# EMBRACE THE FLOOD

*Introducing a Symbiotic Lifestyle:*
*Designing Resilient and Livable Landscapes in Winnipeg by Integrating Nature-Based Solutions into the Urban Water System*

P5
Chang Sun 5573491
29.6.2023

Urban Ecology Lab
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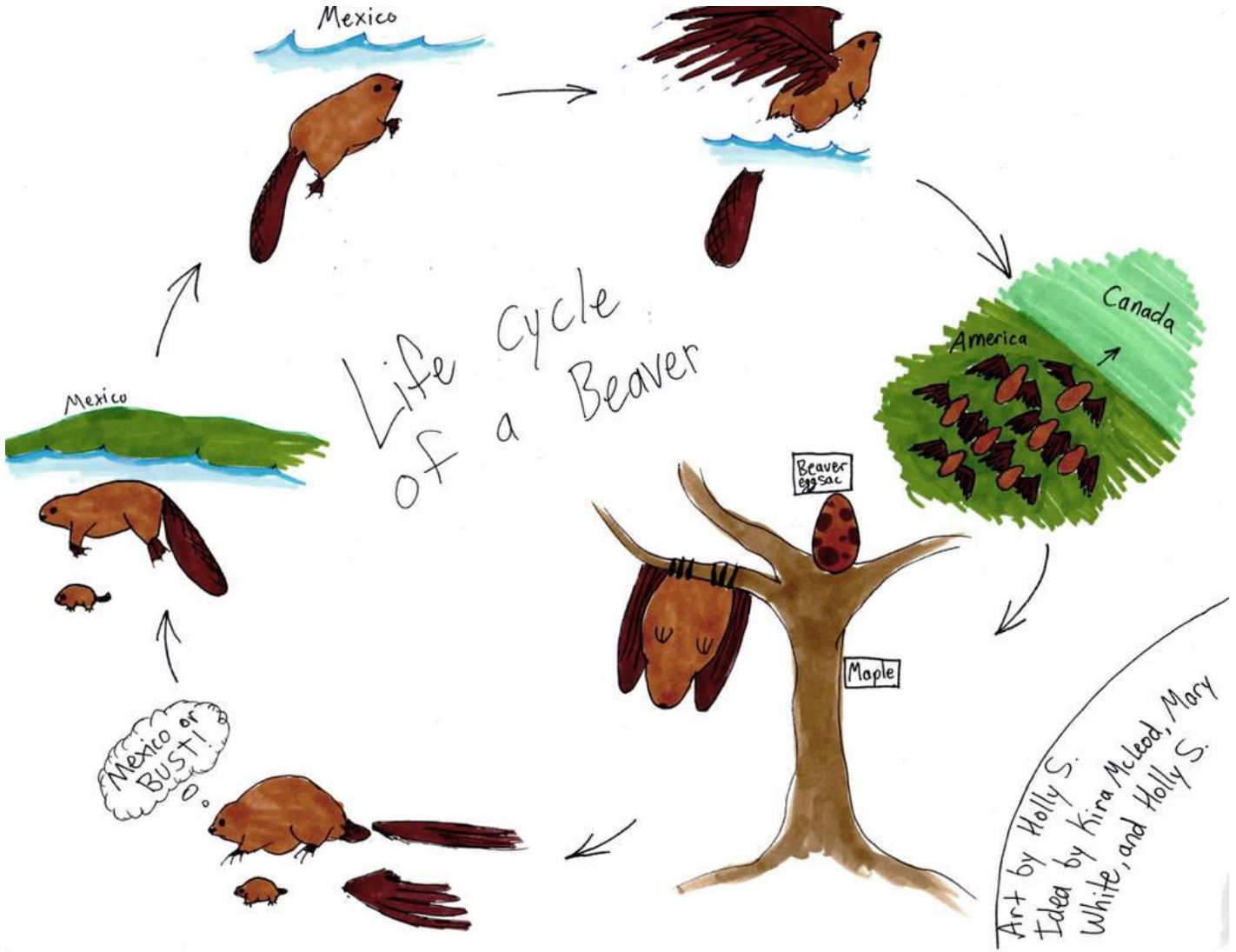
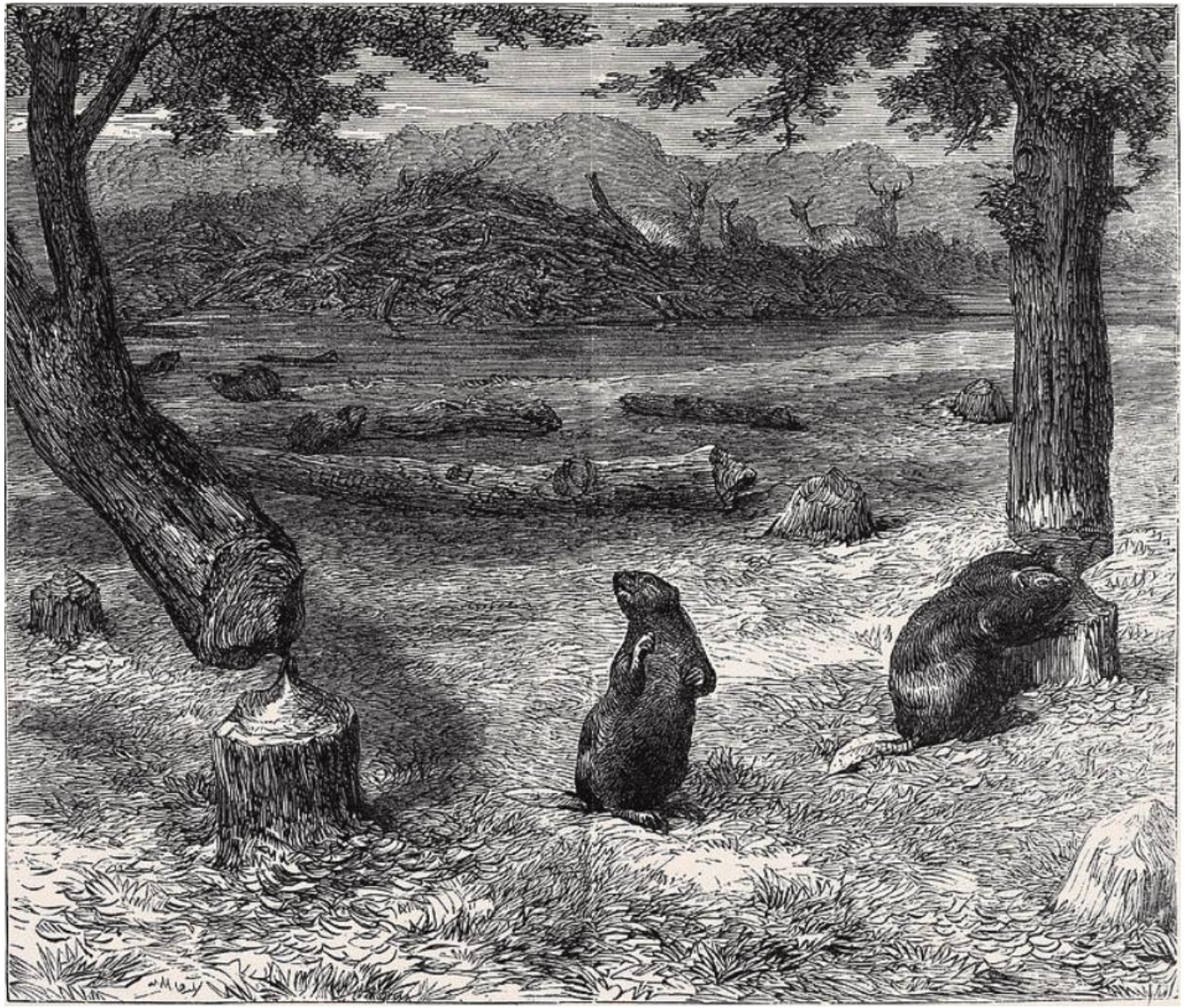
Second Mentor: Kristel Aalbers

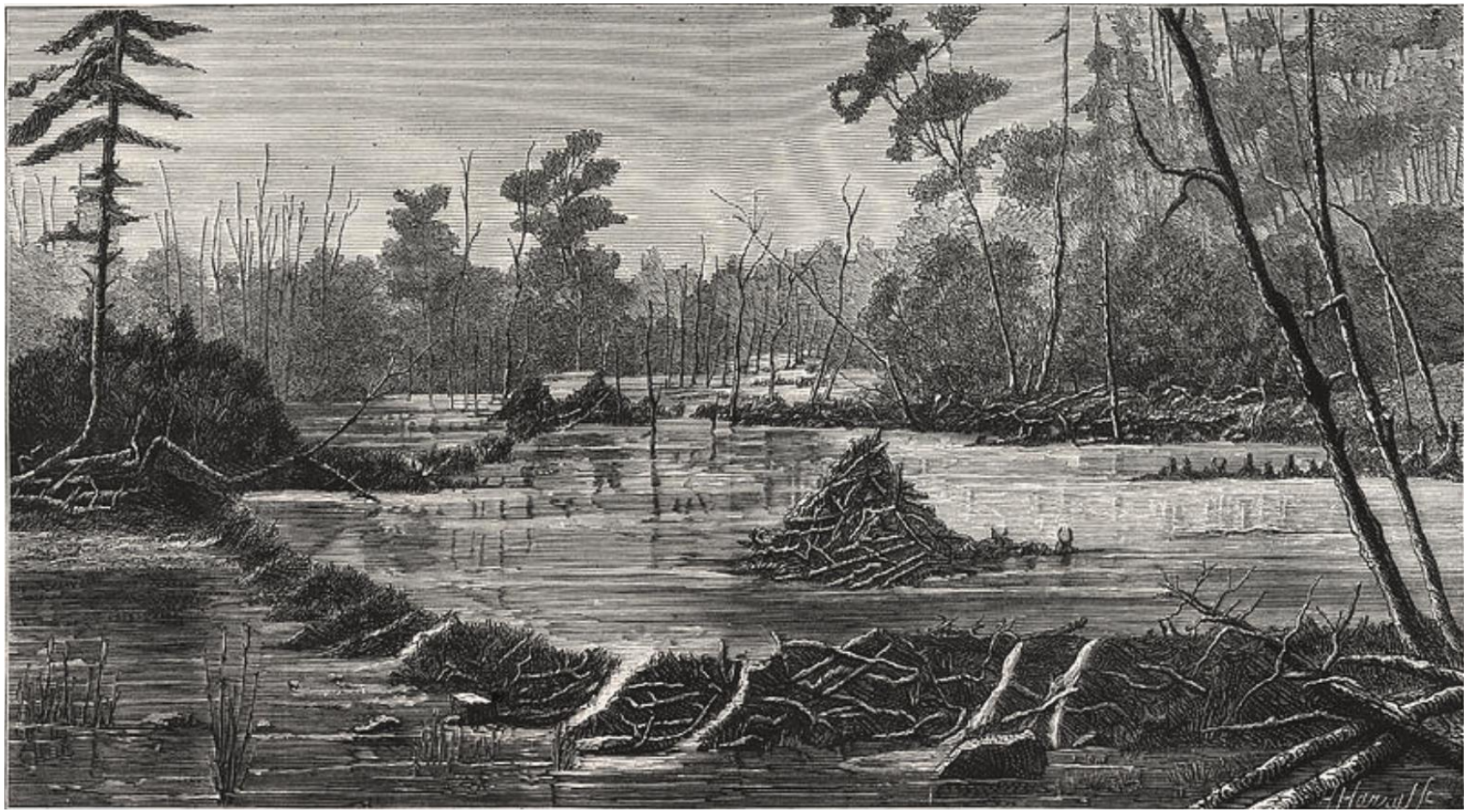

**North American beaver**
*Castor canadensis*


Mexico
Life cycle of a Beaver
Canada
America
Beaver egg sac
Maple
Mexico
Mexico or BUST!
Art by Holly S.
Idea by Kira McLeod, Mary White, and Holly S.



*Beavers Cutting Down Trees*
Source: English School

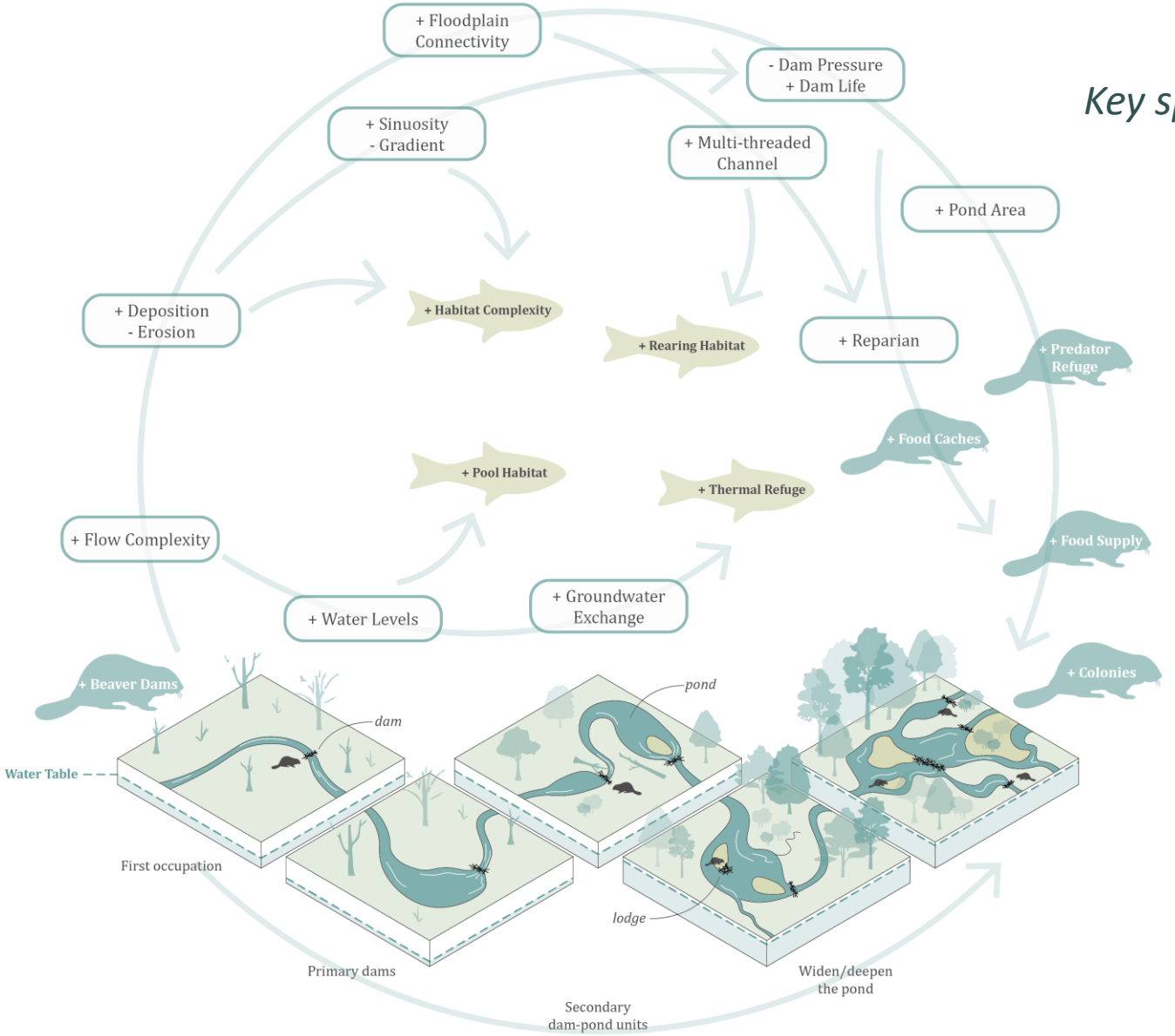
*Beavers With Their Huts And A Dam*
Source: Litz Collection



