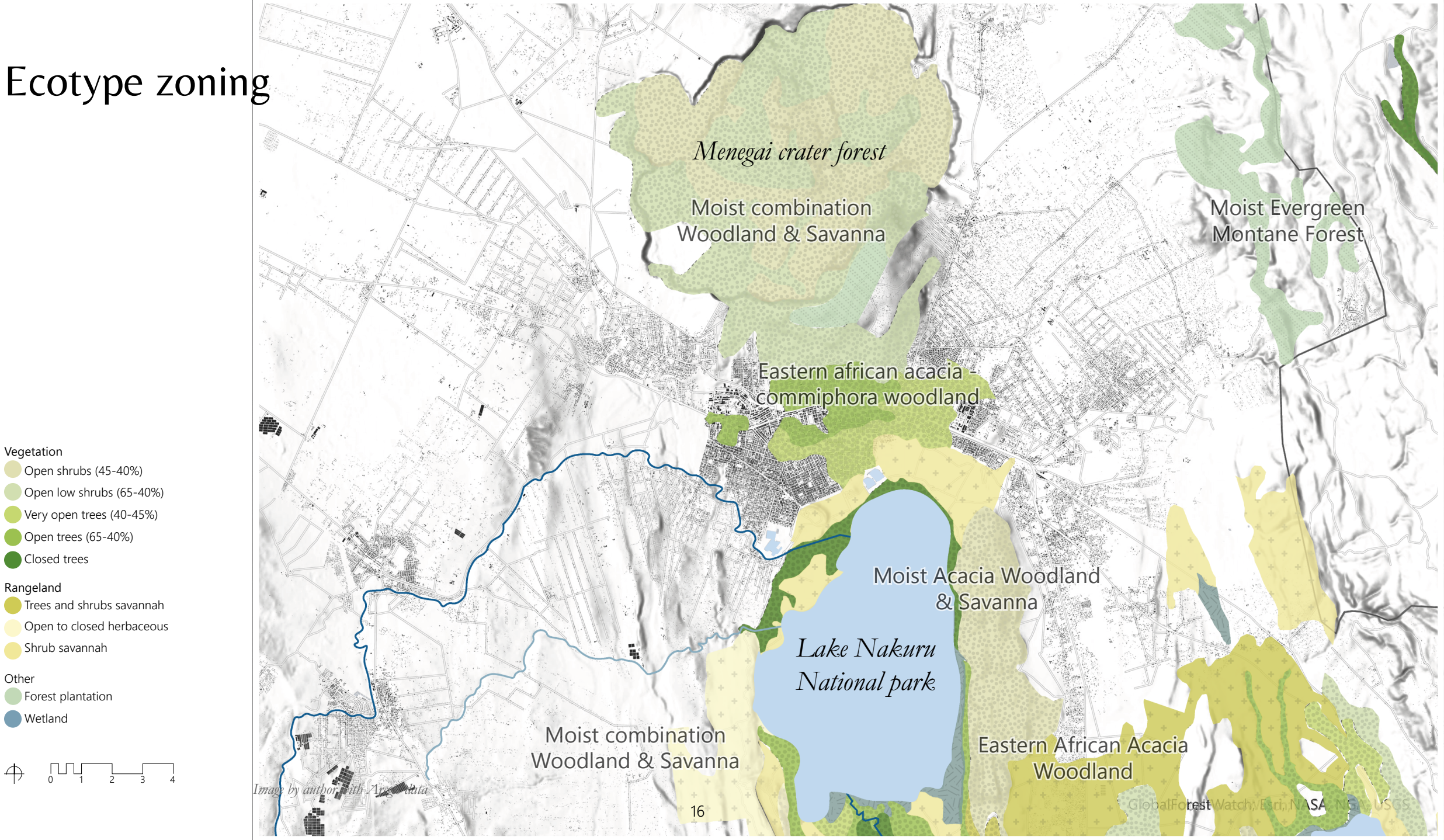


*Image by author with Arcgis data*

# Ecotypes

Moist Evergreen Montane Forest
Moist combination Woodland & Savanna
Eastern african acacia - commiphora woodland
Moist Acacia Woodland & Savanna
Eastern African Acacia Woodland
Moist Evergreen Montane Forest
Moist combination Woodland & Savanna
Moist Acacia Woodland & Savanna
Eastern African Acacia Woodland
Eastern african acacia - commiphora woodland
0 1 2 3 4
Image by author with Arcgis data
GlobalForestWatch; JASA, NGA, USGS

# Ecotype zoning



# Nature

*Menegai forest*

*Menegai crater*

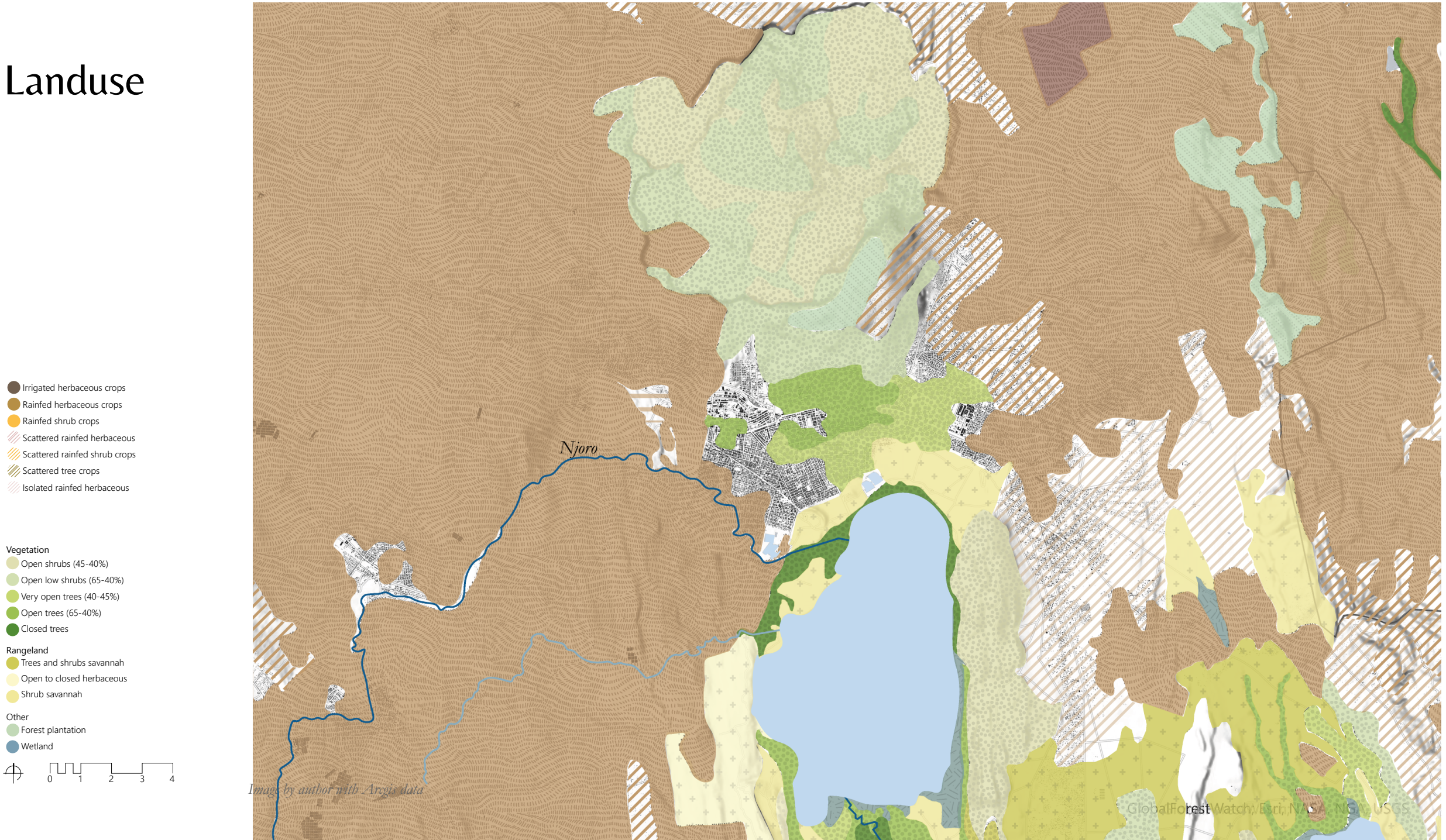
*Barut west*

*Open area near Rhoda*

*Lake nakuru*

*Nakuru national park, zebra with acacia trees*

# Landuse


Irrigated herbaceous crops
Rainfed herbaceous crops
Rainfed shrub crops
Scattered rainfed herbaceous
Scattered rainfed shrub crops
Scattered tree crops
Isolated rainfed herbaceous
Vegetation
Open shrubs (45-40%)
Open low shrubs (65-40%)
Very open trees (40-45%)
Open trees (65-40%)
Closed trees
Rangeland
Trees and shrubs savannah
Open to closed herbaceous
Shrub savannah
Other
Forest plantation
Wetland
0
1
2
3
4
Njoro
Images by author with Arcgis data
GlobalForestWatch, Esri, NASA, NGA, USGS
rest

# Agriculture

*Aerial view of maize farm with harvester in Ngata, Nakuru, Kenya.*

*Private crop field*

*Njoro district in the Rift Valley Province, Kenya*

*Nakuru county, Kenya.*

*Maize during dry season*

*Cropfield near main road*

# Site visit

Methods
- Workshops (Water as Leverage and Egerton University).
- Interviews
- Observations and field notes

*Interview with city planner*

*Nakuru city, 2025*

*Workshop Water as Leverage*

*Water as Leverage*

*Workshop with Egerton students organized by TU Delft students*

*Xuejing He, 2025*

# *Interviews with stakeholders*

**Municipality**
Government
Overseeing implementation

**Educator**
Community
Support environmental education

**Nawassco**
Water management
Sustainable drainage, water reuse and infrastructure maintenance.

**Resident**
Community
End-users and source of local knowledge

**Kenya Wildlife Service**
Ecological Stakeholders
Conservation and protection of ecosystems

**Urban planner**
Government
Integration of regenerative design into spatial planning

**Farmers**
Economic Stakeholders
Could use agroforestry, water retention and re-use practices.

**Schoolchildren**
Community
Youth engagment

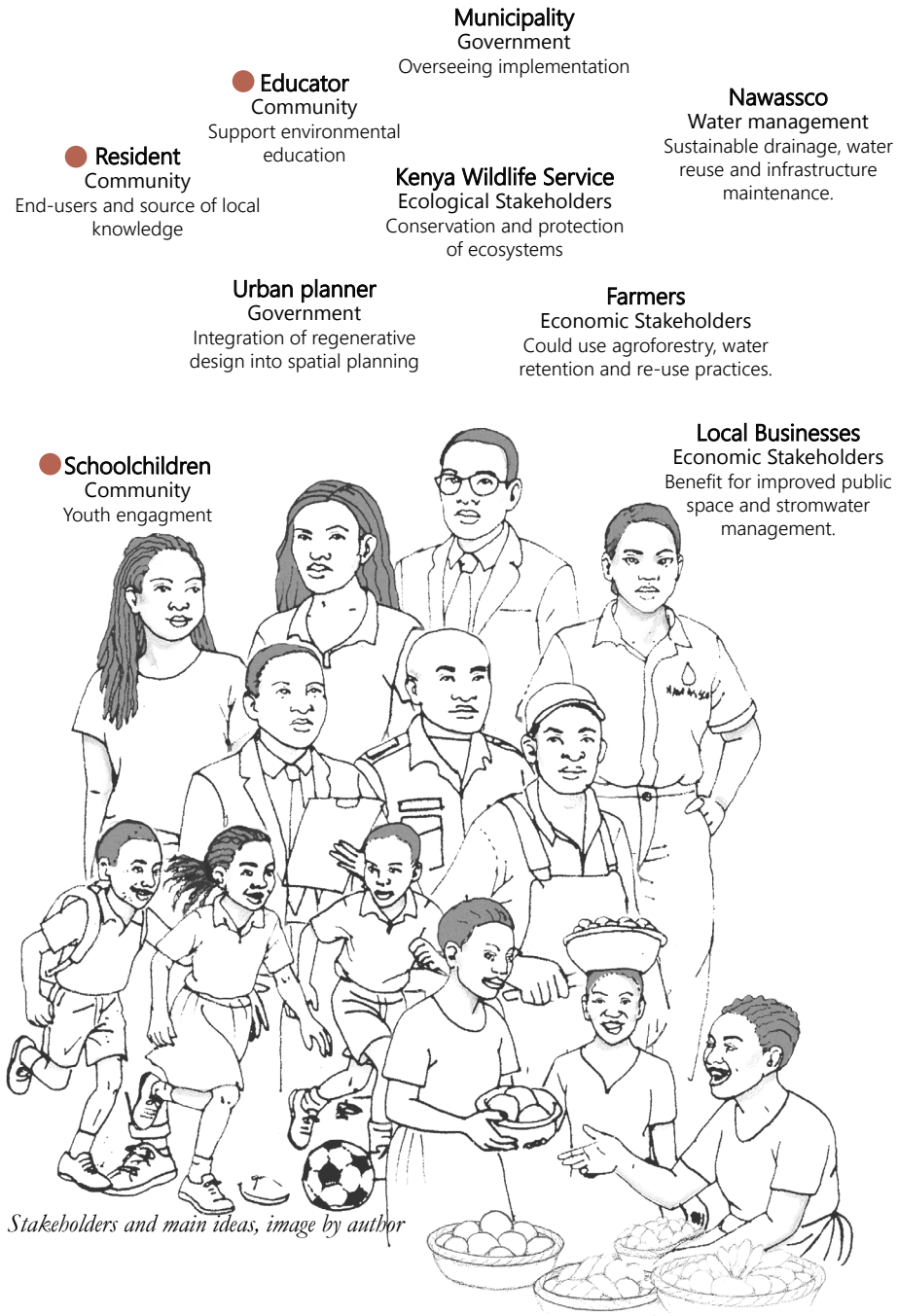
**Local Businesses**
Economic Stakeholders
Benefit for improved public space and stromwater management.