*Beaver Dams and the Pond*
Source: English School

**Distribution of**
**North American beaver**
*Castor canadensis*

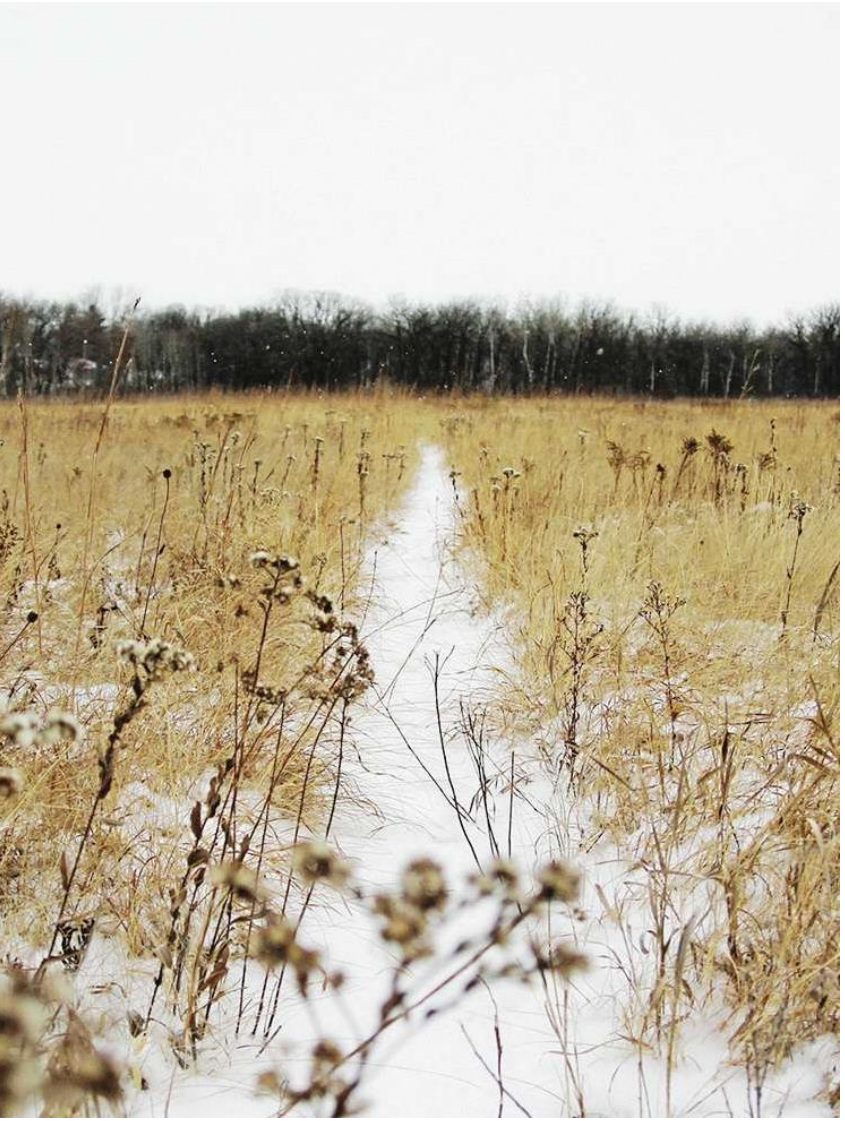
*Key species of a small ecosystem*



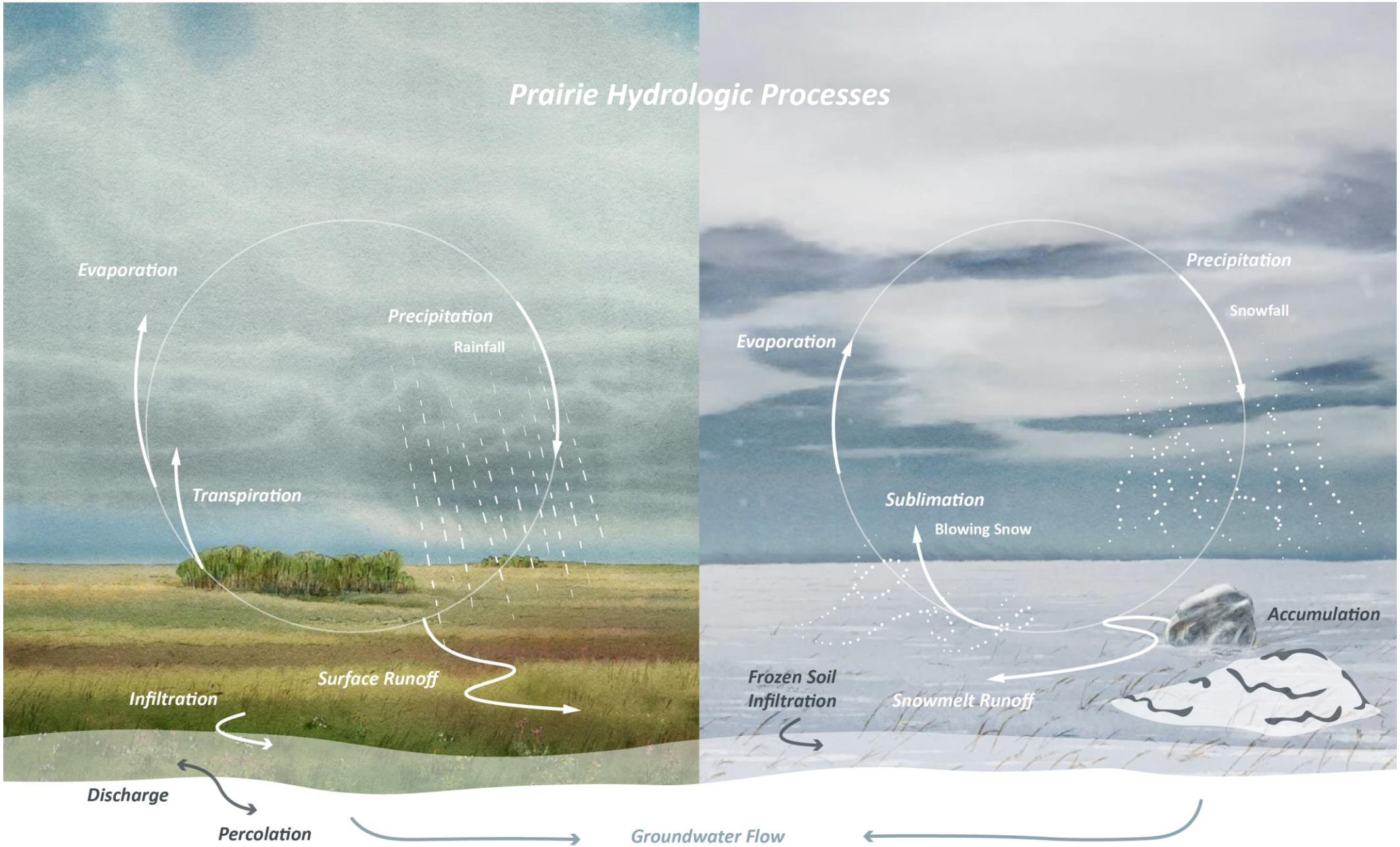


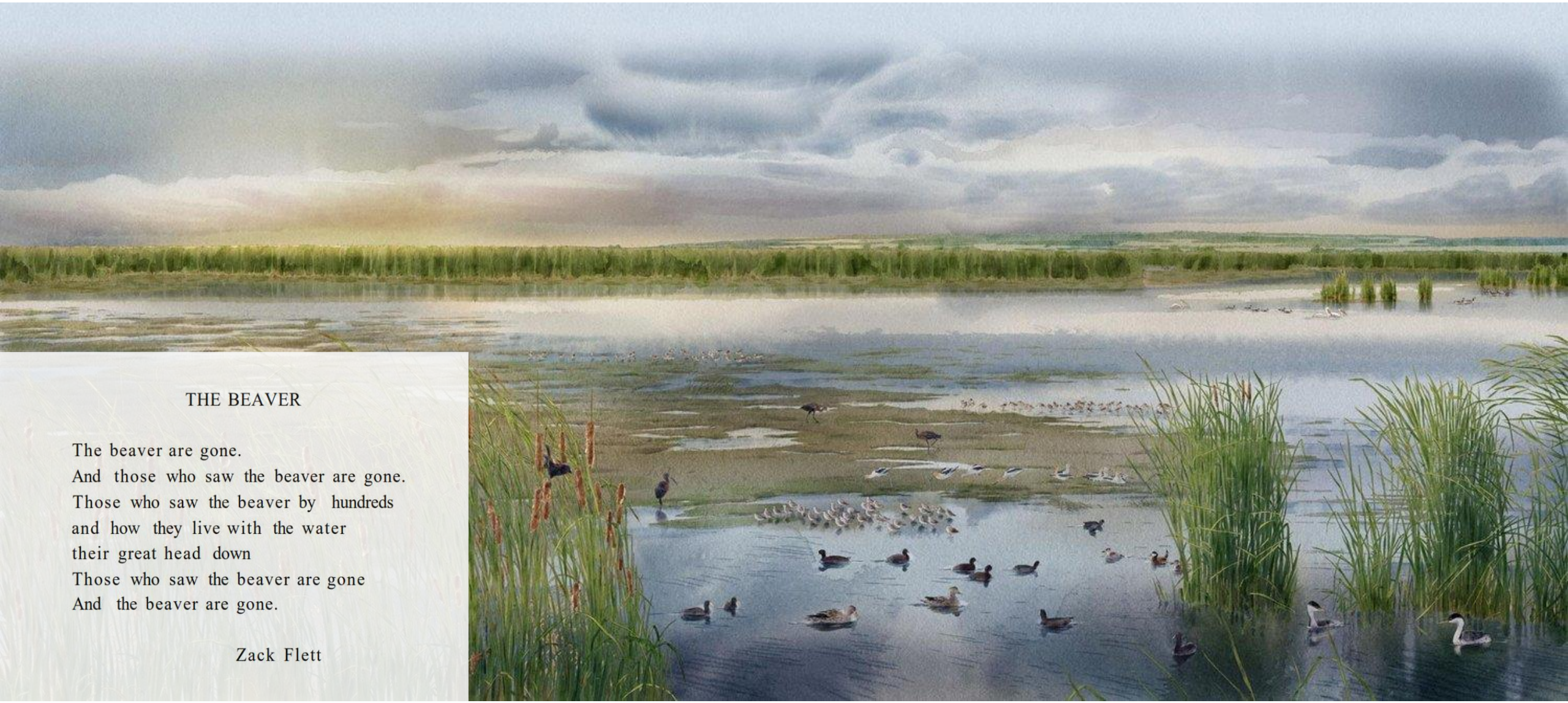
Source : *Nummi, Petri & Liao, Wenfei & Huet, Ophélie & Scarpulla, Erminia & Sundell, Janne. (2019).*

# Experience the Prairie Landscape



Source: Living Prairie Museum


Prairie Hydrologic Processes
Evaporation
Precipitation
Rainfall
Transpiration
Surface Runoff
Infiltration
Discharge
Percolation
Groundwater Flow
Evaporation
Precipitation
Snowfall
Sublimation
Blowing Snow
Accumulation
Frozen Soil
Infiltration
Snowmelt Runoff



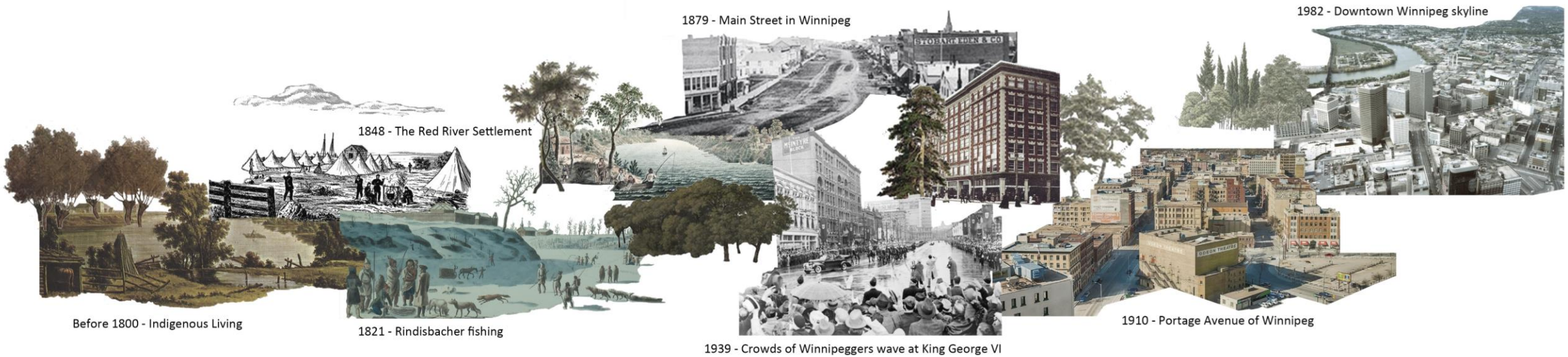
## THE BEAVER

The beaver are gone.
And those who saw the beaver are gone.
Those who saw the beaver by hundreds
and how they live with the water
their great head down
Those who saw the beaver are gone
And the beaver are gone.

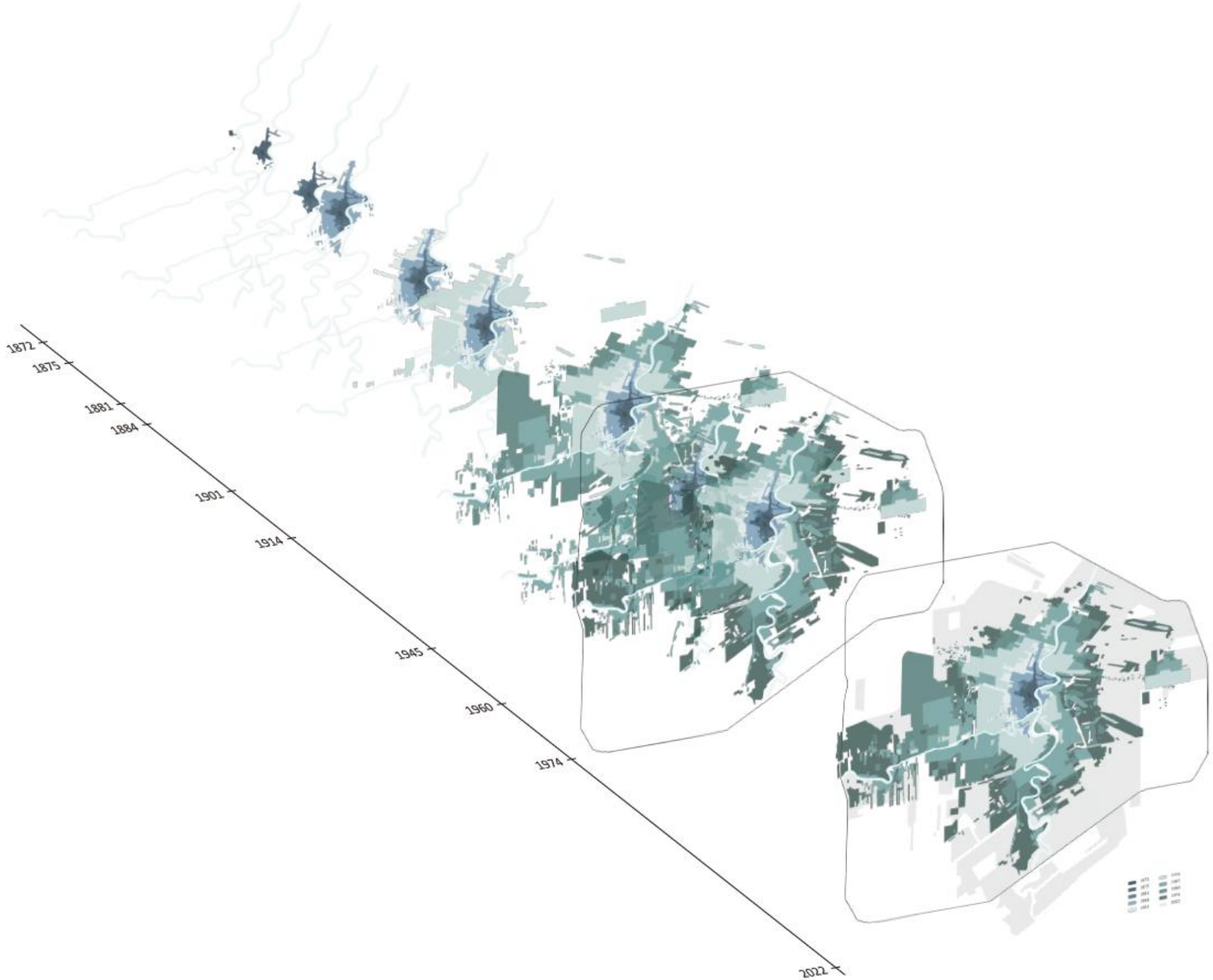
Zack Flett

*Source: Canadian Journal of Native Studies, Vol. 5 No. 2, 1985*

# Modern Landscape

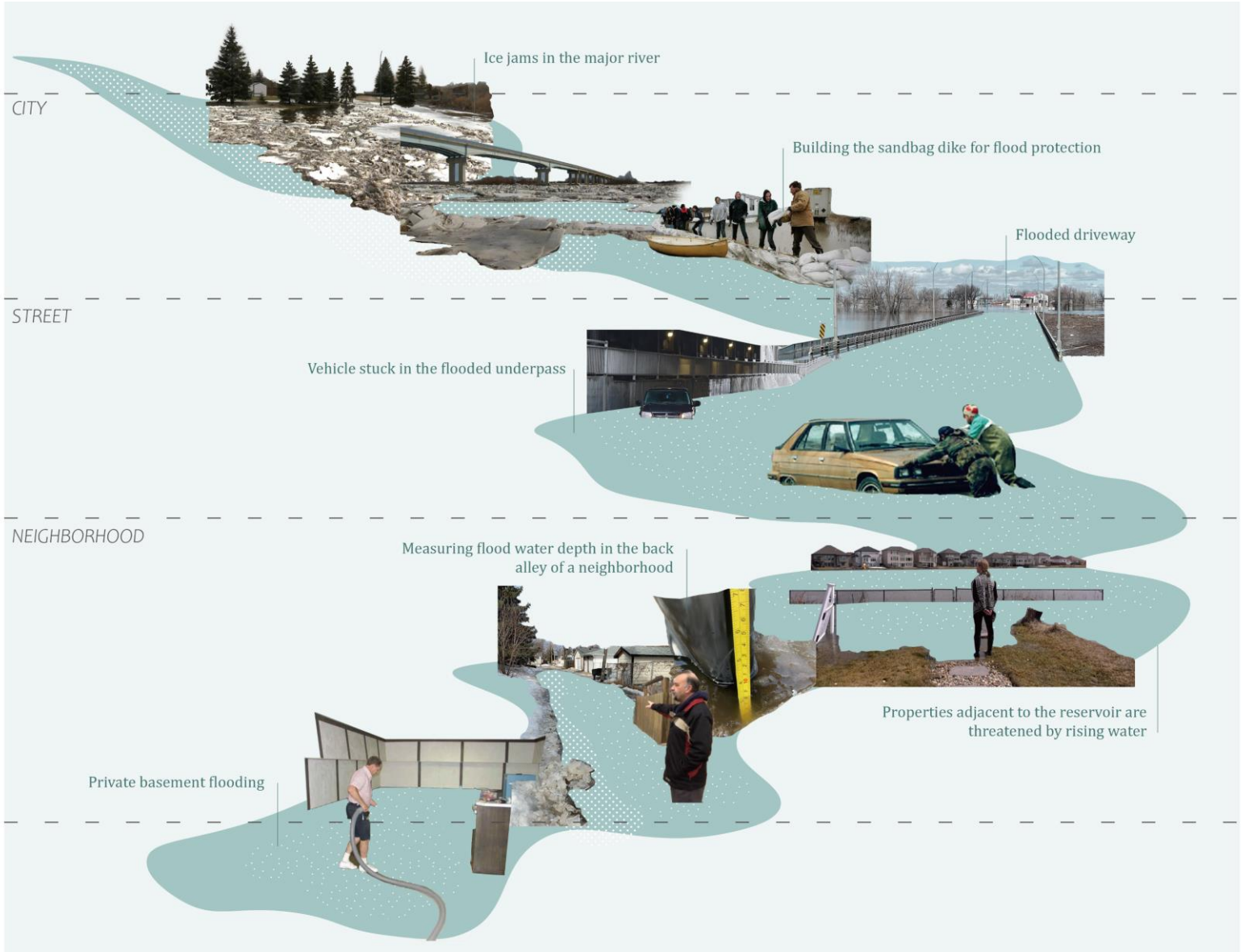


## Urban Expansion Footprint

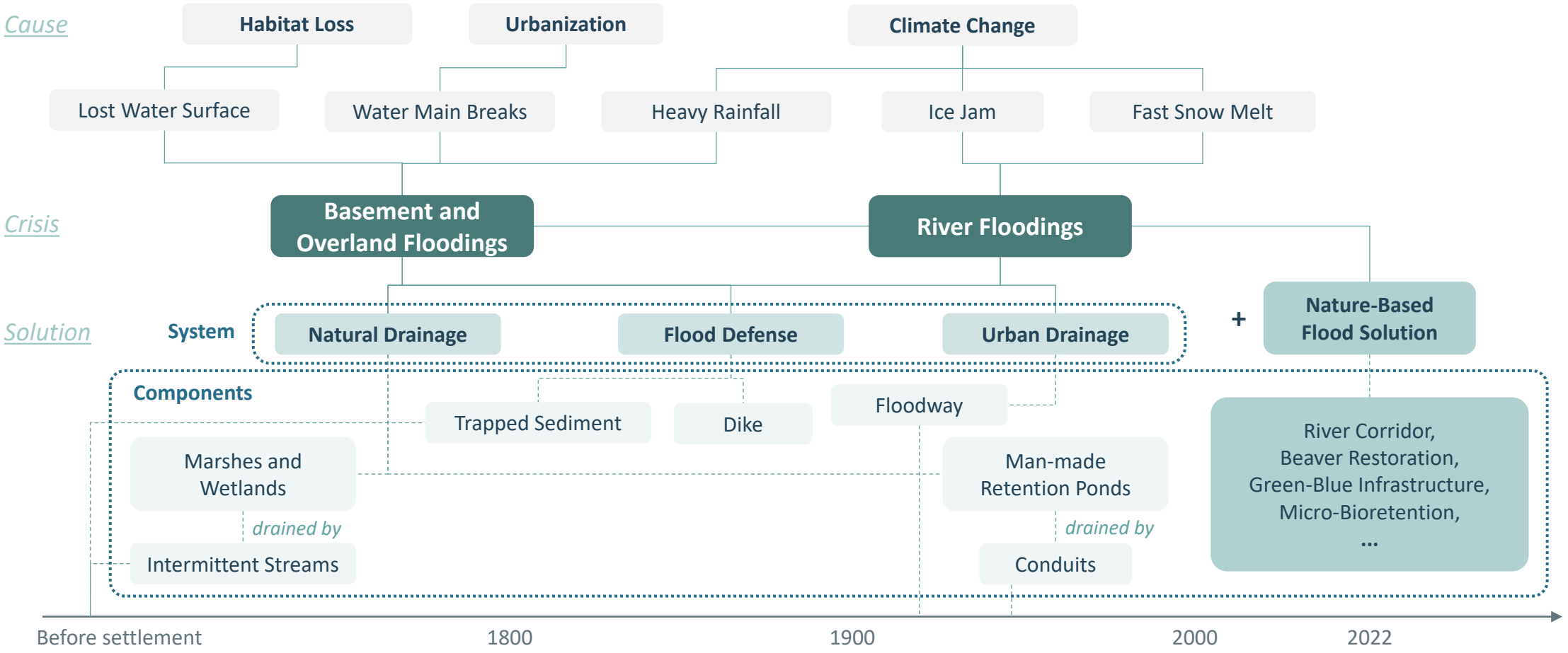


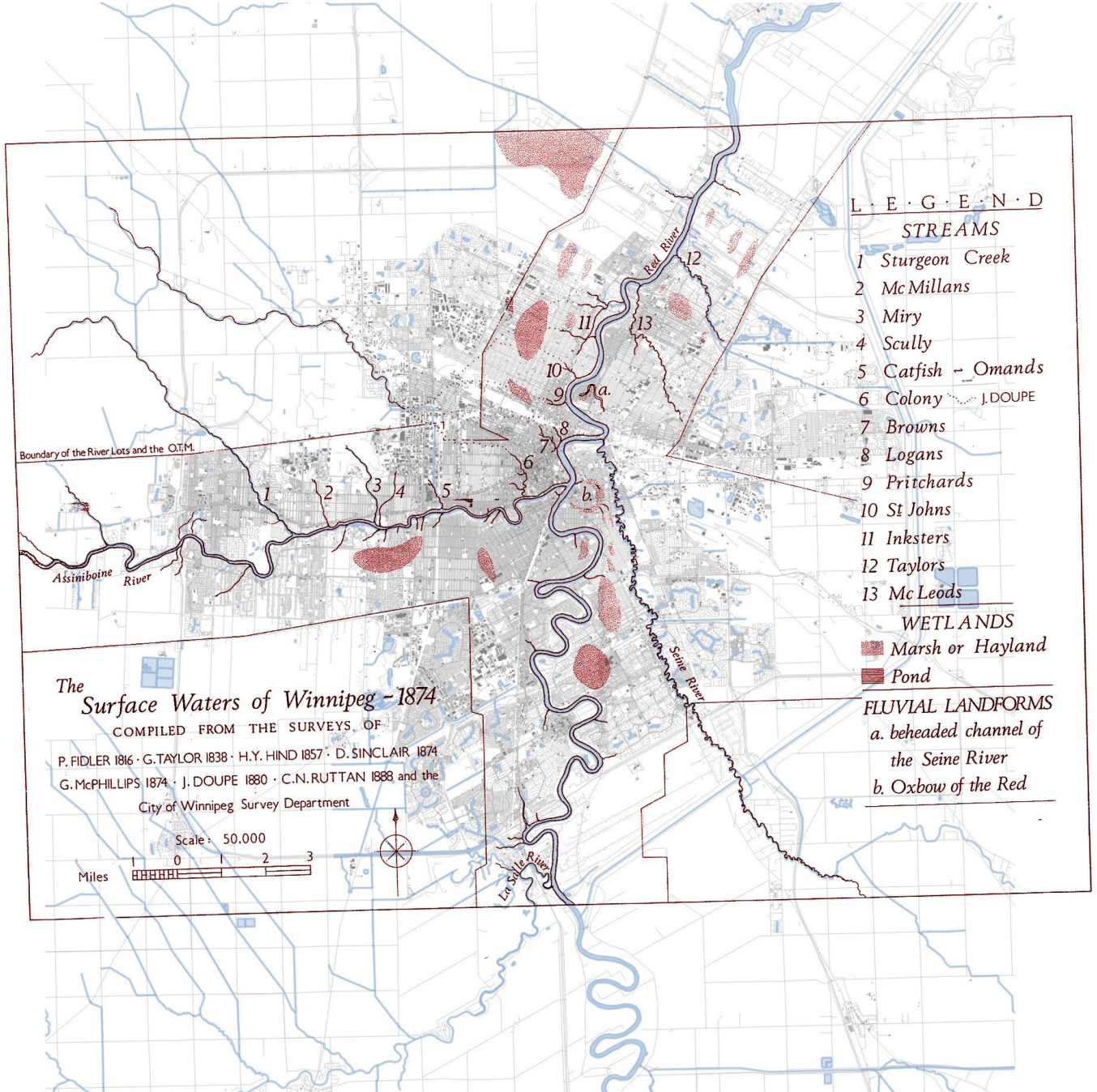
*RESULT!*

Source: City of Winnipeg, 1950

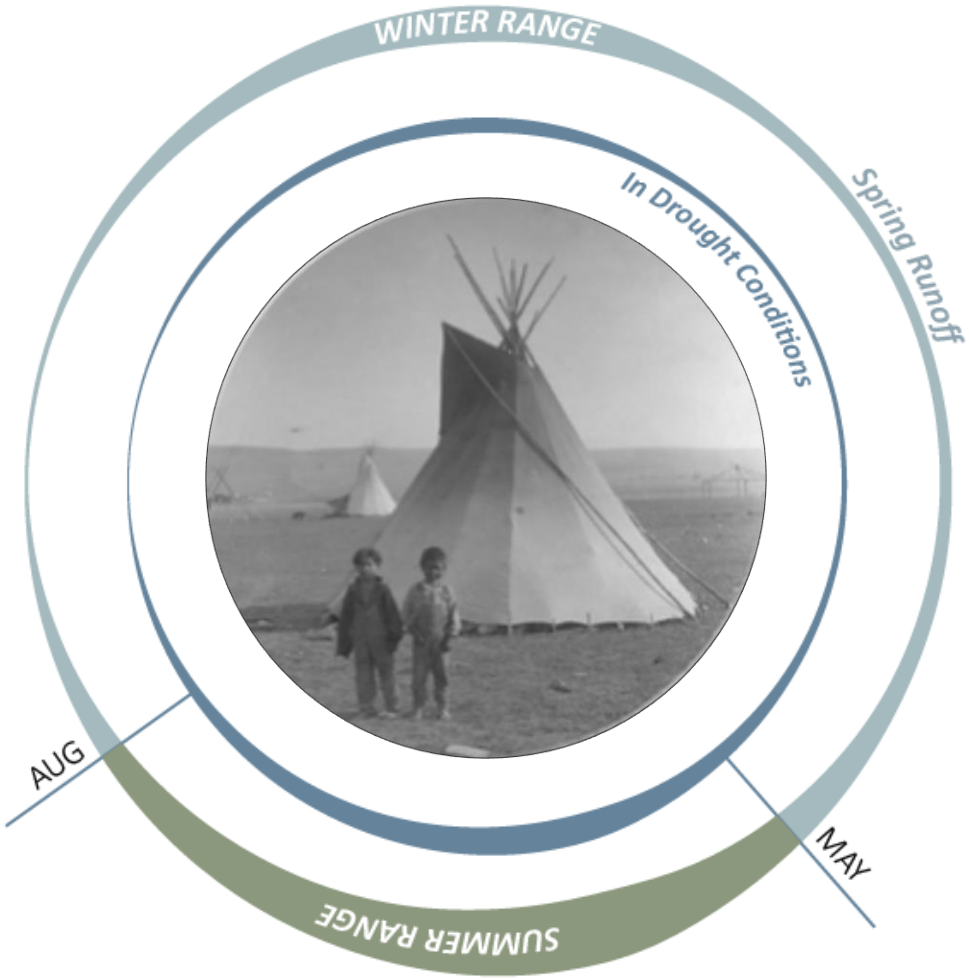

Ice jams in the major river
CITY
Building the sandbag dike for flood protection
Flooded driveway
STREET
Vehicle stuck in the flooded underpass
NEIGHBORHOOD
Measuring flood water depth in the back alley of a neighborhood
Properties adjacent to the reservoir are threatened by rising water
Private basement flooding

# Understanding the Urban Hydrologic System




The Surface Waters of Winnipeg - 1874
COMPILED FROM THE SURVEYS OF
P. FIDLER 1816 · G. TAYLOR 1838 · H.Y. HIND 1857 · D. SINCLAIR 1874
G. McPHILLIPS 1874 · J. DOUPE 1880 · C.N. RUTTAN 1888 and the
City of Winnipeg Survey Department
Scale: 50.000
Miles 1 0 1 2 3
Boundary of the River Lots and the O.T.M.
Assiniboine River
Red River
Seine River
La Salle River
L · E · G · E · N · D
STREAMS
1 Sturgeon Creek
2 McMillans
3 Miry
4 Scully
5 Catfish - Omands
6 Colony
7 Browns
8 Logans
9 Pritchards
10 St Johns
11 Inksters
12 Taylors
13 McLeods
J. DOUPE
WETLANDS
Marsh or Hayland
Pond
FLUVIAL LANDFORMS
a. beheaded channel of the Seine River
b. Oxbow of the Red