Civil
Public
Private

*Stakeholders and main ideas, image by author*

# *Interviews with stakeholders*

- **Civil (Community Stakeholders):**
  Residents bring local knowledge, educators and schoolchildren help in the future with shaping green spaces through schools and gardens.

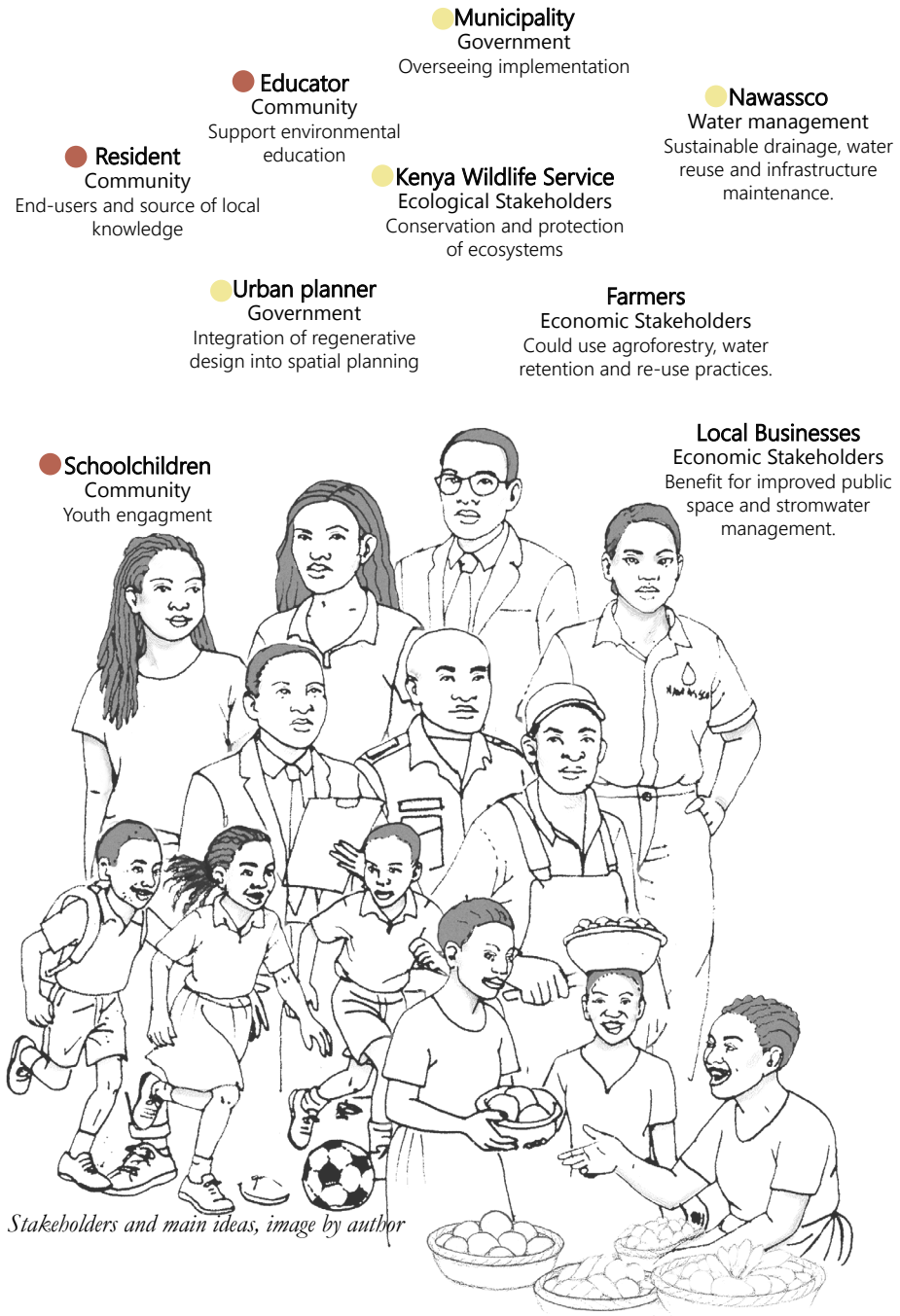



*Stakeholders and main ideas, image by author*

# *Interviews with stakeholders*

- **Civil (Community Stakeholders):**
  Residents bring local knowledge, educators and schoolchildren help in the future with shaping green spaces through schools and gardens.

- **Public (Government Stakeholders):**
  Municipality and Nawassco are critical for implementation and water management, while urban planners integrate ecological principles into city plans.



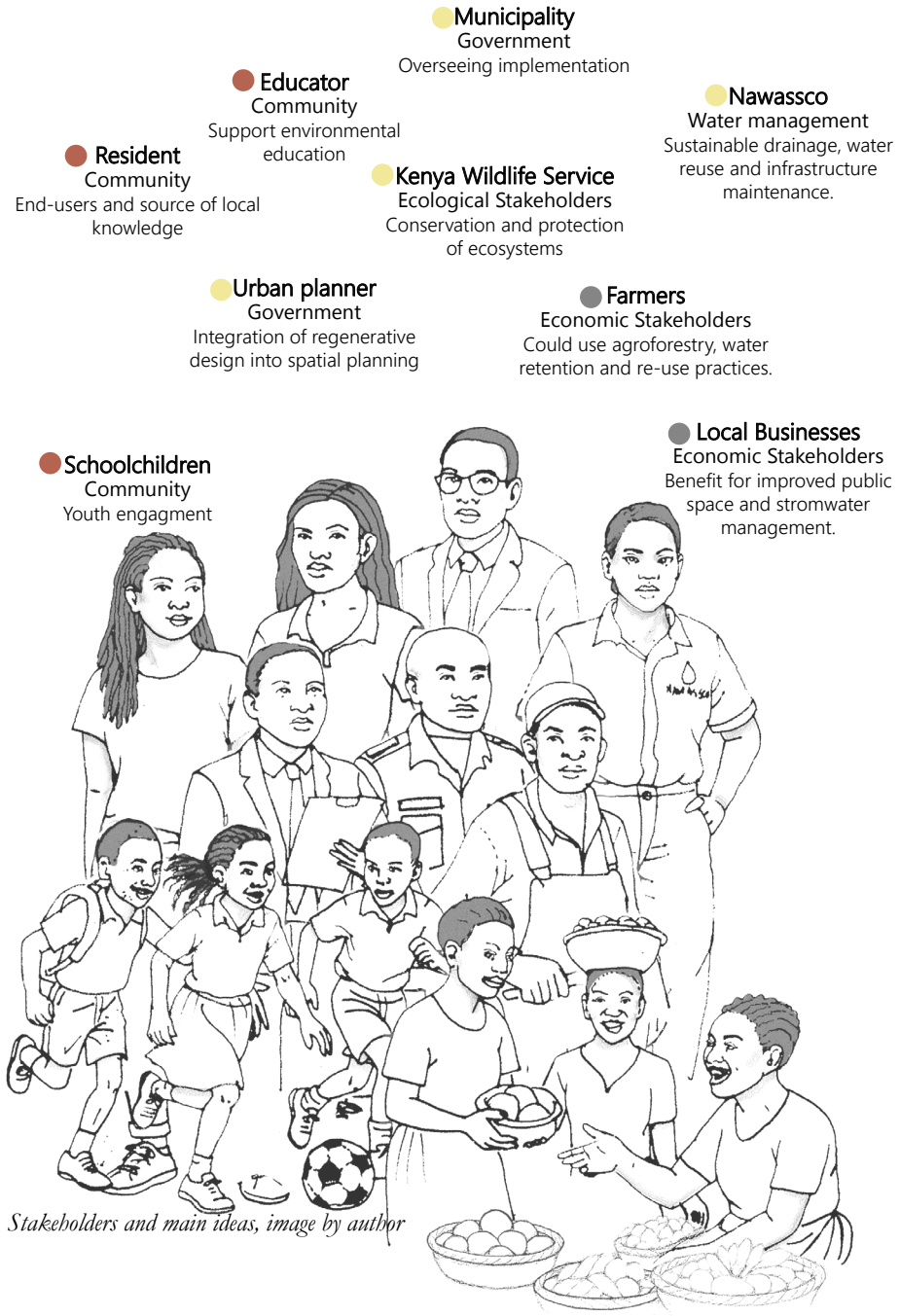

*Stakeholders and main ideas, image by author*

# *Interviews with stakeholders*

- **Civil (Community Stakeholders):**
  Residents bring local knowledge, educators and schoolchildren help in the future with shaping green spaces through schools and gardens.

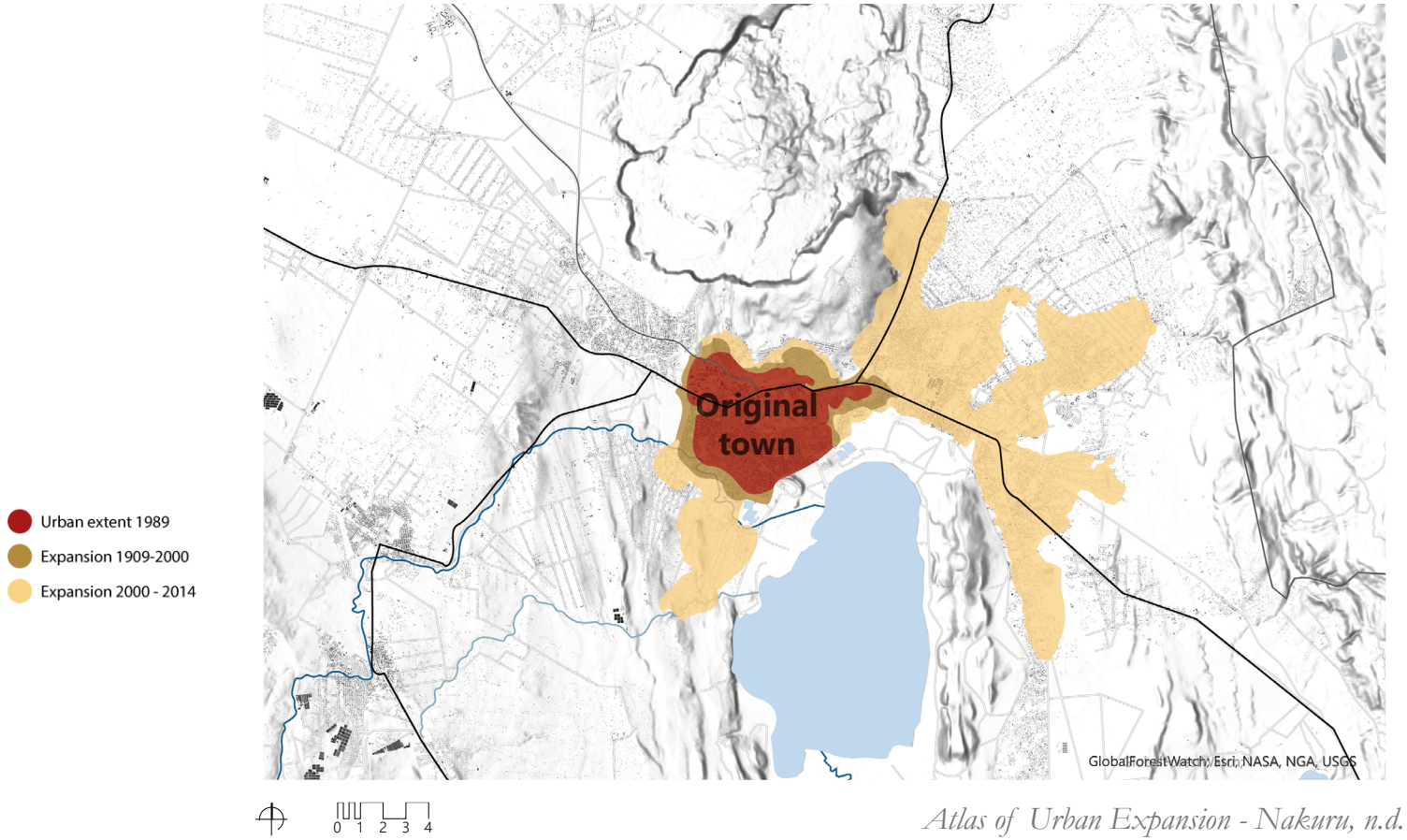
- **Public (Government Stakeholders):**
  Municipality and Nawassco are critical for implementation and water management, while urban planners integrate ecological principles into city plans.

- **Private (Economic Stakeholders):**
  Farmers and businesses benefit directly from interventions like agroforestry, retention parks and improved public space. They have a smaller role in implementation.



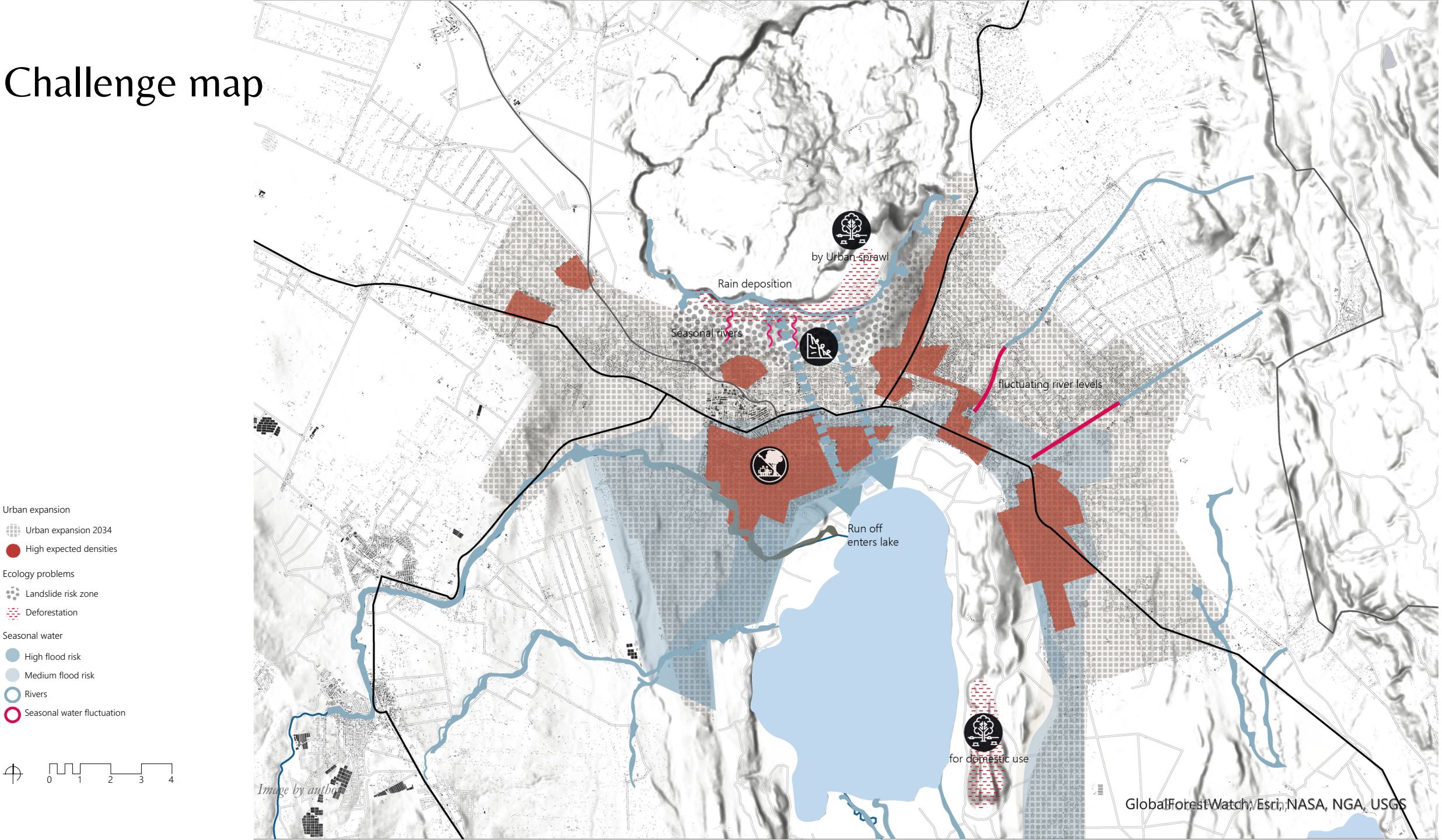

*Stakeholders and main ideas, image by author*

# Urban Expansion

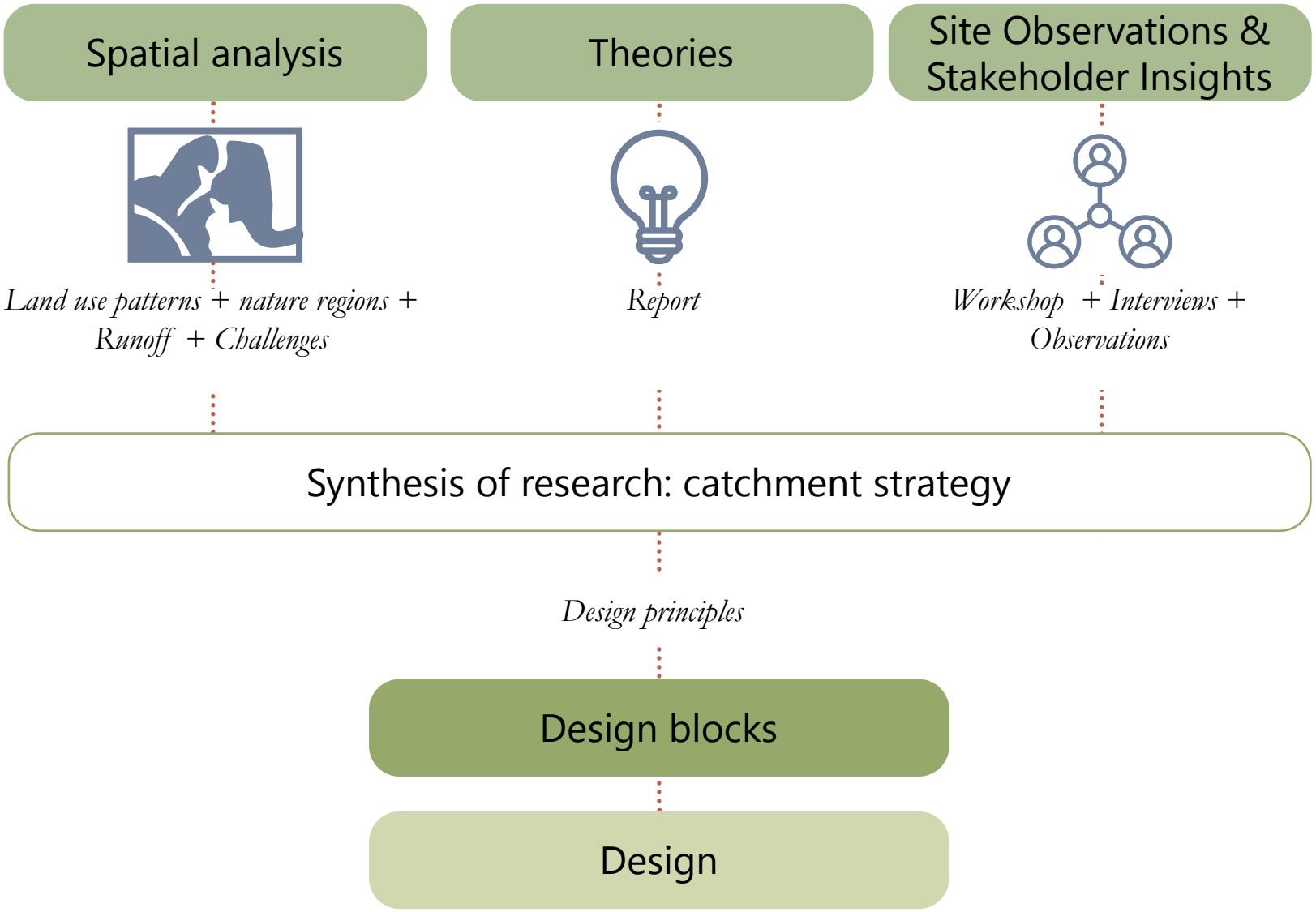



*Atlas of Urban Expansion - Nakuru, n.d.*

# Challenge map



# How research translates into regenerative design

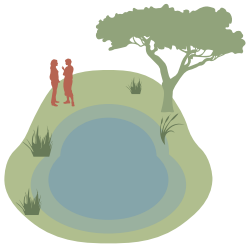


# Design principles

## Ecological regeneration

*Restore green areas using native vegetation to enhance biodiversity and water infiltration.*

## Multifunctional design

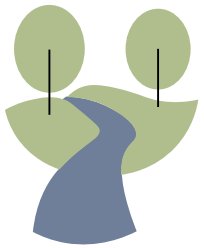


*Create multifunctional water retention areas for flood mitigation with public use*

## Purpose-driven protection

*Protect natural areas by assigning a purpose. This is good protecting nature from urban expansion.*

## Systemic design approach

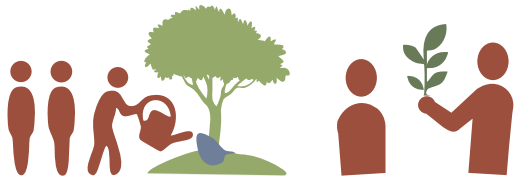


*The framework follows a systemic approach based on the natural watercourses of run-off water.*

## Water as structuring element

*Green-blue networks to enhance water retention, improve urban resilience and cool the city*