*Indigenous Living Pattern on the Prairie*



# Indigenous People Migration Pattern on the Prairie

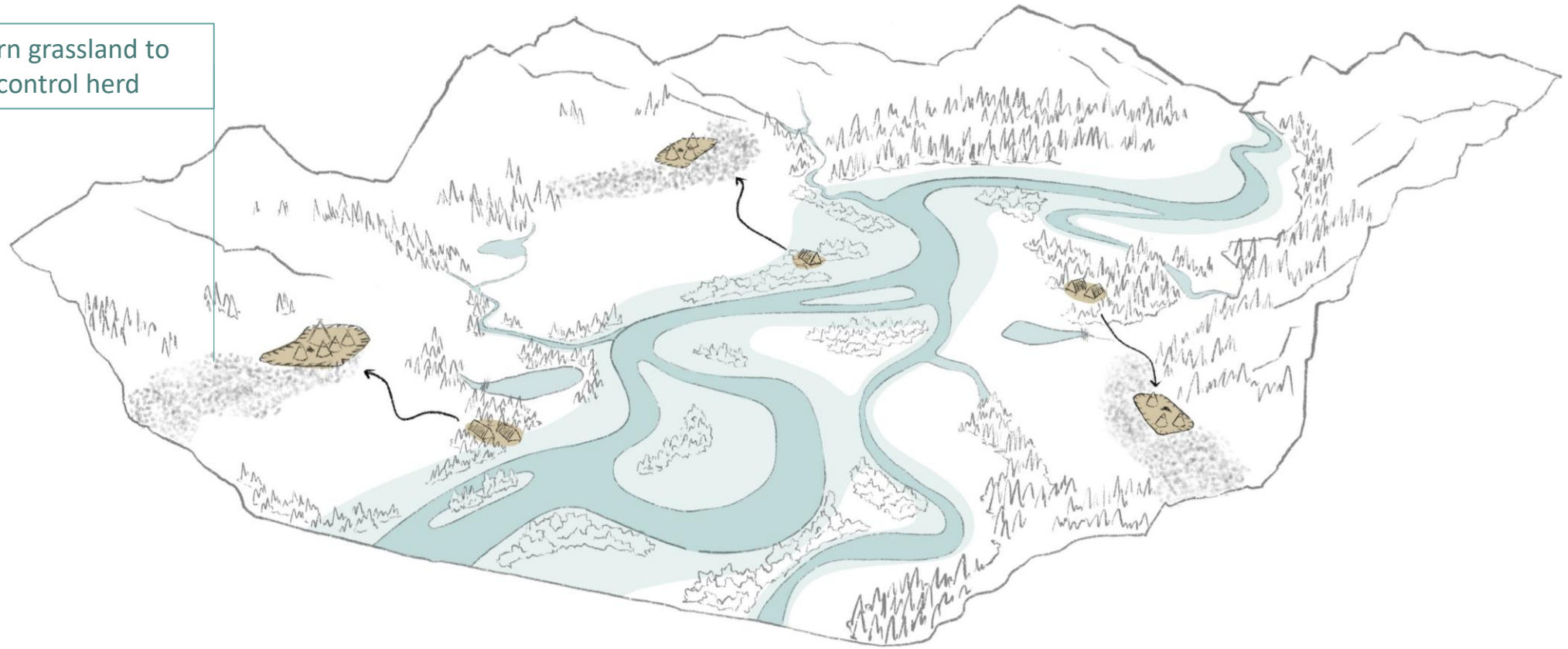
**SPRING RUNOFF** → **SUMMER RANGE** → **WINTER RANGE**

*Move into Higher Ground*

MAY

AUG

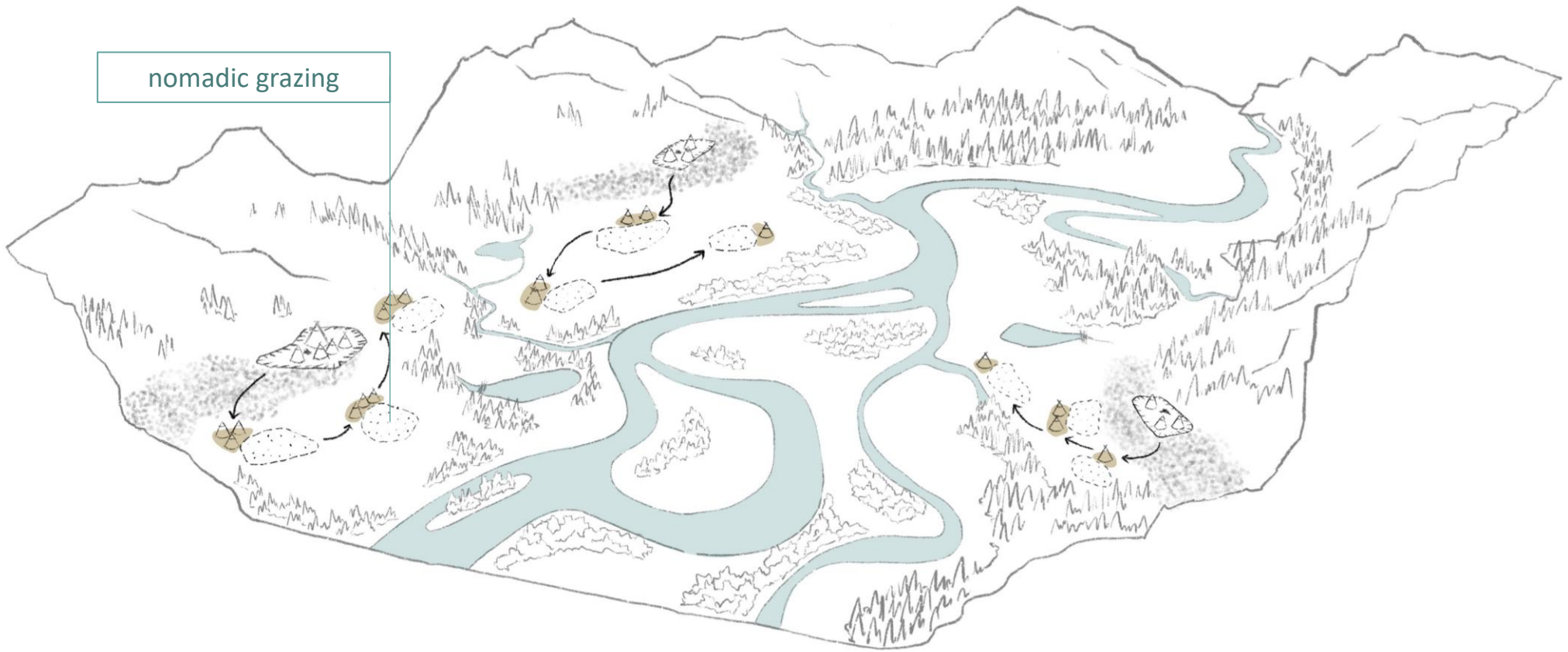
burn grassland to control herd



# Indigenous People Migration Pattern on the Prairie

SPRING RUNOFF → SUMMER RANGE → WINTER RANGE

MAY — *Move to the Prairie* — AUG



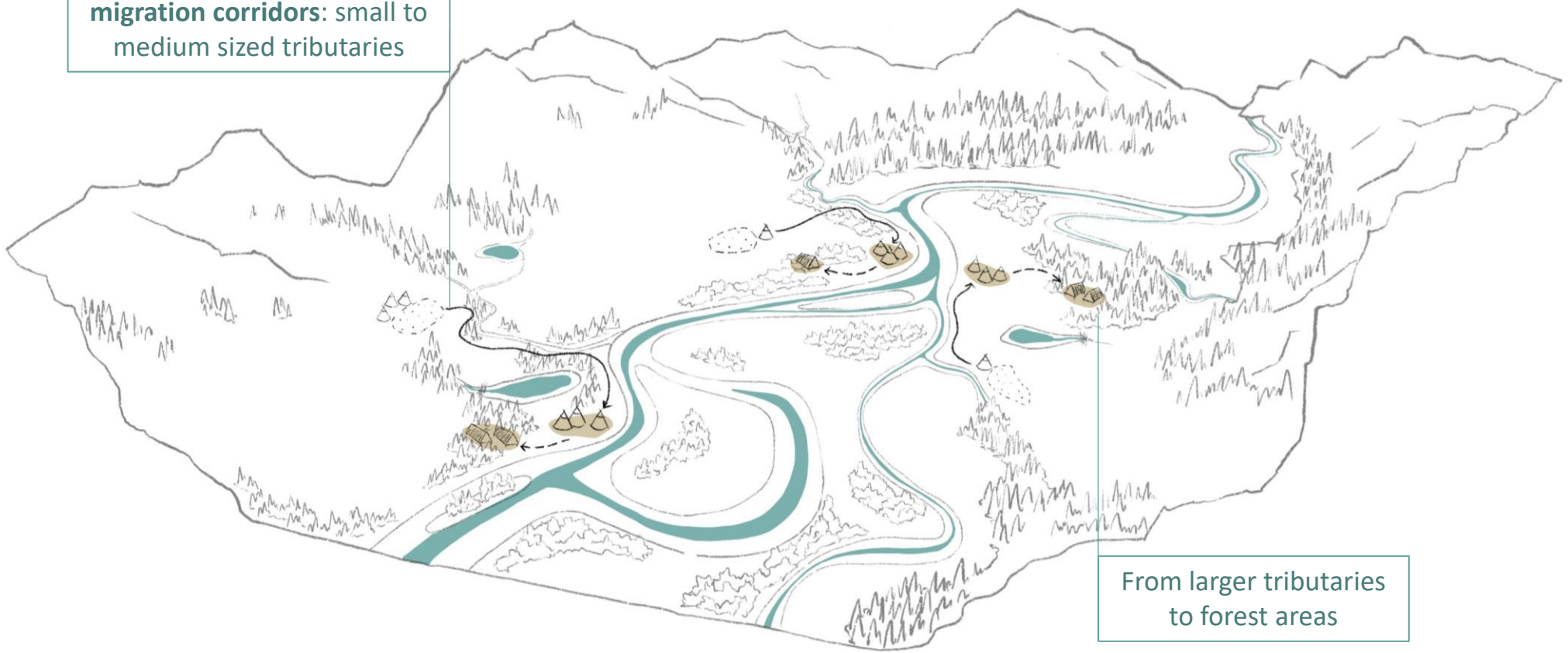
# Indigenous People Migration Pattern on the Prairie