## Community and care



*Engage local institutions for long-term greening and care*

*Image by author*

# Design goal

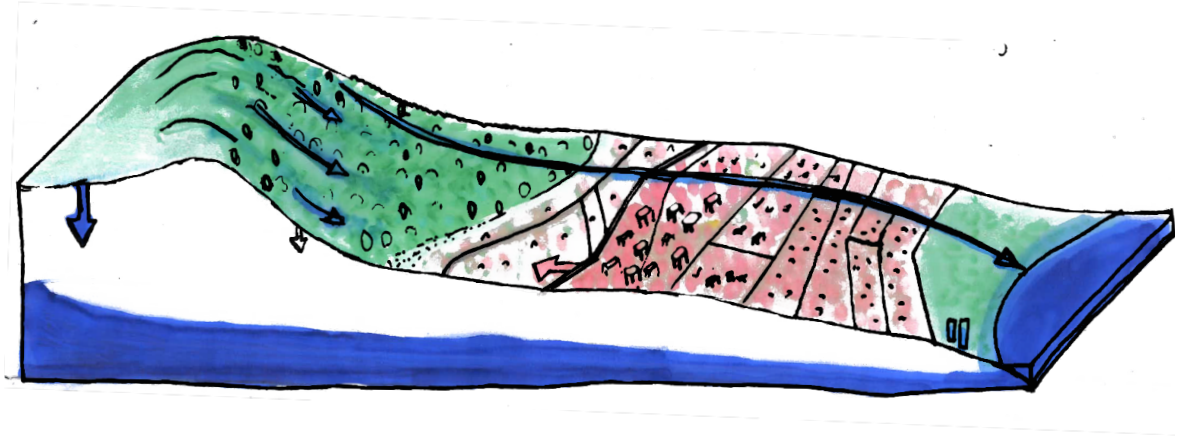


*Image by author*

# Design goal

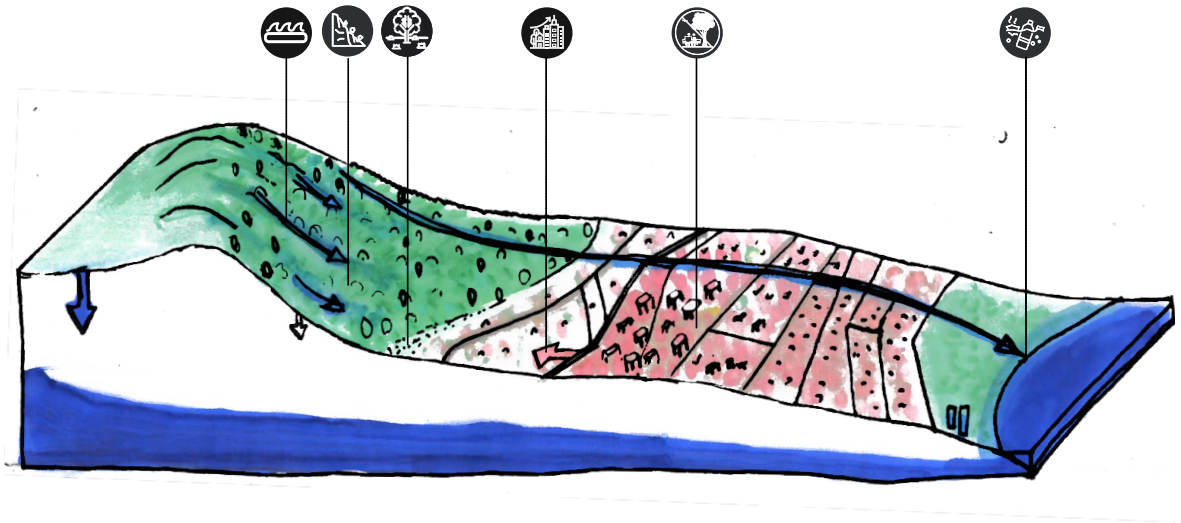
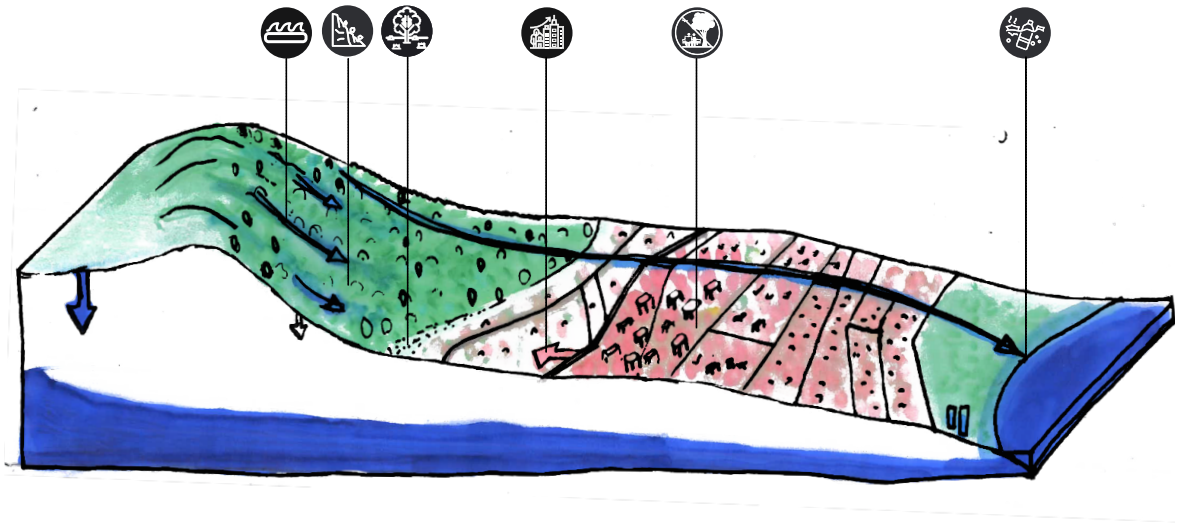


*Image by author*

# Regenerative runoff spatial strategy



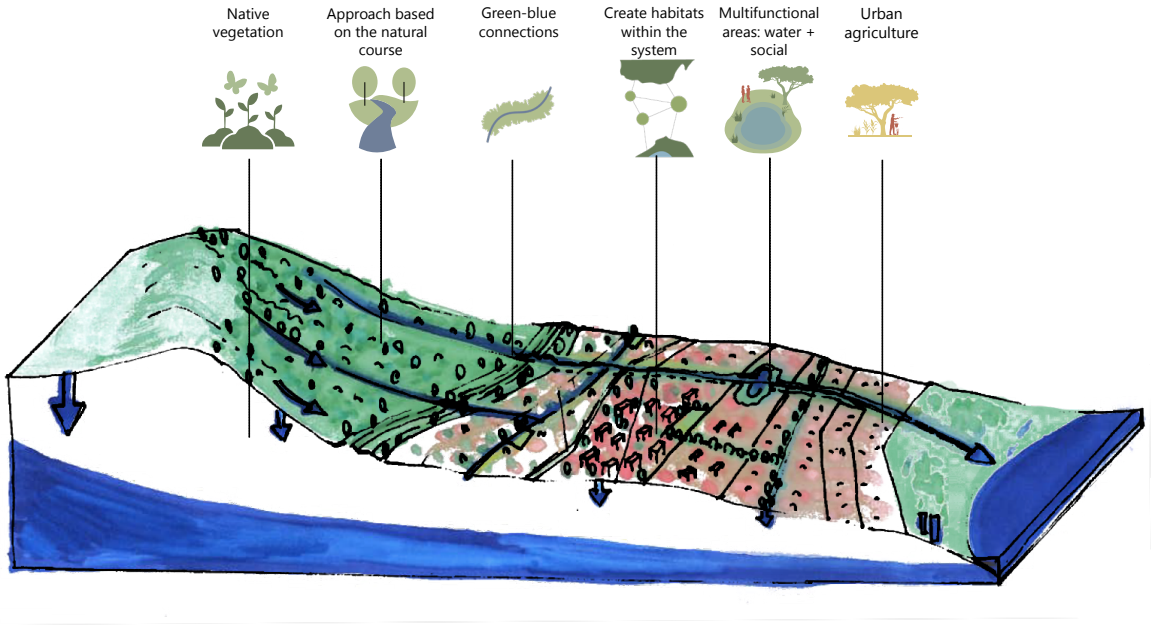



*Image by author*

# Regenerative runoff spatial strategy

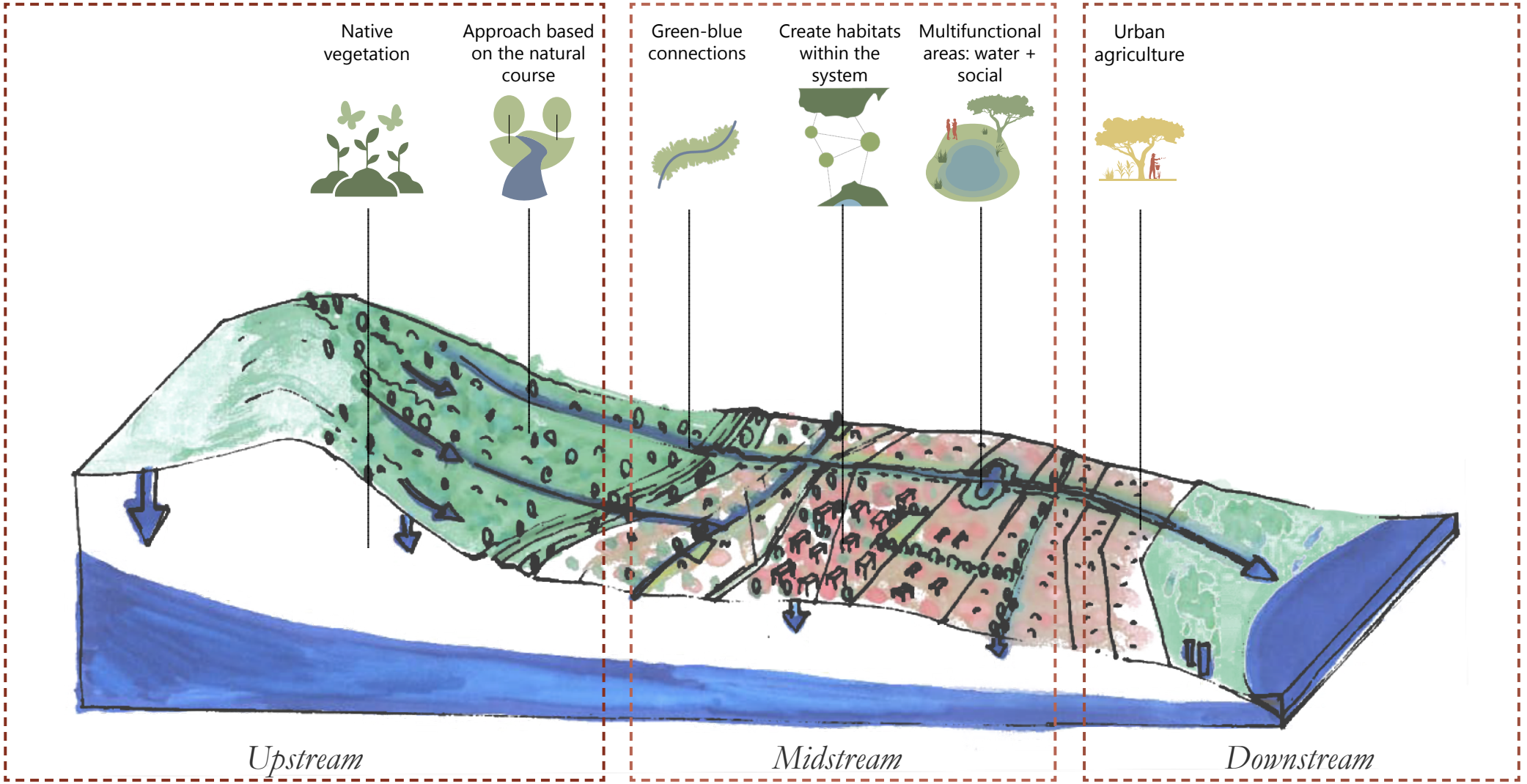
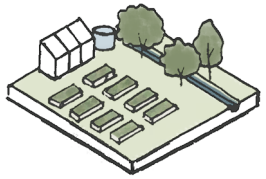



*Image by author*

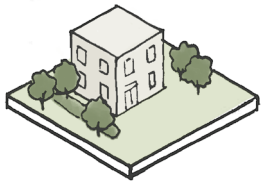
# Building Blocks
*of Regenerative Design*

## Socio-productive



Community garden

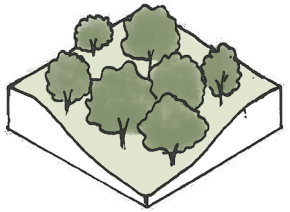
School garden



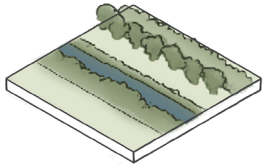
Building and public space

Agroforestry

## Ecological

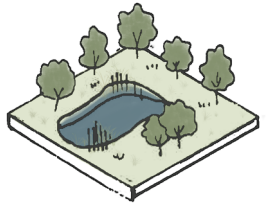


Indigenous trees



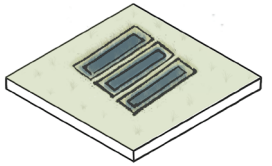
Water inclusive corridor

## Water management

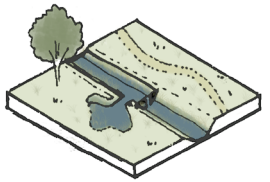


Water retention and park

Retention pond

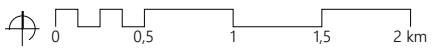


Water filtration ponds



Slow delay

# Natural water flow



# Concept

**1. Control / Capture (Upland – Steep & Vegetated)**

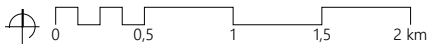
To slow and capture runoff before it enters the urban core.

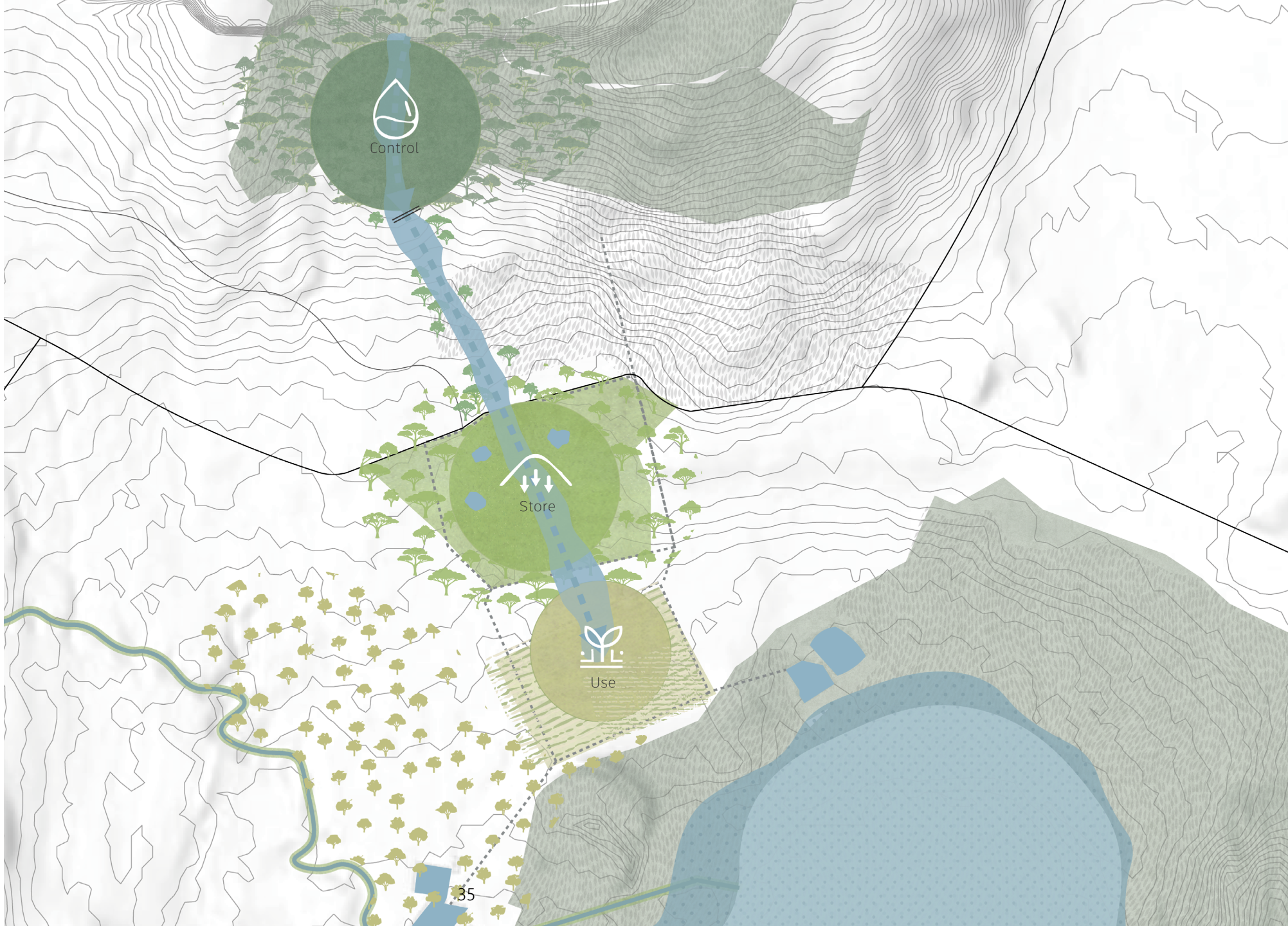
**2. Store (Midstream – Urban & Dense)**

Zones of temporary storage and urban greening.

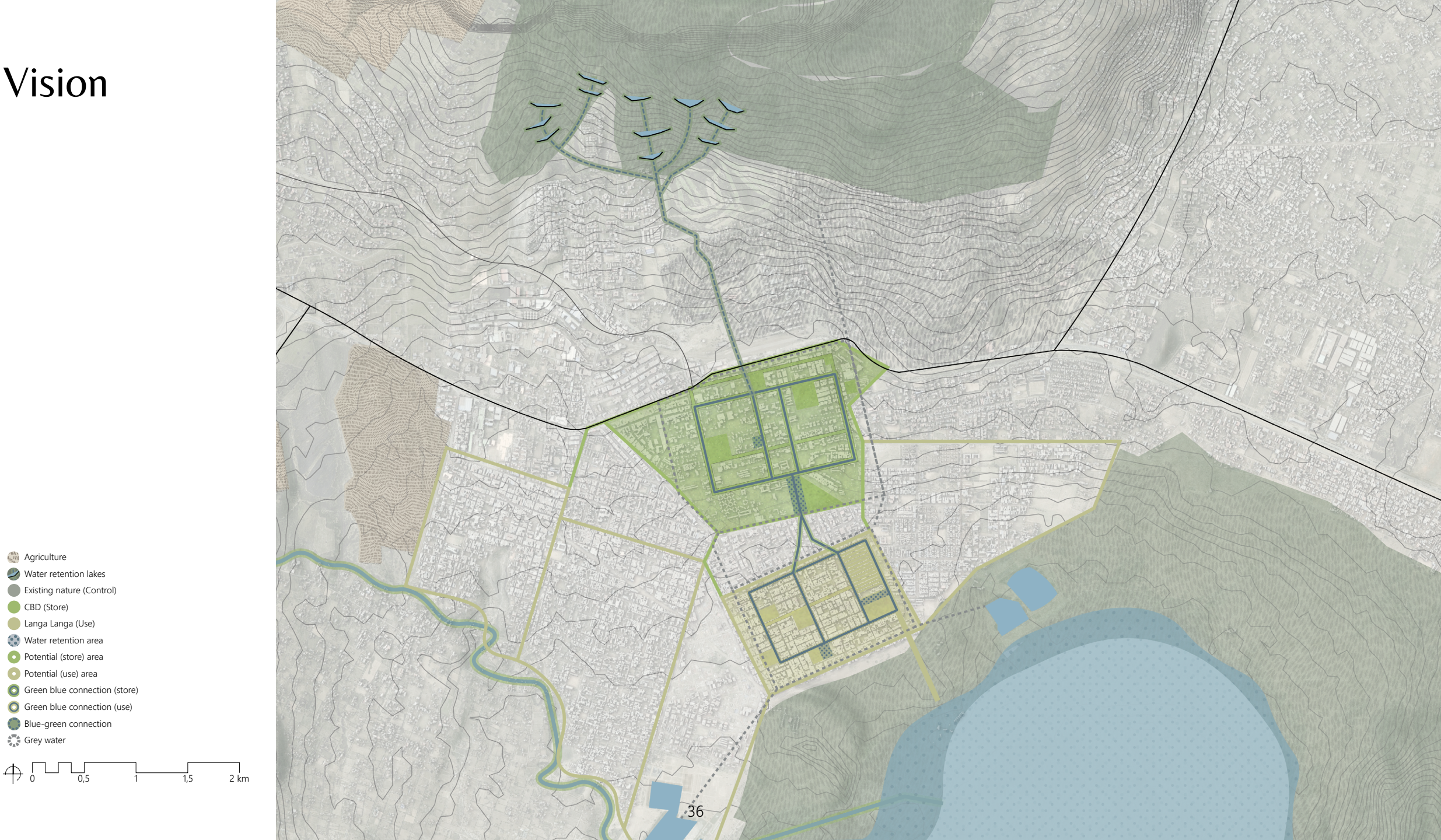
**3. Use (Downstream – Flat & Flood-Prone)**

Use the water more



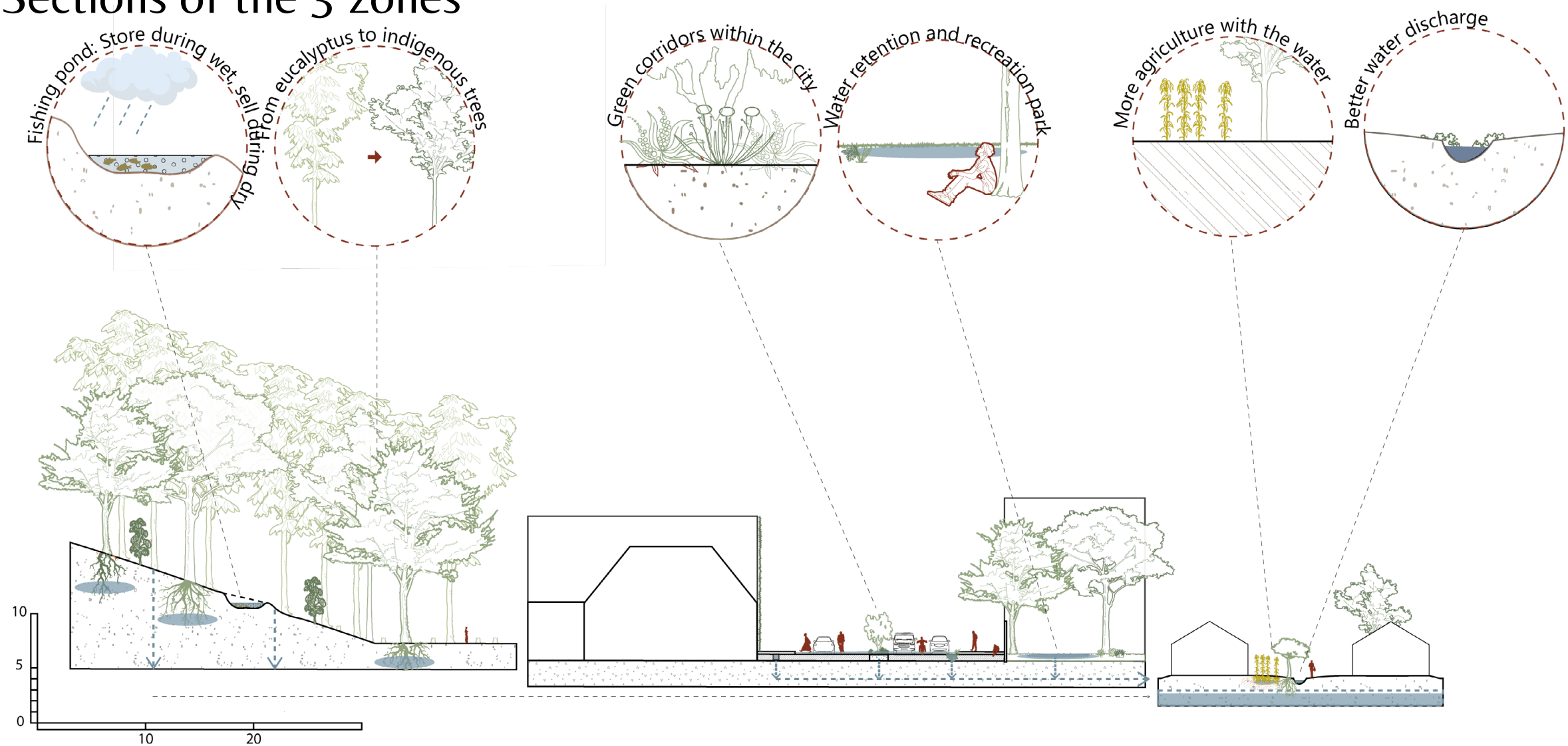
# Vision


Agriculture
Water retention lakes
Existing nature (Control)
CBD (Store)
Langa Langa (Use)
Water retention area
Potential (store) area
Potential (use) area
Green blue connection (store)
Green blue connection (use)
Blue-green connection
Grey water
0
0,5
1
1,5
2 km

# Vision

Protection through direct purpose
Native vegetation
Green-blue connections
Create habitats within the system
Combining functions water retention and social gathering
Urban agriculture
Engage local institutions for greening efforts and long-term care
Agriculture
Water retention lakes
Existing nature (Control)
CBD (Store)
Langa Langa (Use)
Water retention area
Potential (store) area
Potential (use) area
Green blue connection (store)
Green blue connection (use)
Blue-green connection
Grey water
0
0,5
1
1,5
2 km

# Sections of the 3 zones




1. Control / Capture (Upland – Steep & Vegetated)

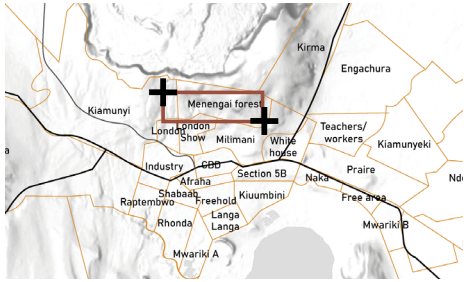
2. Store (Midstream – Urban & Dense)