**SPRING RUNOFF** → **SUMMER RANGE** → **WINTER RANGE**

MAY AUG

*Move into the Valley Complex Networks*

**migration corridors**: small to medium sized tributaries



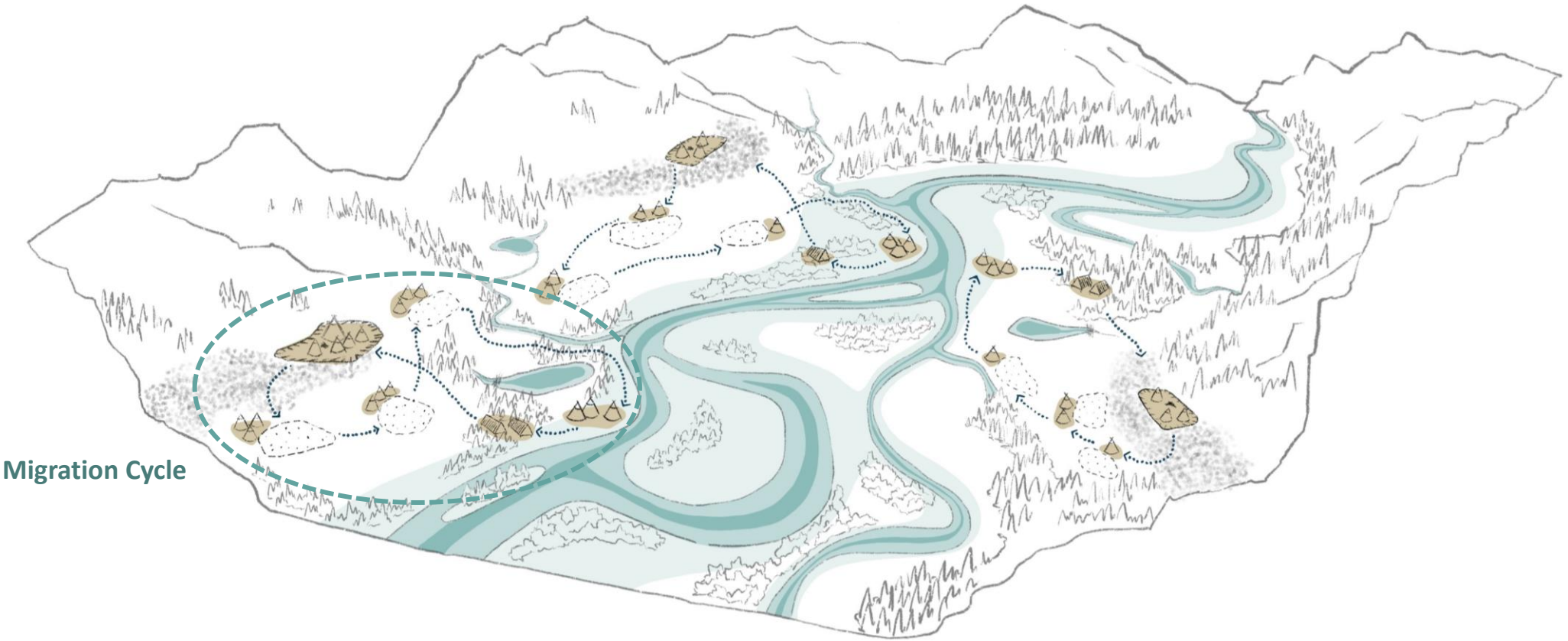
From larger tributaries to forest areas

# Indigenous People Migration Pattern on the Prairie

## In Normal Conditions

SPRING RUNOFF → SUMMER RANGE → WINTER RANGE

MAY AUG



A Migration Cycle

# Indigenous People Migration Pattern on the Prairie

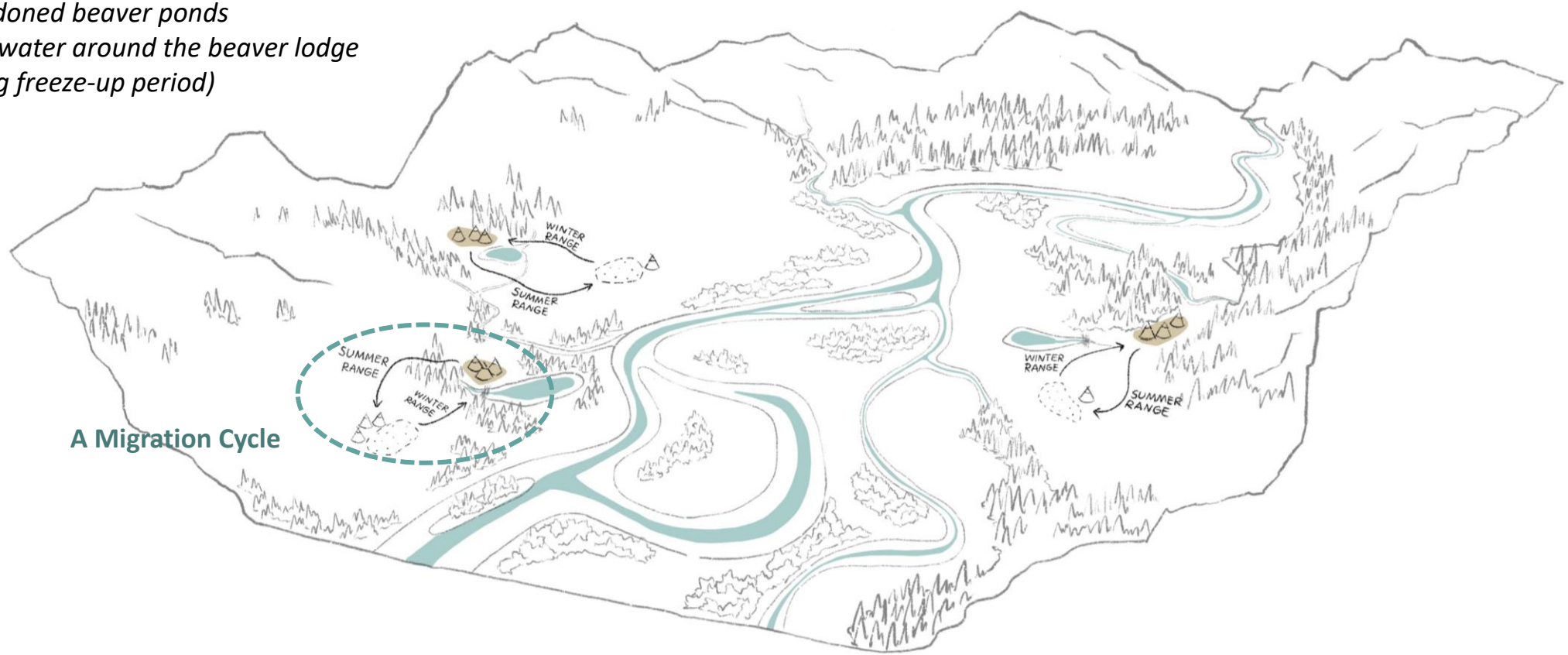
## In Dry Conditions

**SPRING RUNOFF** → **SUMMER RANGE** → **WINTER RANGE**

MAY AUG

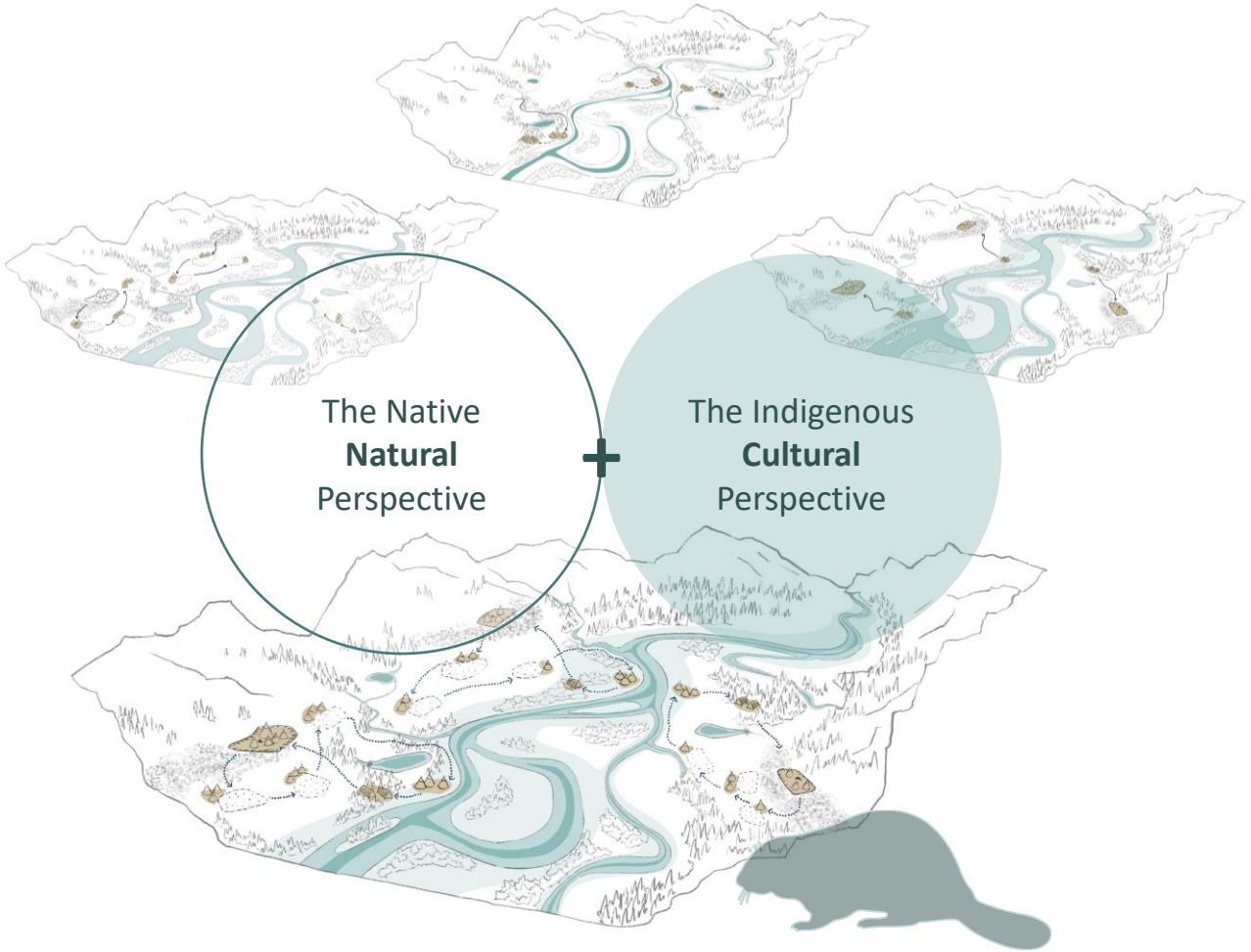
Rely on their knowledge about **beaver habitats** to settle around water sources:

- *the most stable beaver-occupied areas*
- *abandoned beaver ponds*
- *open water around the beaver lodge (during freeze-up period)*

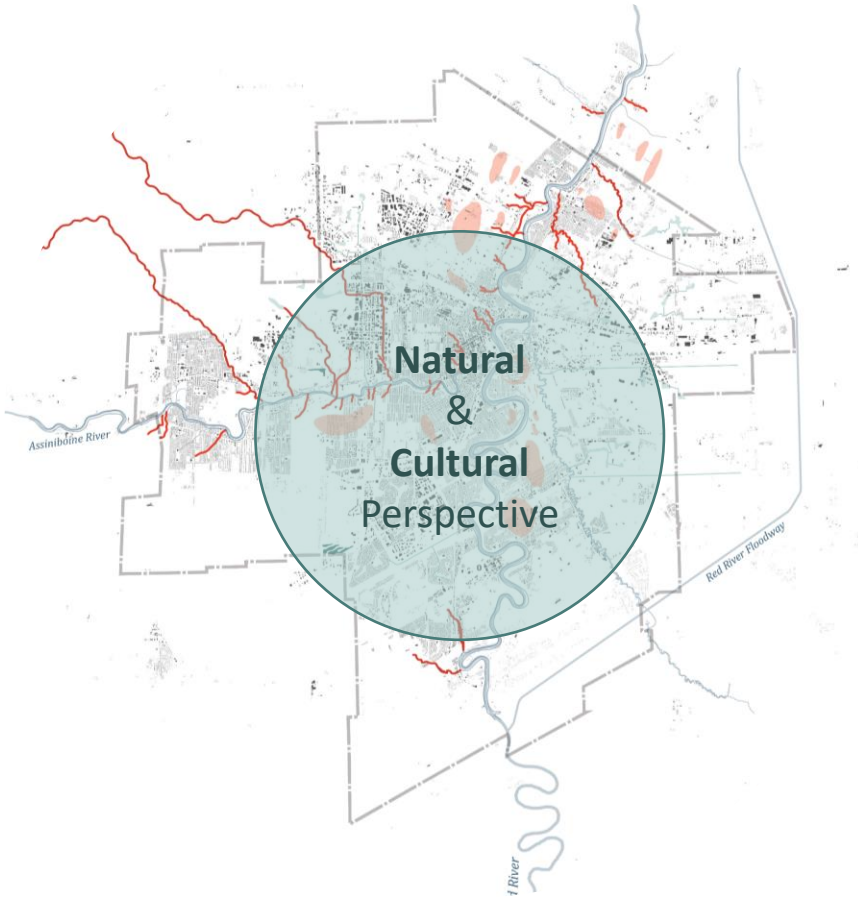



A Migration Cycle

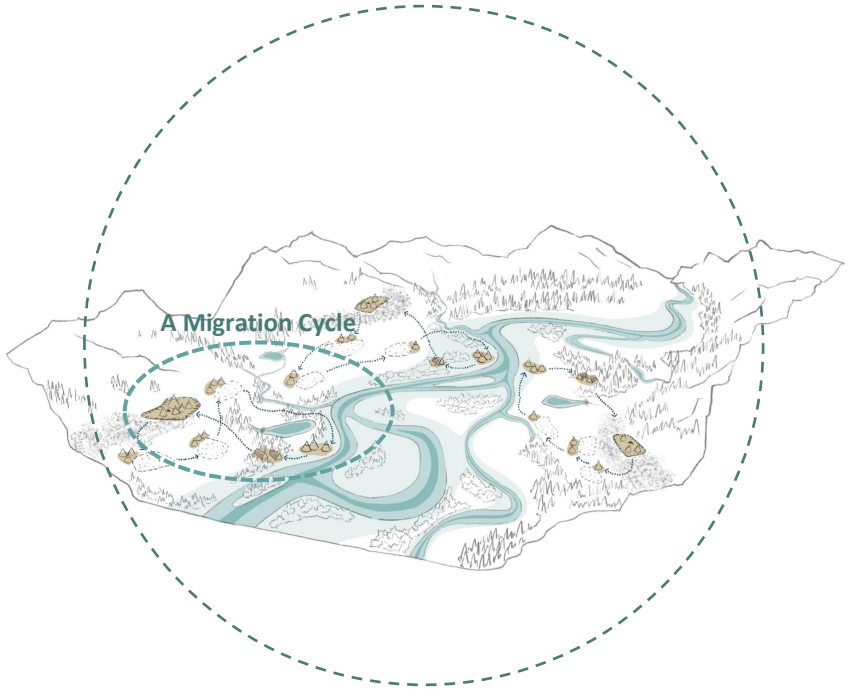
## Reading the **Aboriginal Landscape**



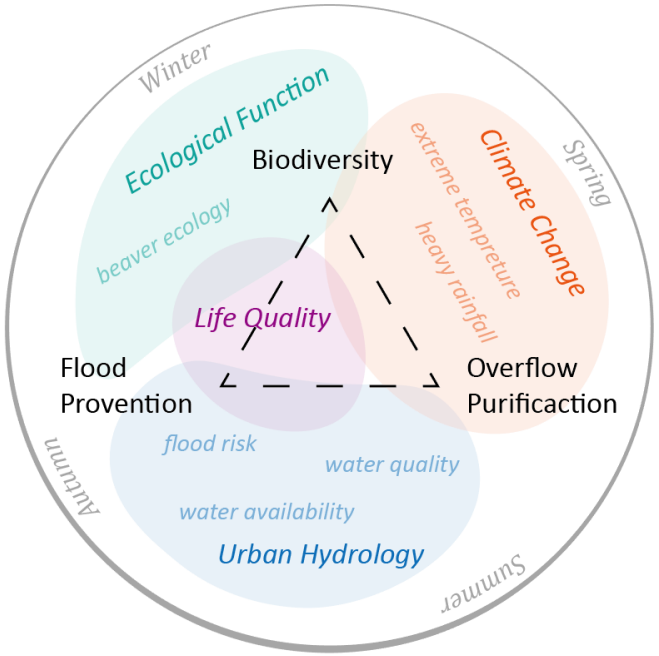

## Reading the **Modern Landscape**



## *Wisdom of using the* ***Aboriginal Landscape***




## *Main Crisis in the* ***Modern Landscape***




## *Imagine the* ***Future Landscape***

*A Livable Cycle?*

+ Economic, social benefits [life quality]
+ Environmental benefits [local biodiversity]

# RESEARCH QUESTION

How to design a **resilient spatial framework** for Winnipeg in response to the flood challenge and integrate nature-based principles to achieve **long-term coexistence between man and wildlife** in a cohesive neighborhood design?

*1. How can we increase **stormwater storage** through ecological rehabilitation based on the current fragmented open space structure?*

*2. How to incorporate Winnipeg's **urban hydrologic system and ecosystem** into the solution response to threatening floods?*

*3. In what way can we use **beaver ecology** as a cost-effective strategy to secure and stabilize water flows in the urban system?*

*4. Can the deep connection of **human settlements and local ecosystem** in the indigenous insight be revitalized in the urban dwelling environment?*

**Keywords:** Flood Resilience, Urban Water System, Nature-based Solution, Green-blue Infrastructure, Livable Cities, Urban Ecology, Beaver Recolonization

# EMBRACE THE FLOOD

*Solving the Uncertainty?*

# EMBRACE THE FLOOD

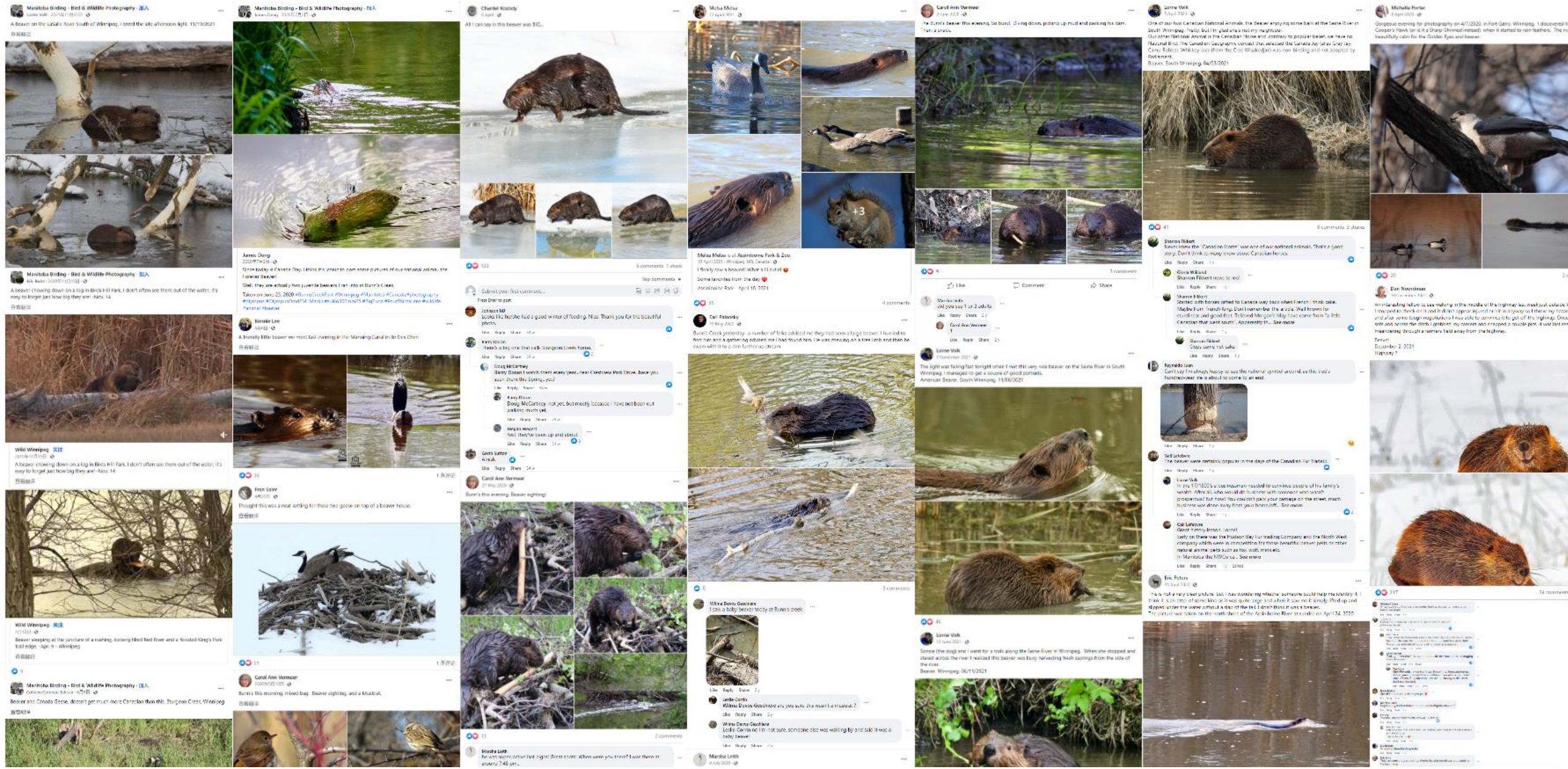
*To Live with the Uncertainty!*

*Imagine*

*A Landscape Evolving with*

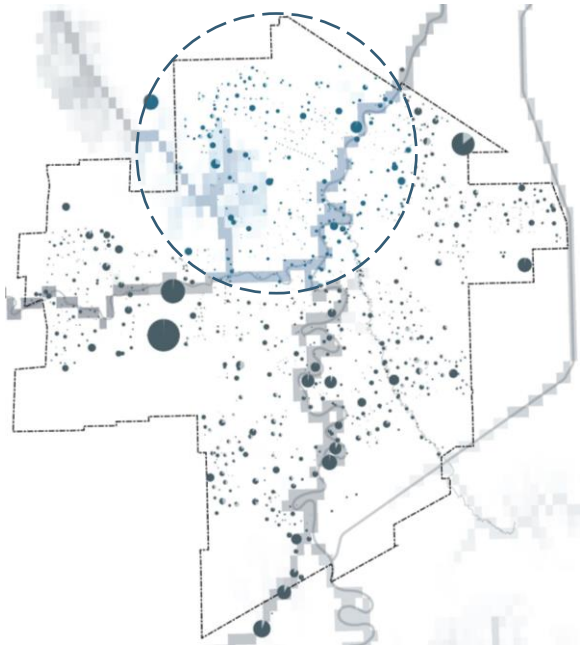
**Collaboration of**

**HUMAN and WILDLIFE**

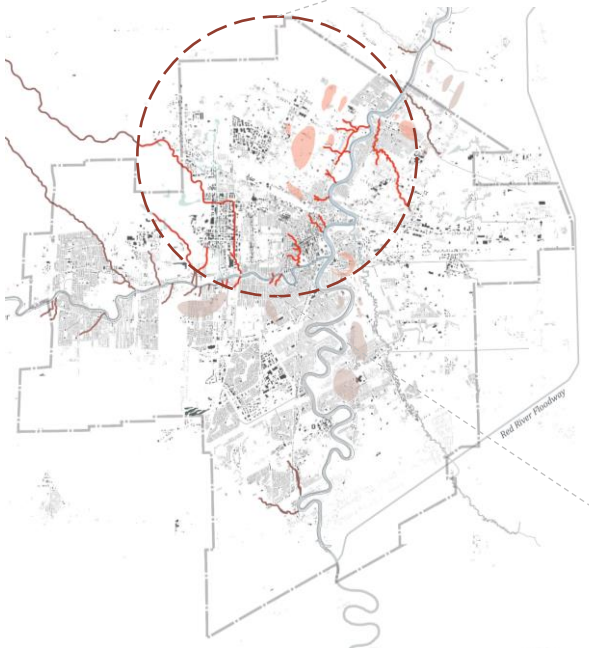


## Study Area

Northwest region of the Fork



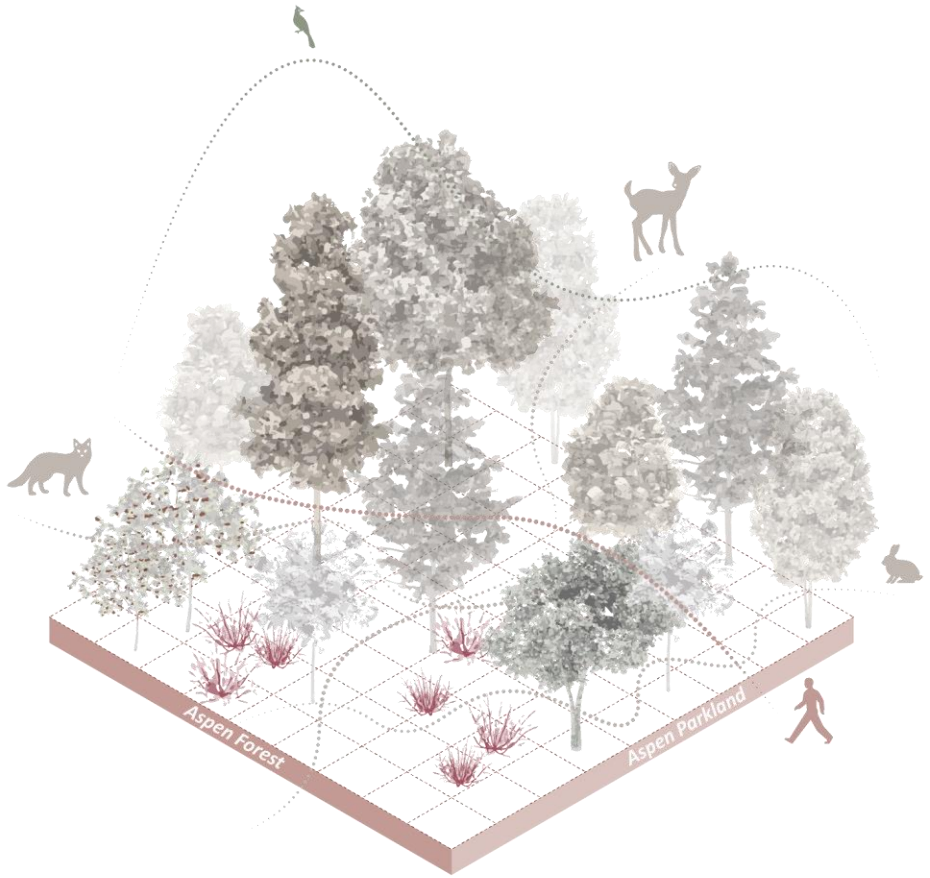
Urban area with poor resilience



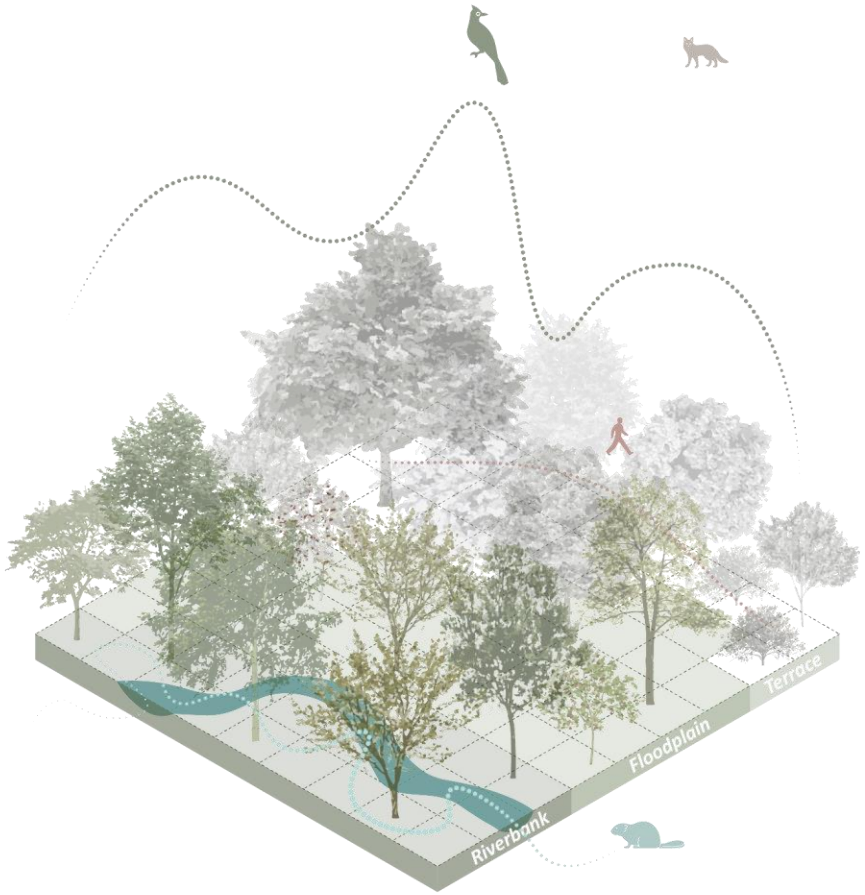
Buried creeks and wetlands


Reviving The Native Habitats

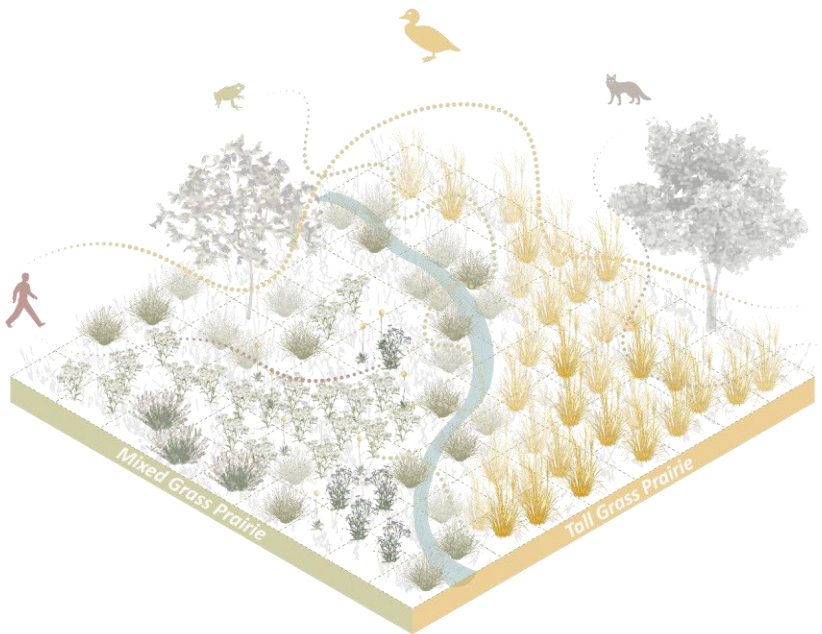
**Aspen Forest**




**Riverbottom Forest**

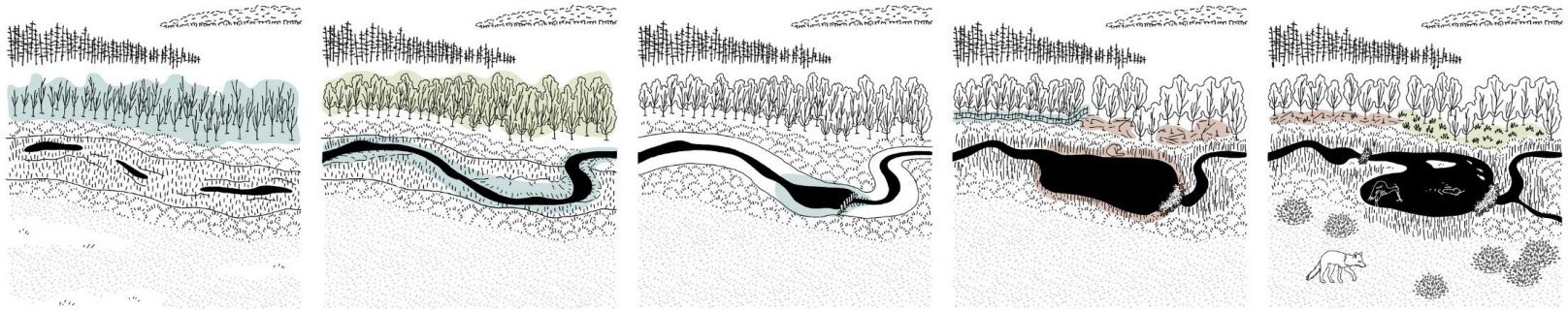



**Prairie**

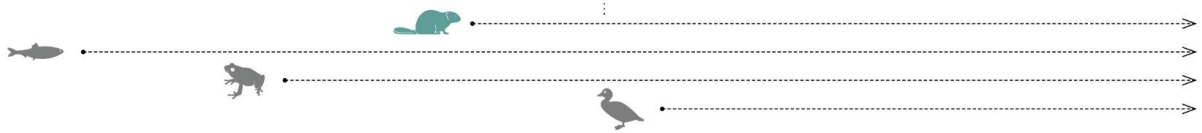



**Wetlands`**

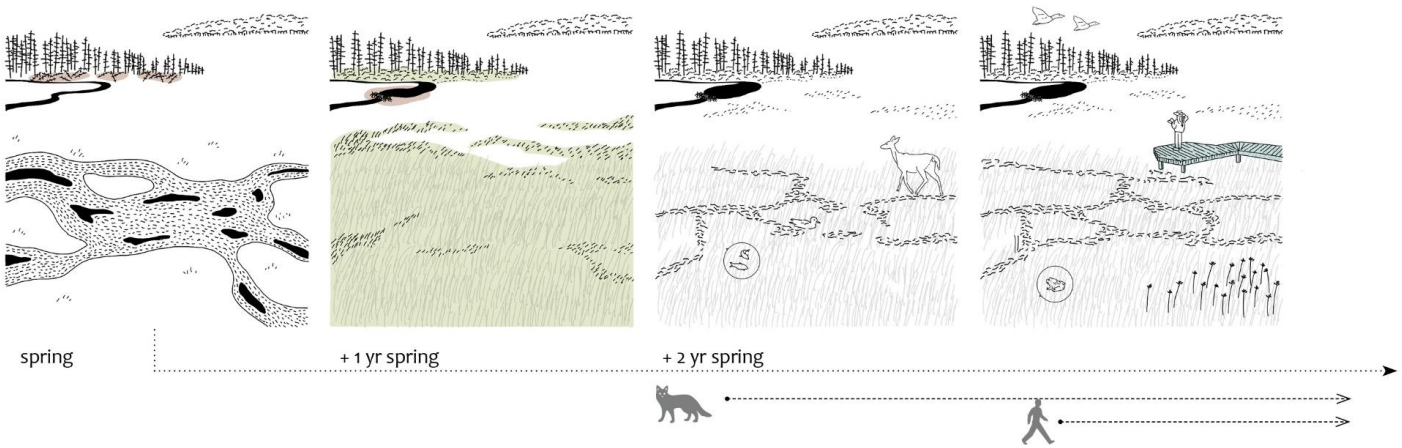

*Habitat Creation* *Connect Water Body* *Install Beaver Dam Analog* *Beaver Introduction* *A Beaver Pond Complex*



Present 2 yr 3 yr 4 yr 5 yr



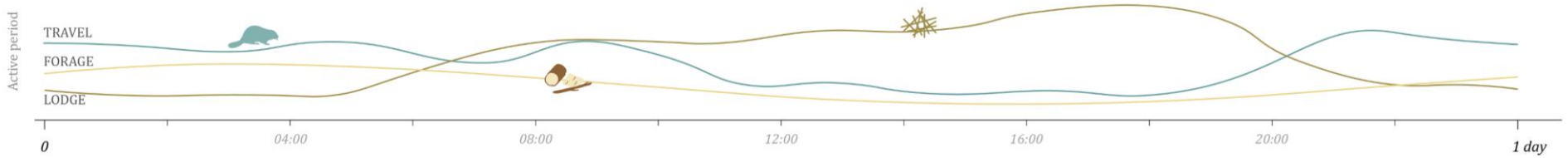
*If beavers abandon their ponds* *A New Prairie Grows* *Small Mammals Inhabit* *Low Impact Recreation Facilities*