3. Use (Downstream – Flat & Flood-Prone)

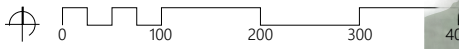
# *Control*
# *Menegai crater*

## *Menegai Crater*

*Forest | High elevated areas | Steep hills*



# *Control*
# *Menegai crater*



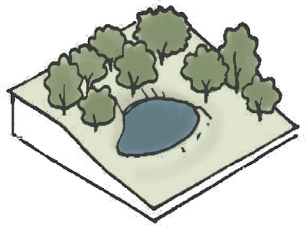

Fishing pond

New indigenous trees

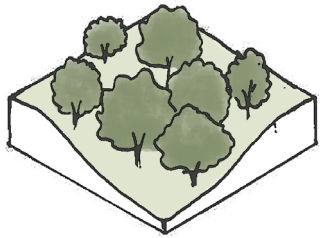
Existing forest

Channel to Nakuru centre

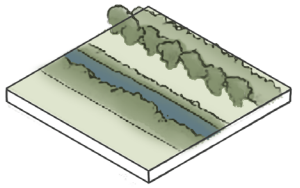
# *Control*
# *Menegai crater*



Retention pond



Indigenous trees



Nature inclusive corridor

Fishing pond

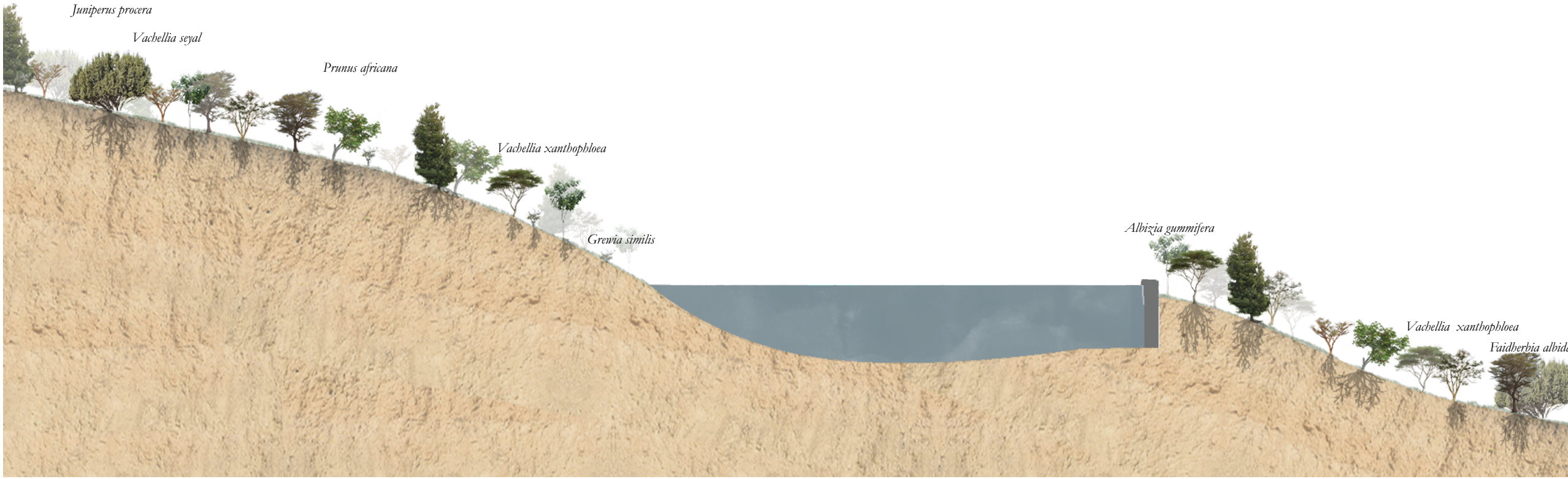
New indigenous trees

Existing forest

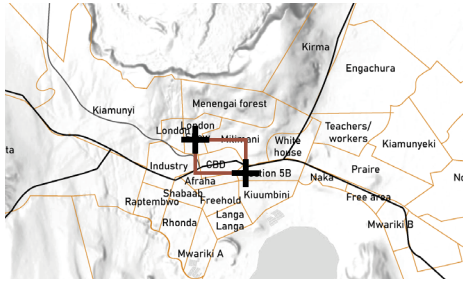
Channel to Nakuru centre

0 100 200 300 400

# *Section Menegai crater*



# *Store & Regreen*
# *CBD*




## *CBD*

*Dense | urban | high rise*

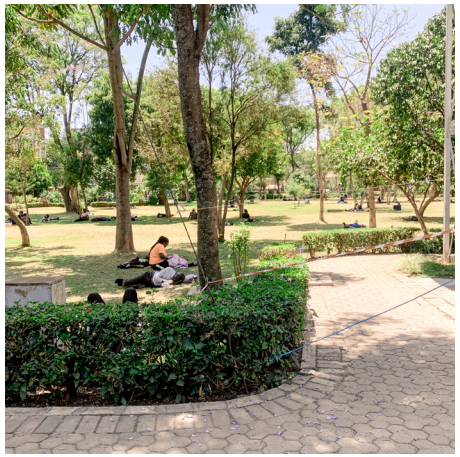
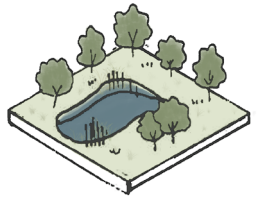


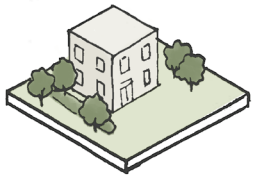
*Image by author*

# *Store & Regreen CBD*

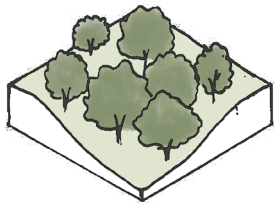
# *Store & Regreen CBD*



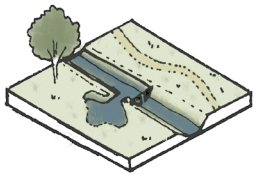
Water retention and park



Building and public space

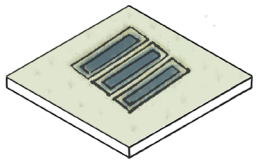


Indigenous trees

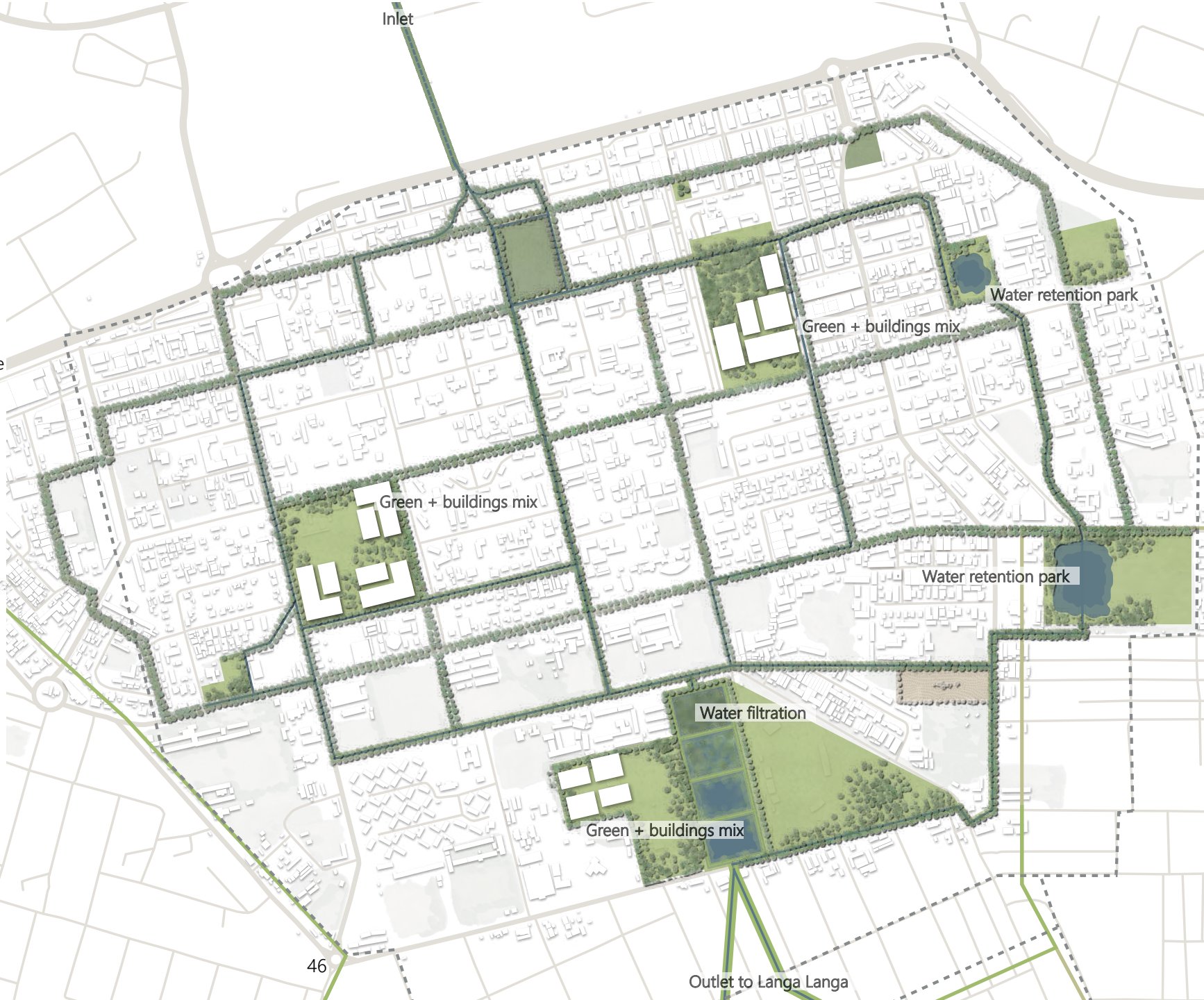


Slow delay

- Agriculture
- Green corridors
- Existing parks
- CBD (Store) parks
- Water retention area
- Blue connection
- Grey water



Water filtration ponds



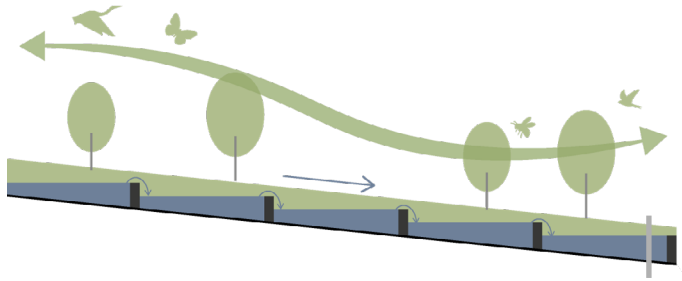
# *Store & Regreen CBD*

- Agriculture
- Green corridors
- Existing parks
- CBD (Store) parks
- Water retention area
- Blue connection
- Grey water