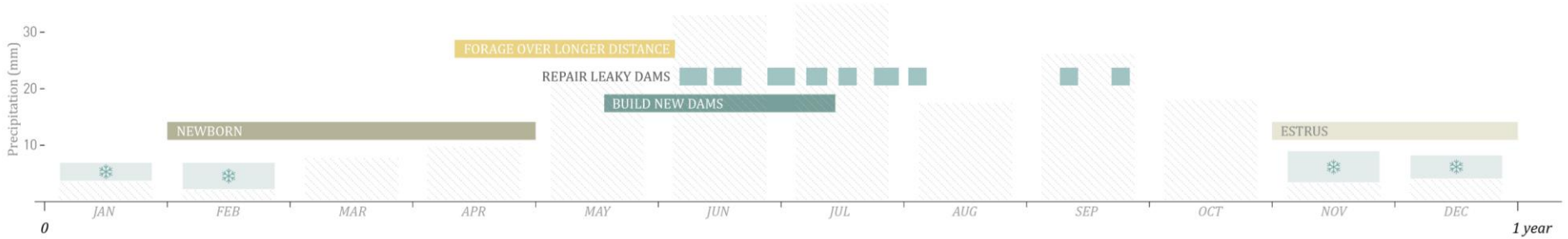

spring + 1 yr spring + 2 yr spring

# Empower Nature

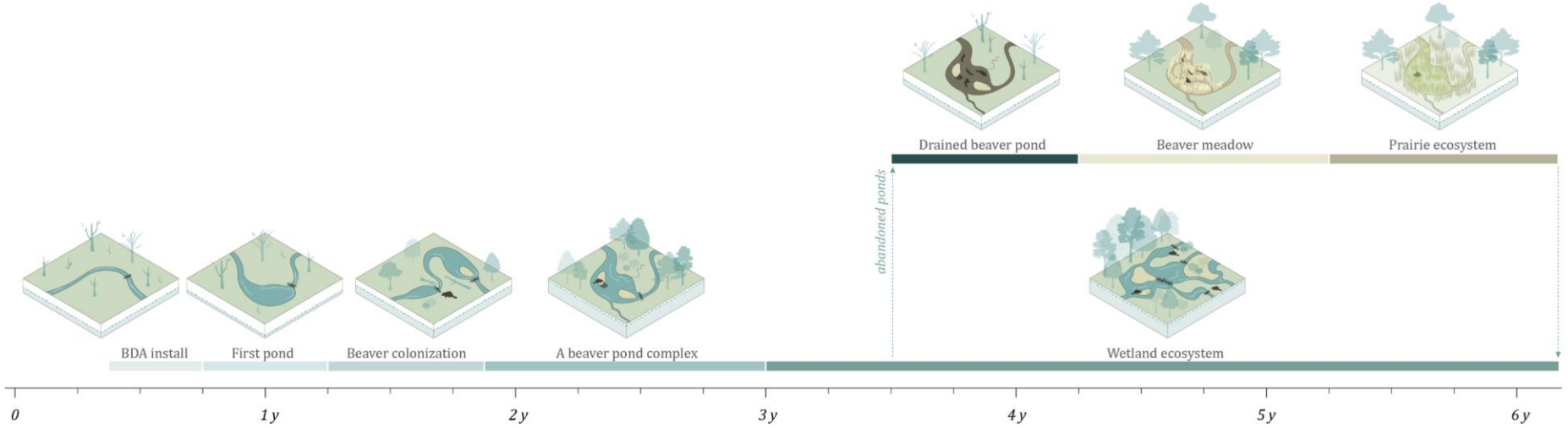
Beaver behavior in 1 day



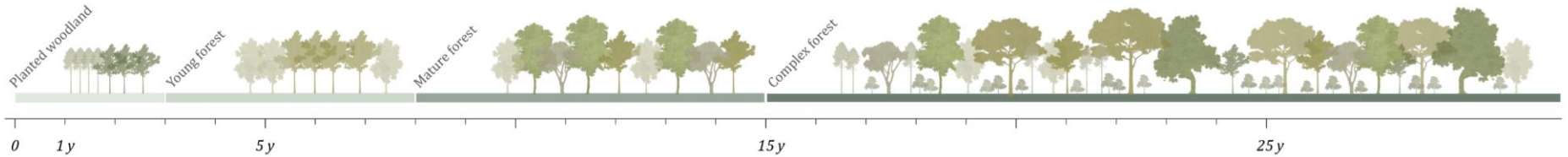

Beaver behavior in 1 year




Beaver Ponds Evolution Stages




Natural Succession Stages



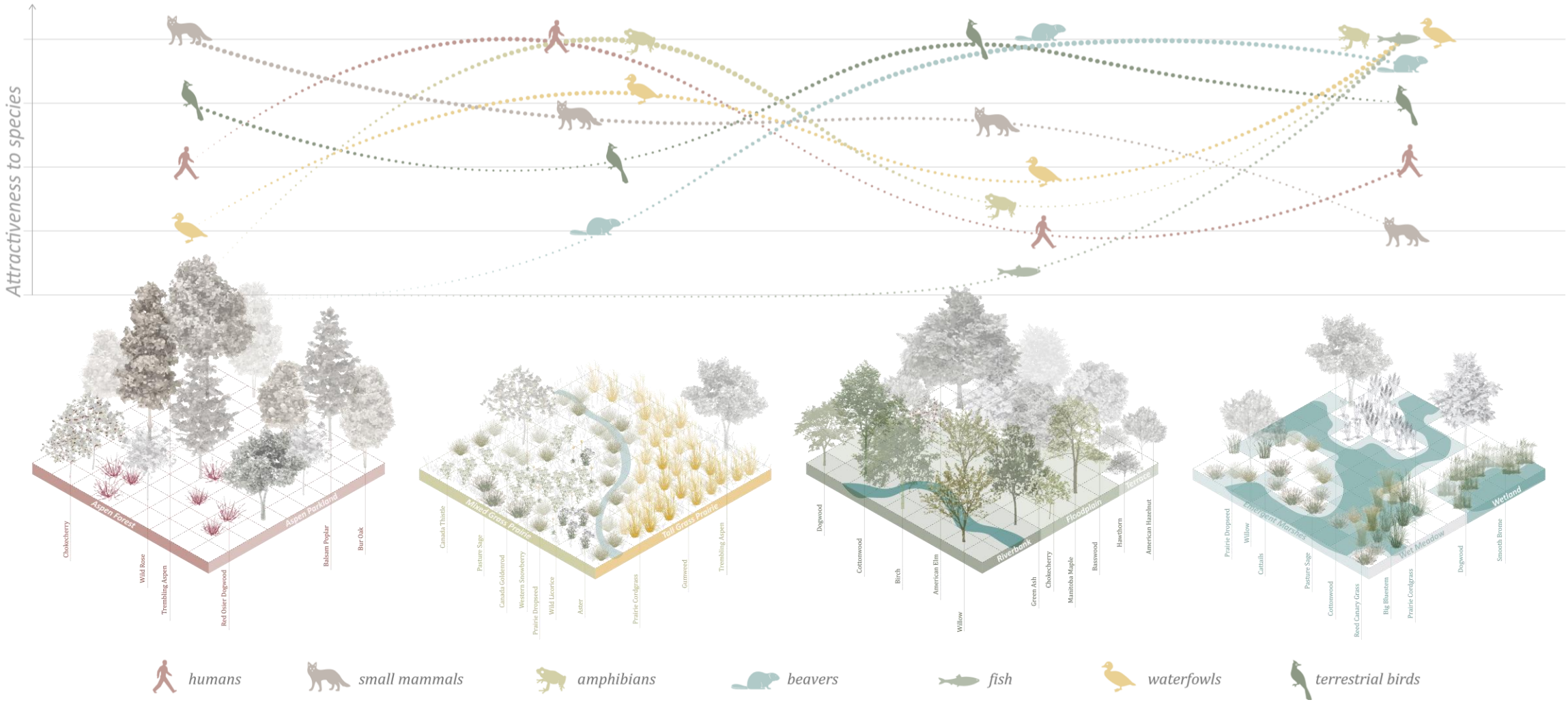
# Suitable Habitats for Different Wildlife