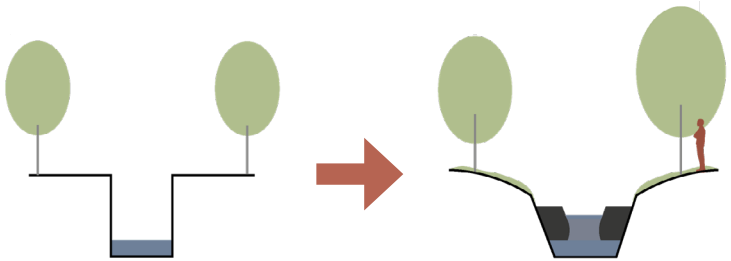
0 100 200 300 400

# *Store & Regreen*
# *CBD*

## Weirs in the drainage channels

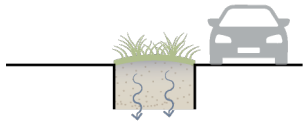


*Slow drainage with weirs*

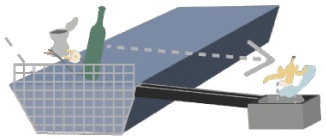


*Old and new drainage channels*

## Green corridors

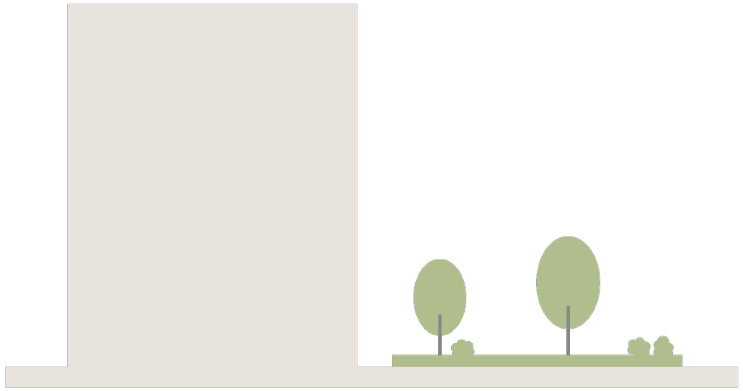


*Green buffer near road*



*Draingage channel with garbage filtration*

## Mixed uses



*New building mixed with green*

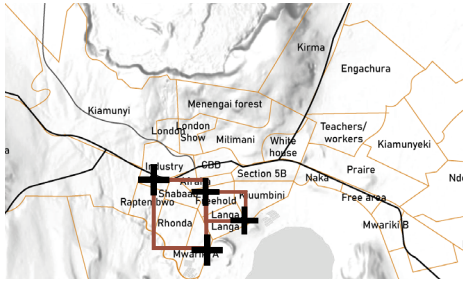
# *Store & Regreen*
# *CBD*

# *Store & Regreen*
# *CBD*

*Store & Regreen*
*CBD*

*Store & Regreen*
*CBD*

# *Use*
# *Langa Langa*

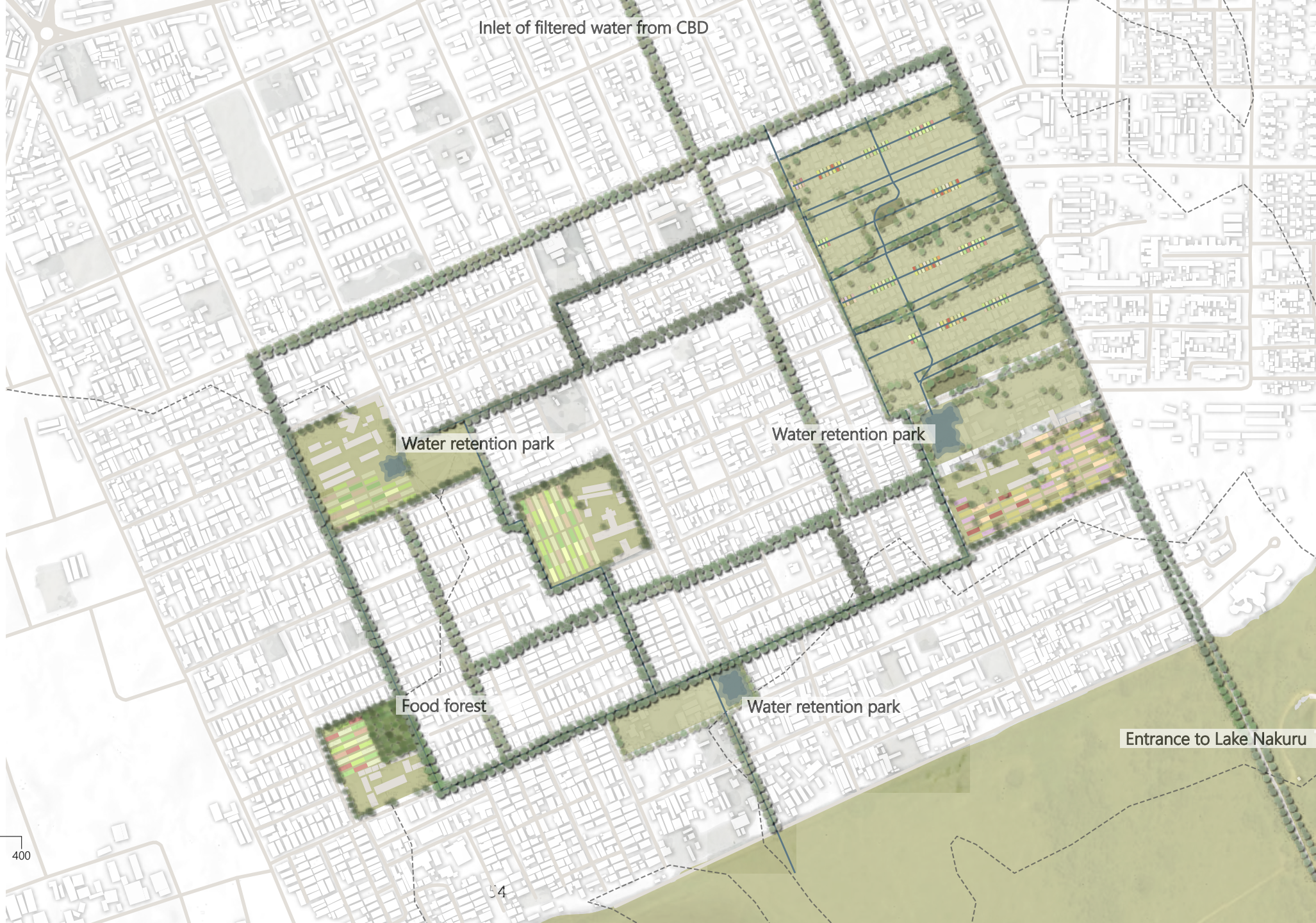



## *Langa Langa*

*Flood risk | lower | flatter*

*Image by author*

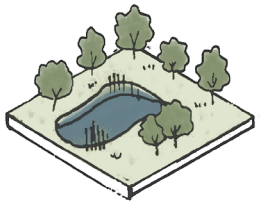
# *Use*
# *Langa Langa*




- Existing nature (Control)
- Langa Langa (Use)
- Green connection
- Urban agriculture
- Blue connection
- Water retention area
- Grey water

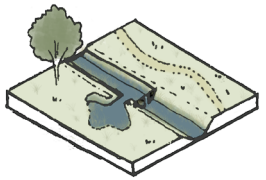
0 100 200 300 400

# *Use*
# *Langa Langa*



Water retention and park

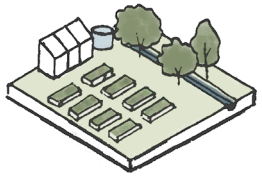
Agroforestry



Slow delay

School garden

- Existing nature (Control)
- Langa Langa (Use)
- Green connection
- Urban agriculture
- Blue connection
- Water retention area
- Grey water



Community garden

0 100 200 300 400

Inlet of filtered water from CBD

Water retention park

Water retention park

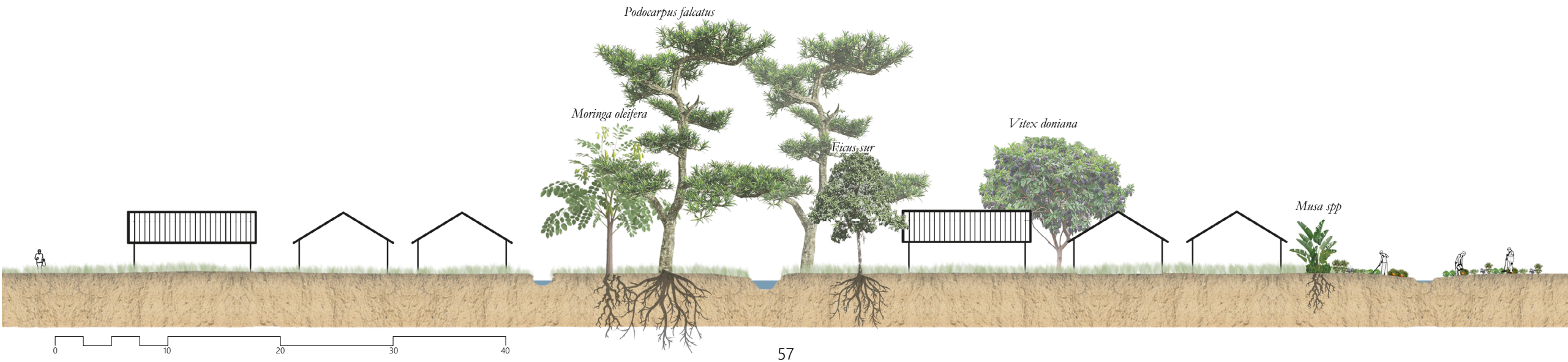
Food forest

Water retention park

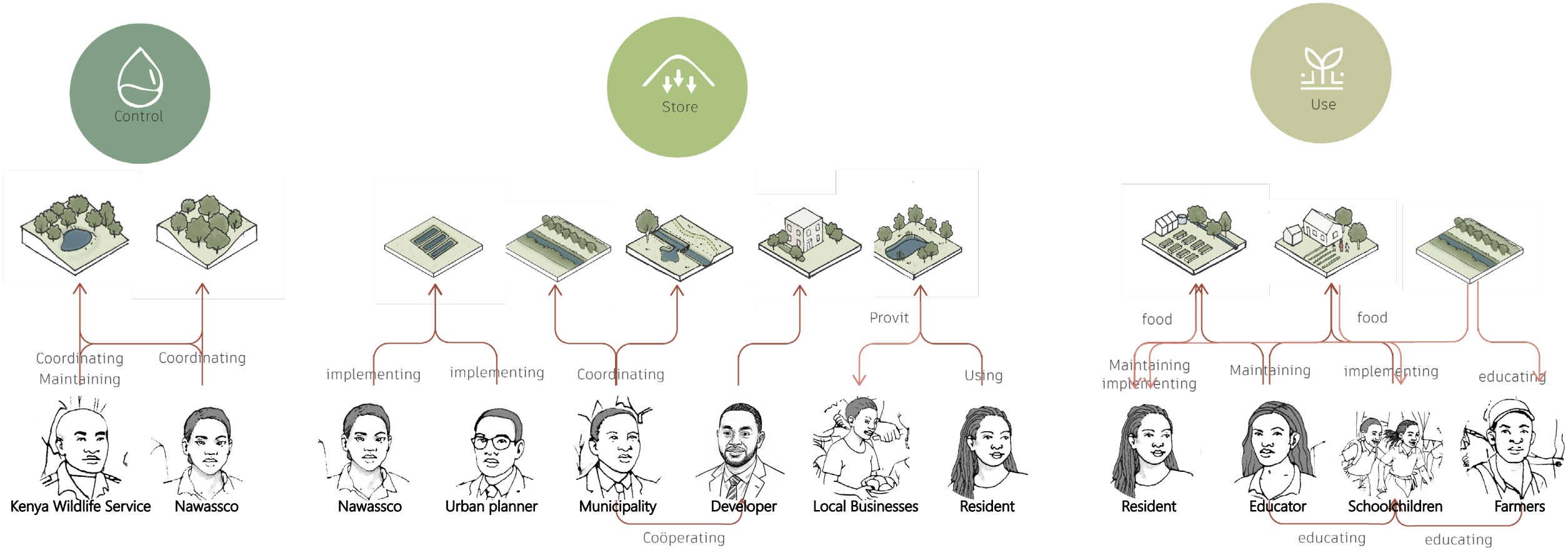
Entrance to Lake Nakuru

*Use*
*Langa Langa*

# *Use*
# *Section Langa Langa*



# Stakeholder engagement

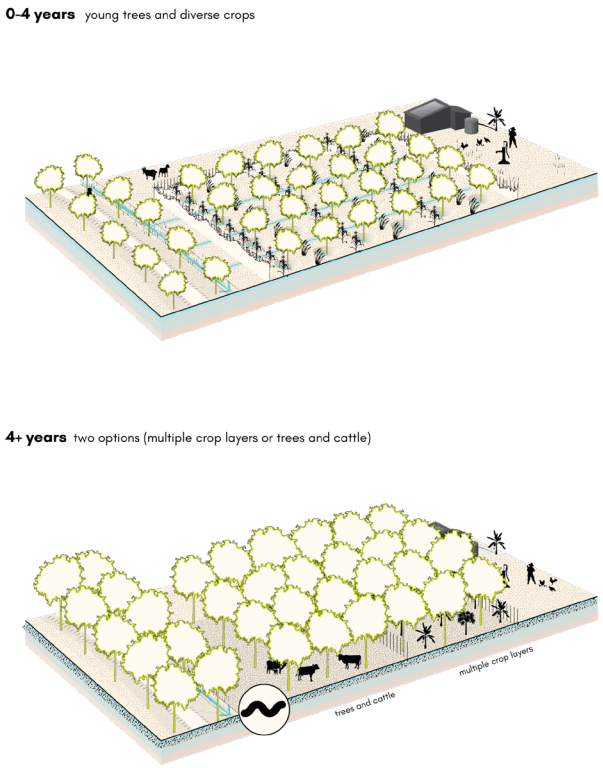


# Succes stories

International Tree Foundation, Nakuru

*Images from Globe Gone Green's past school projects (International Tree Foundation, 2023)*

African Wood Grow



*(Africa Wood grow, 2024)*

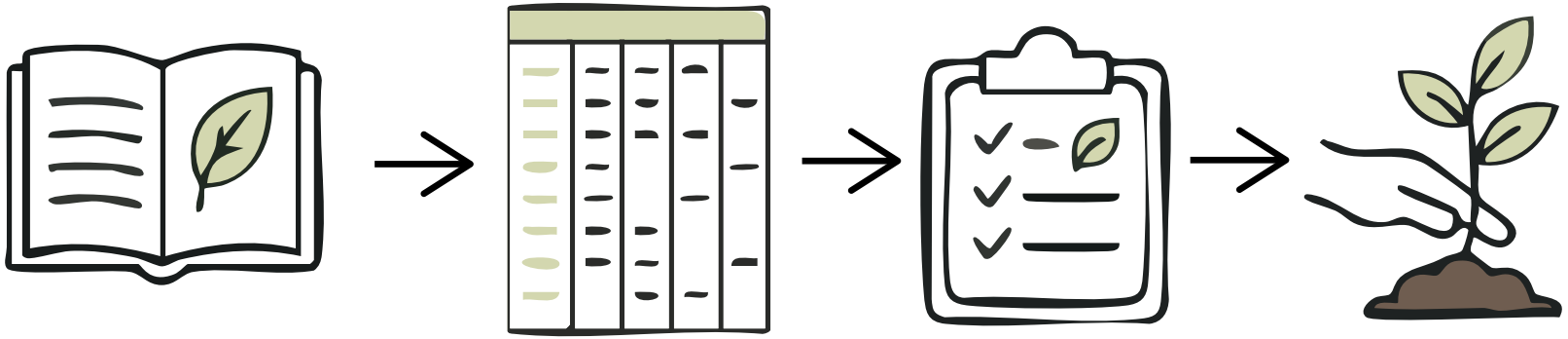
# Species manual

*Search species*

*Look for specific species qualities*

*Select species*

*Plant and care for the selected species*



# Timeline

Phase 1
*0-3 years*

Phase 2
*3-7 years*

Phase 3
*7-12*

Phase 4
*12-20 years*

Future of Nakuru
*20-50 years*

What **regenerative urban landscape framework** can guide rapidly growing Nakuru to balance **water management** and **biodiversity restoration**?

**Control, Store, and Use.** Each one reflects not just topography, but also local needs, ecotypes, and governance capacity.

The framework is rooted in water, driven by ecology, and shaped by people.

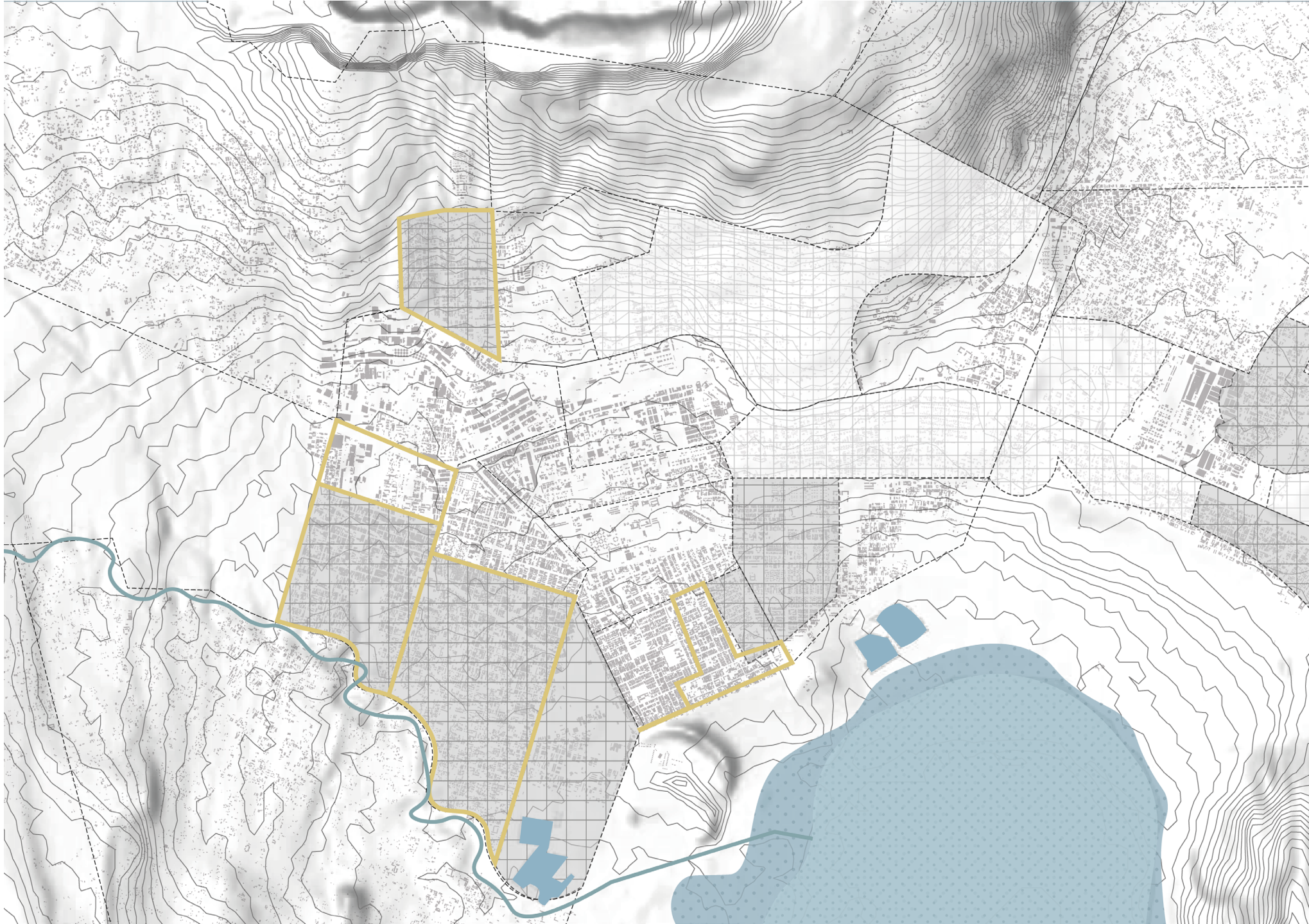
This design shows that regenerative urbanism is more than reducing harm, it's about actively repairing systems. It's not a one-time fix, but a continuous process of co-creation, stewardship, and adaptation.

# Reflection

*This project changed how I see my role as a landscape architect.*
*I've learned that we don't just design space, we design systems of care, participation and resilience. Especially in places with fragile governance, the role becomes even more essential: to connect people, systems, and landscapes in a way that is resilient and regenerative.*

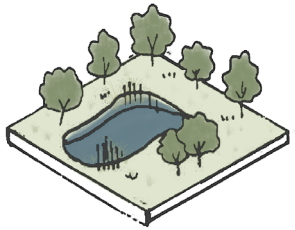
Asante sana
2D

Karibuni Nakuru!

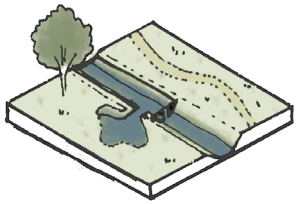


Downstream
Midstream
Upstream
0
0,5
1
1,5
2 km

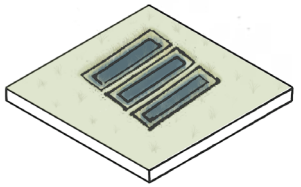
## Water management



Water retention and park



Slow delay

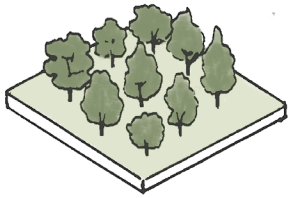


Water filtration ponds

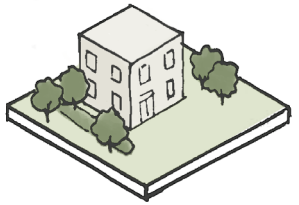
Retention pond

## Socio-productive

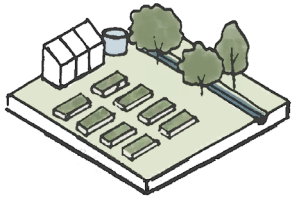
School garden



Agroforestry

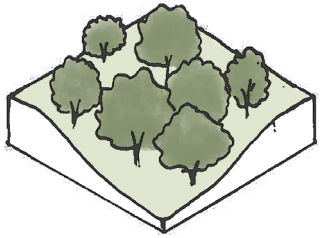


Building and public space

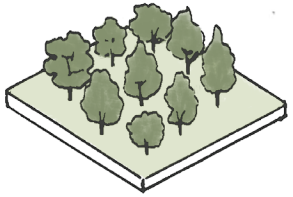


Community garden

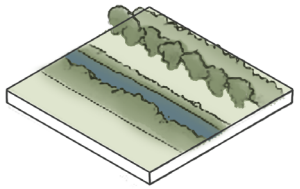
## Ecological



Indigenous trees



Agroforestry



Nature inclusive corridor

- Social Value
- Water retention
- Biodiversity
- Productivity
- Health value

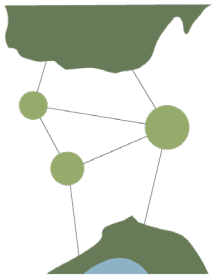
# Design principles

Connect through local potential

Co-evolution for humans and species

Green-blue connections

Create habitats within the system

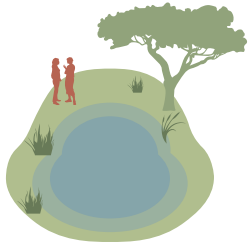


Native vegetation

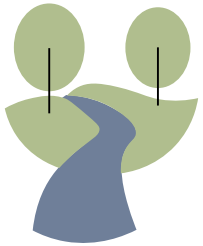
Protection through direct purpose

Urban agriculture

Combining functions water retention and social gathering



Approach based on the natural course



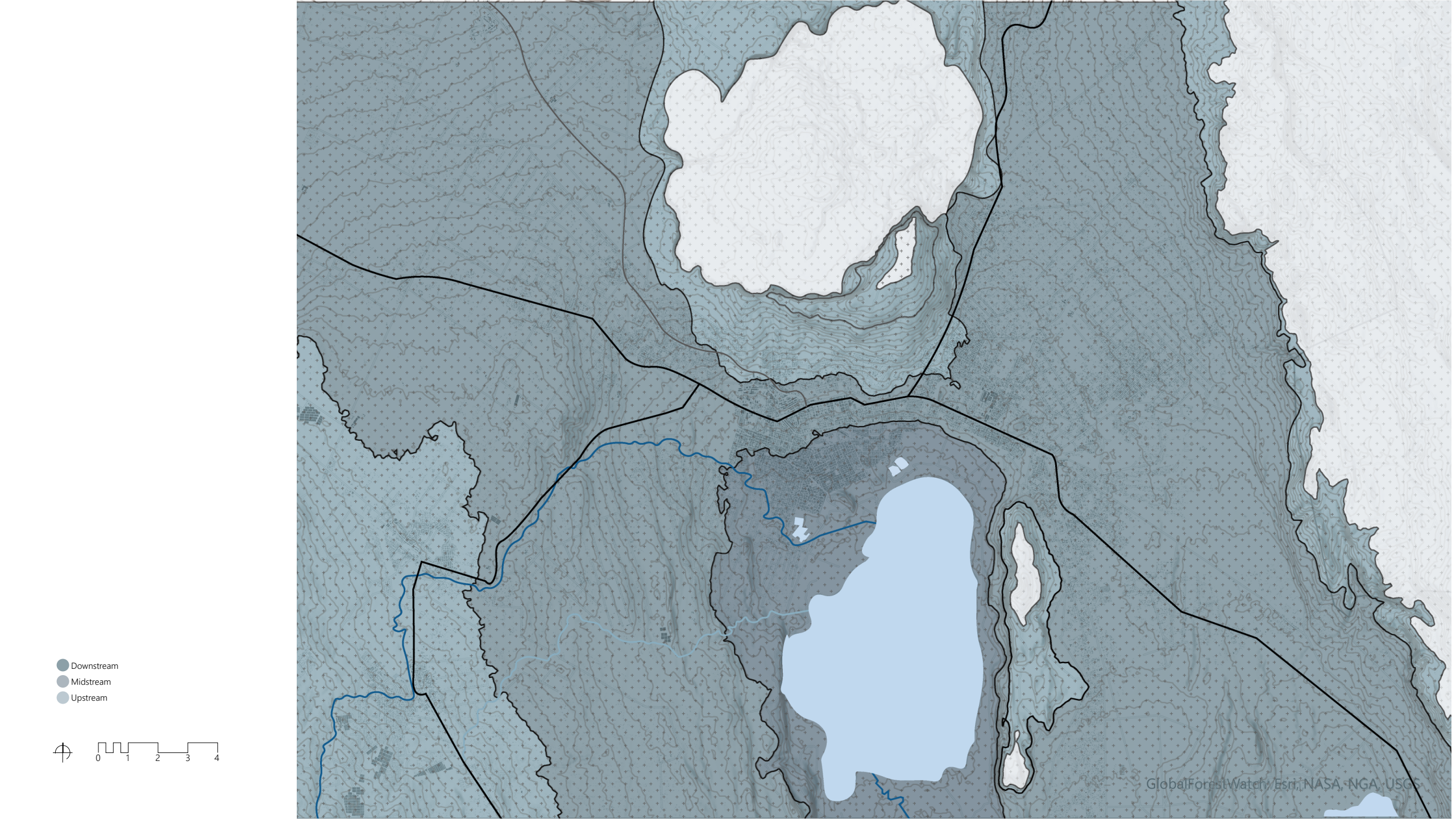
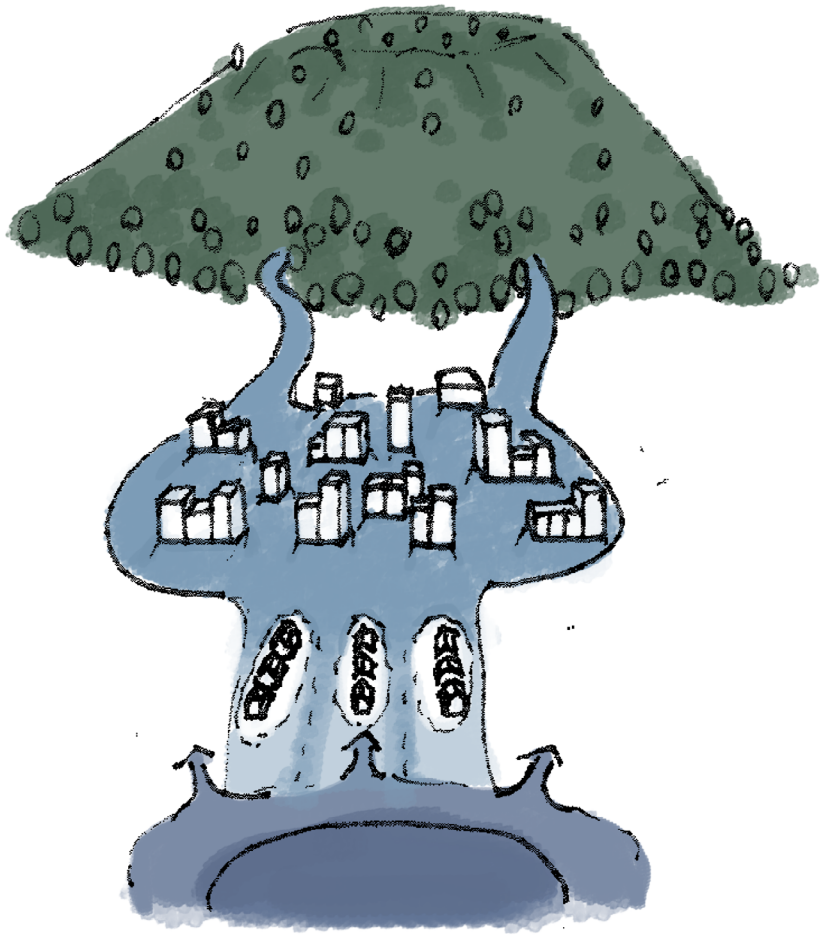
Engage local institutions for greening efforts and long-term care

Knowledge sharing

*Image by author*

NOW Open!
NAKURU HOUSE
OMEGA
OPTICIANS
Kimotho Hse
Ground Floor
Kenyatta Avenue
0712 267 676
www.omegaopticians.com
MEDICAL CARDS ACCEPTED
HD+ WATERPROOF FULLSCREEN
A37
LAMS BUSINESS MALL

NOW Open!
OMEGA
OPTICIANS
Kimotho Hse
Ground Floor
Kenyatta Avenue
0712 267 676
MEDICAL CARDS ACCEPTED
JUMAH
LANG BUSINESS MALL


Downstream
Midstream
Upstream
0
1
2
3
4
GlobalForestWatch, Esri, NASA, NGA, USGS

# Problems