**Aspen Forest**

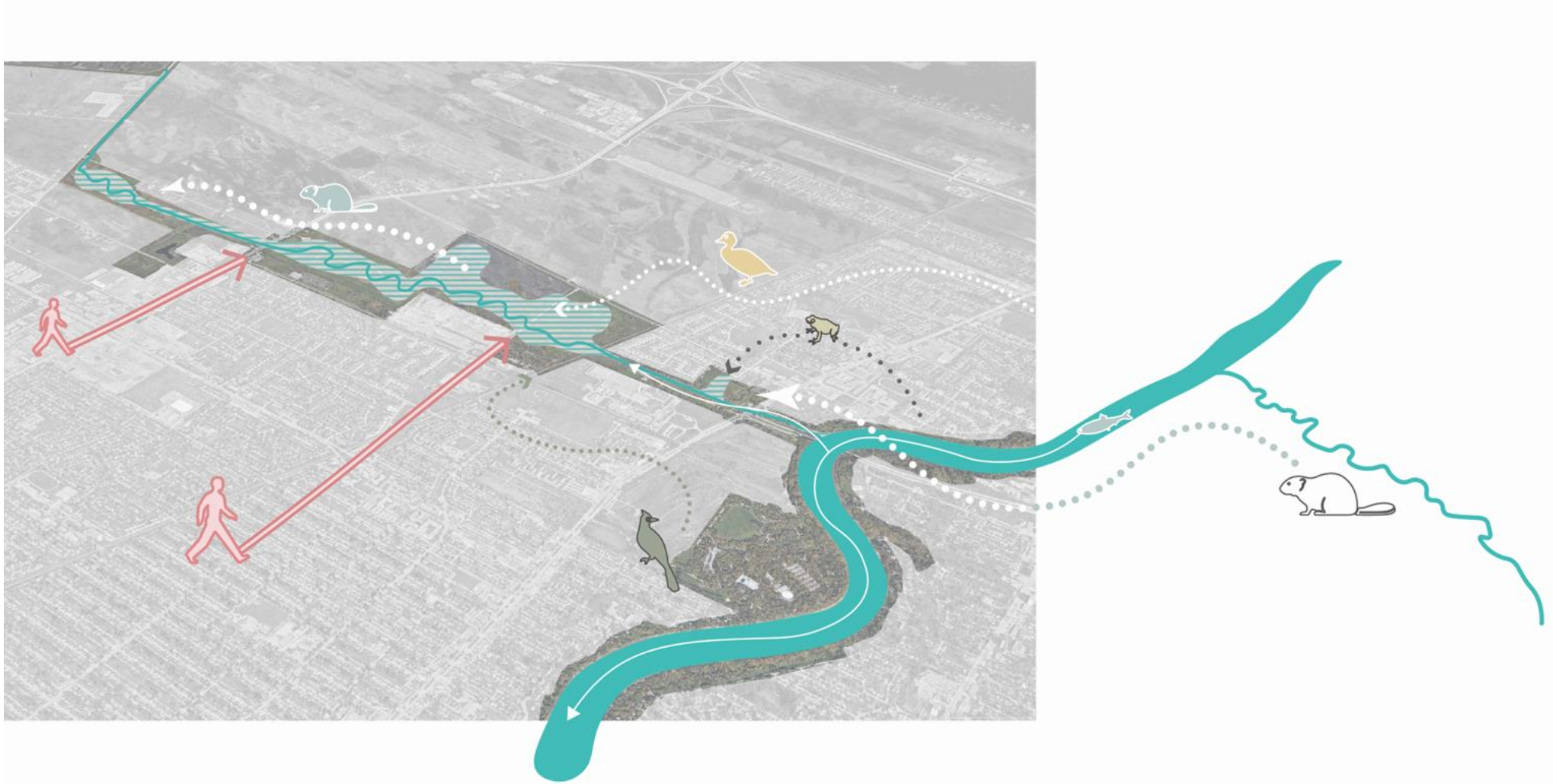
**Prairie**
Tall Grass & Mixed Grass

**Riverbottom Forest**
Riverbank, Floodplain, Terrace

**Wetlands`**
Bogs, Marshes, Swamps, Wet Meadow

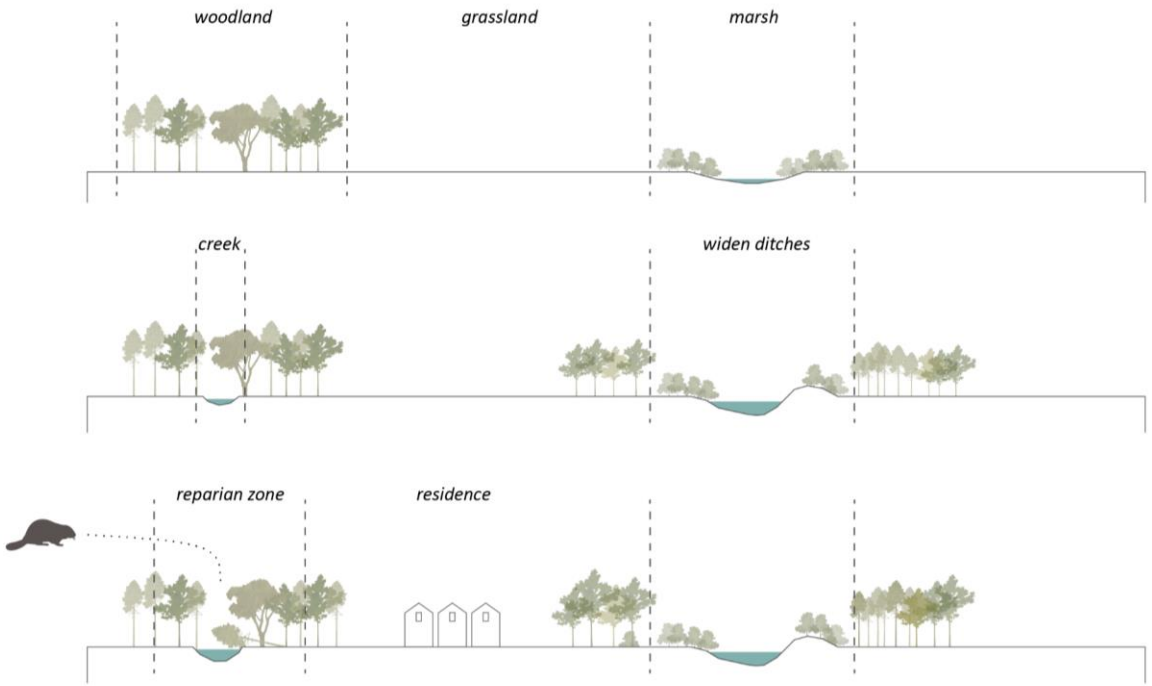


# Introducing Route

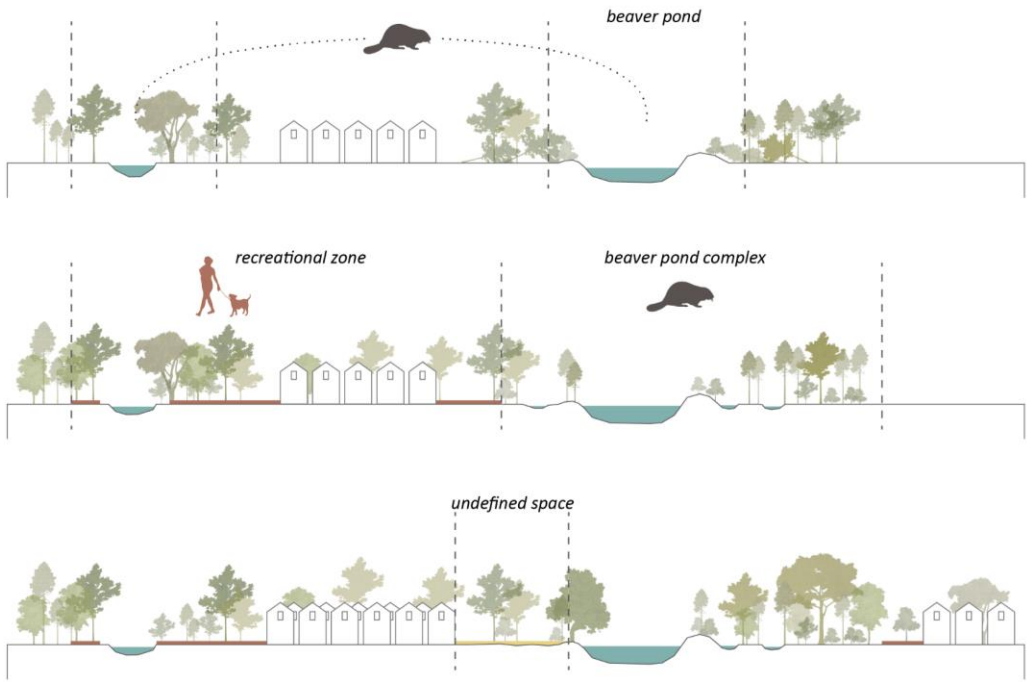


# Construction Stages

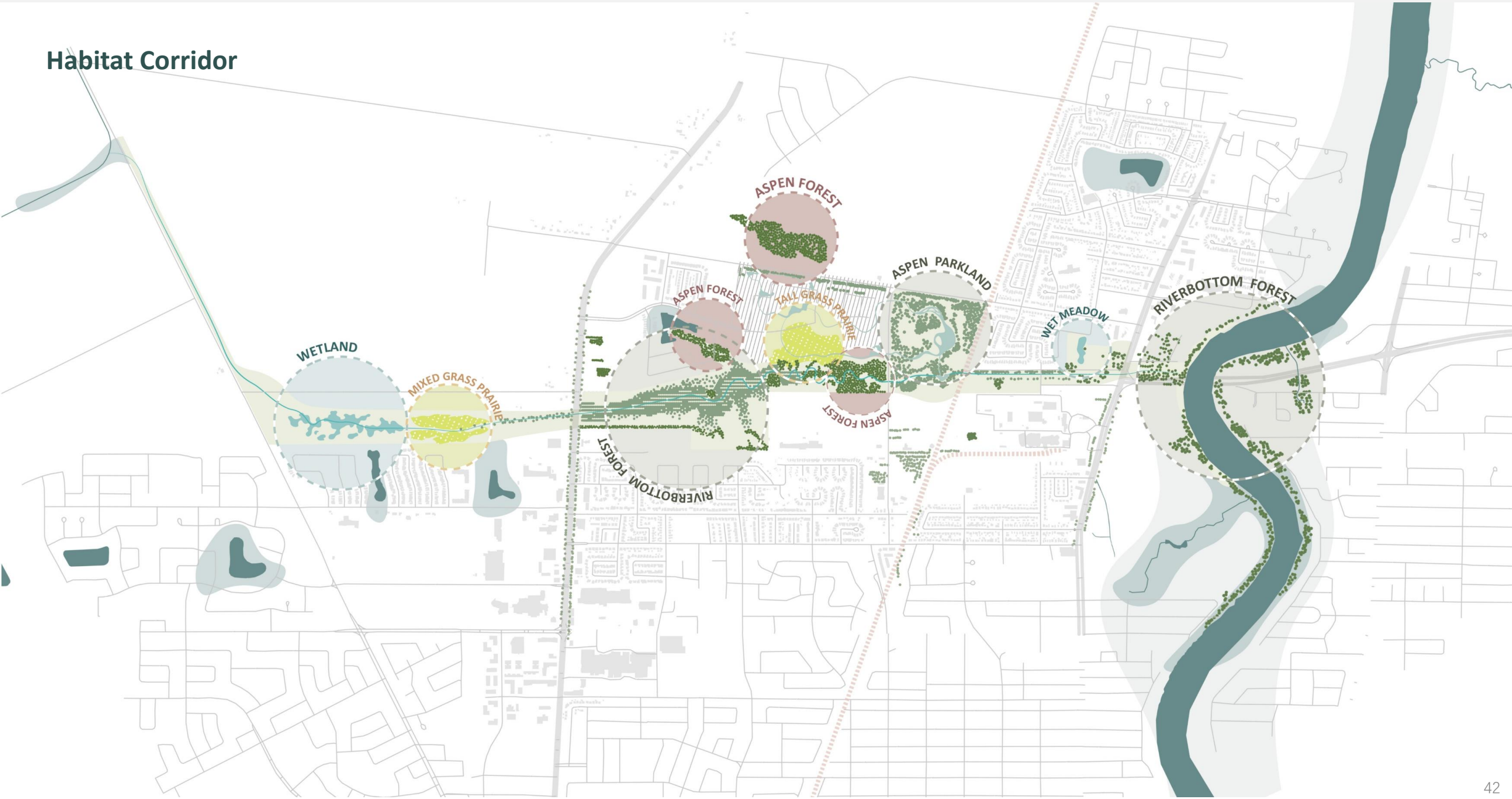
## Stage 1 + 2
## Renovation




## Stage 3 + 4
## Naturalization



# Habitat Corridor



# Symbiotic Neighborhood

1. Beaver Pond Complex
2. Artificial Planting Forest
3. Wetlands Park
4. Detention Basin
5. Retention Area
6. Floodable Zone
7. Tallgrass Prairie
8. Single Family Community
9. Elderly Community
10. Indigenous Student Community
11. Newcomers Community

Circular water system

Wetland park

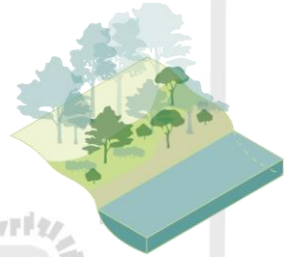
New Creek

Habitat Corridor

Beaver pond complex

0 0.5 1 km

## Potential Toolbox

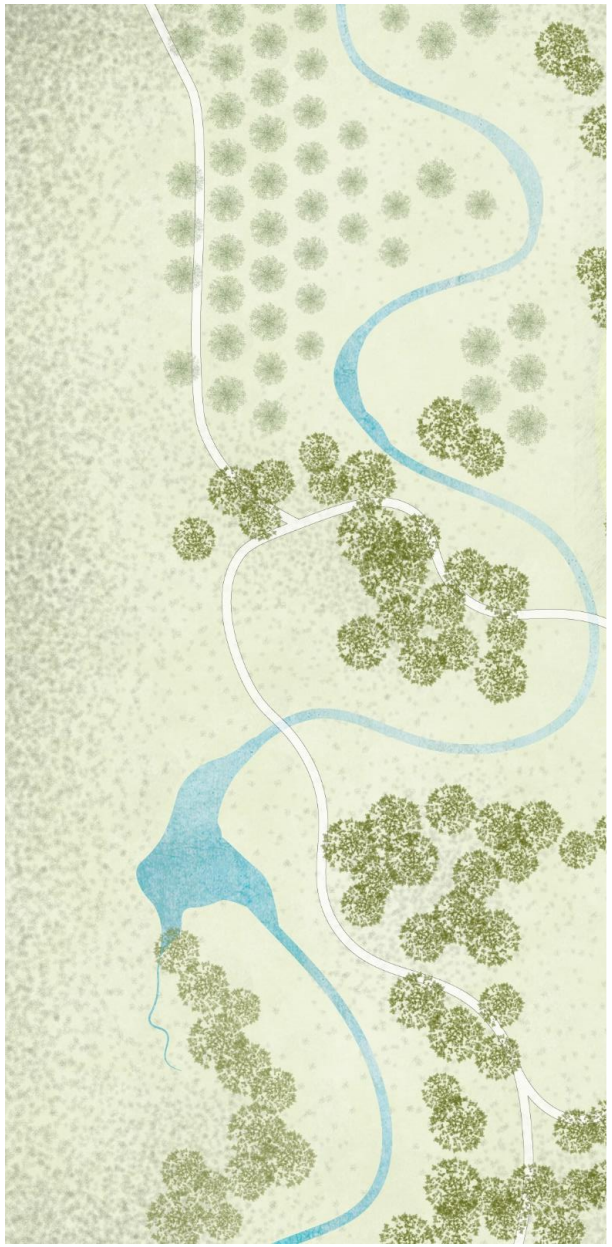


Vegetated River Bank

Habitat Corridor

Beaver Pond

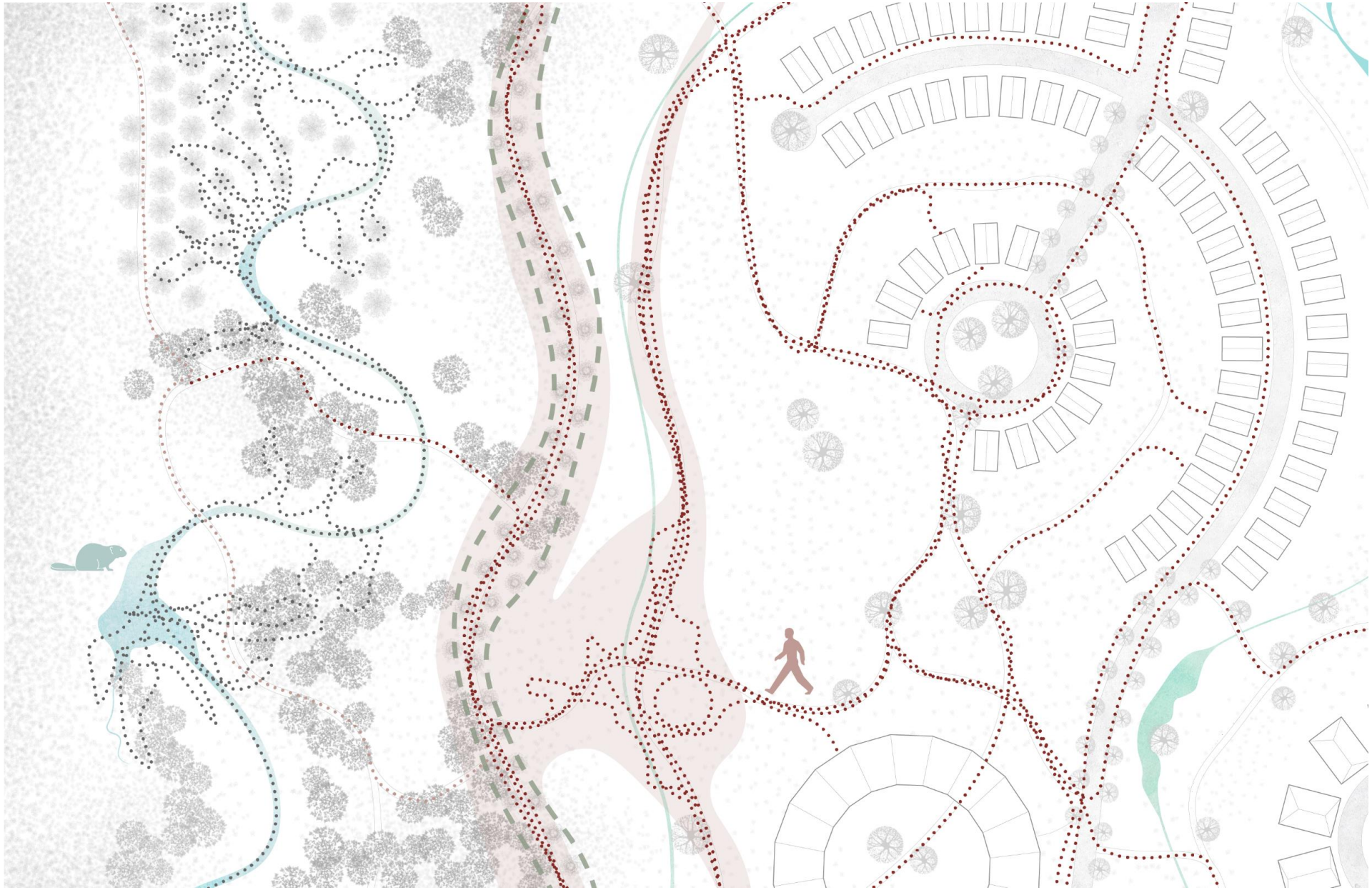
# Symbiotic Neighborhood



*Riparian Zone*

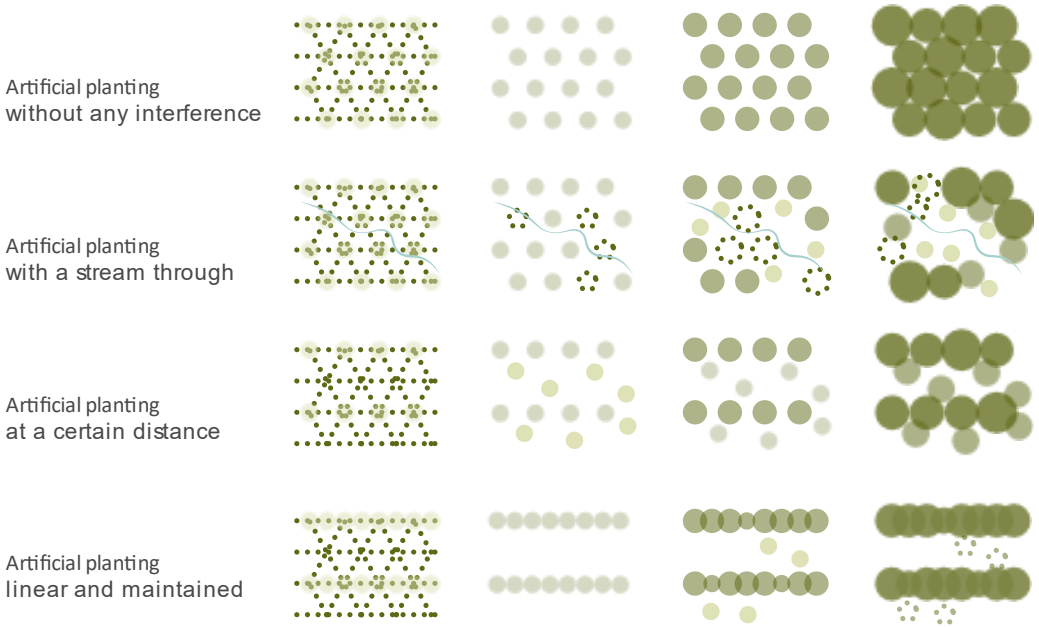
*Transitional Zone*

*Residential Zone*

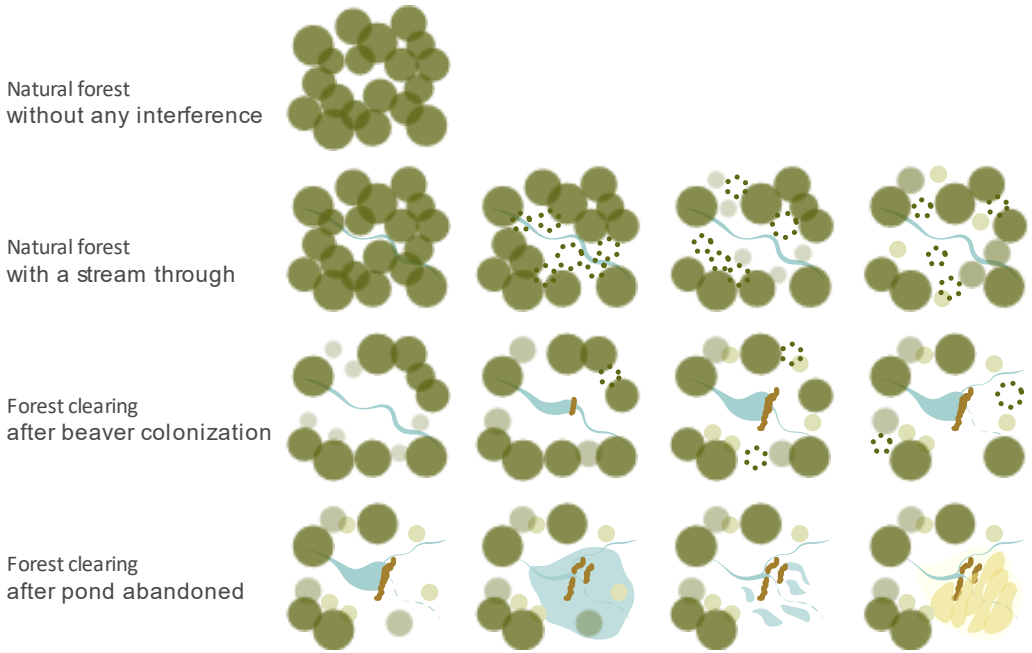


Beaver Active Zone Public Activity Area Semi-private Area

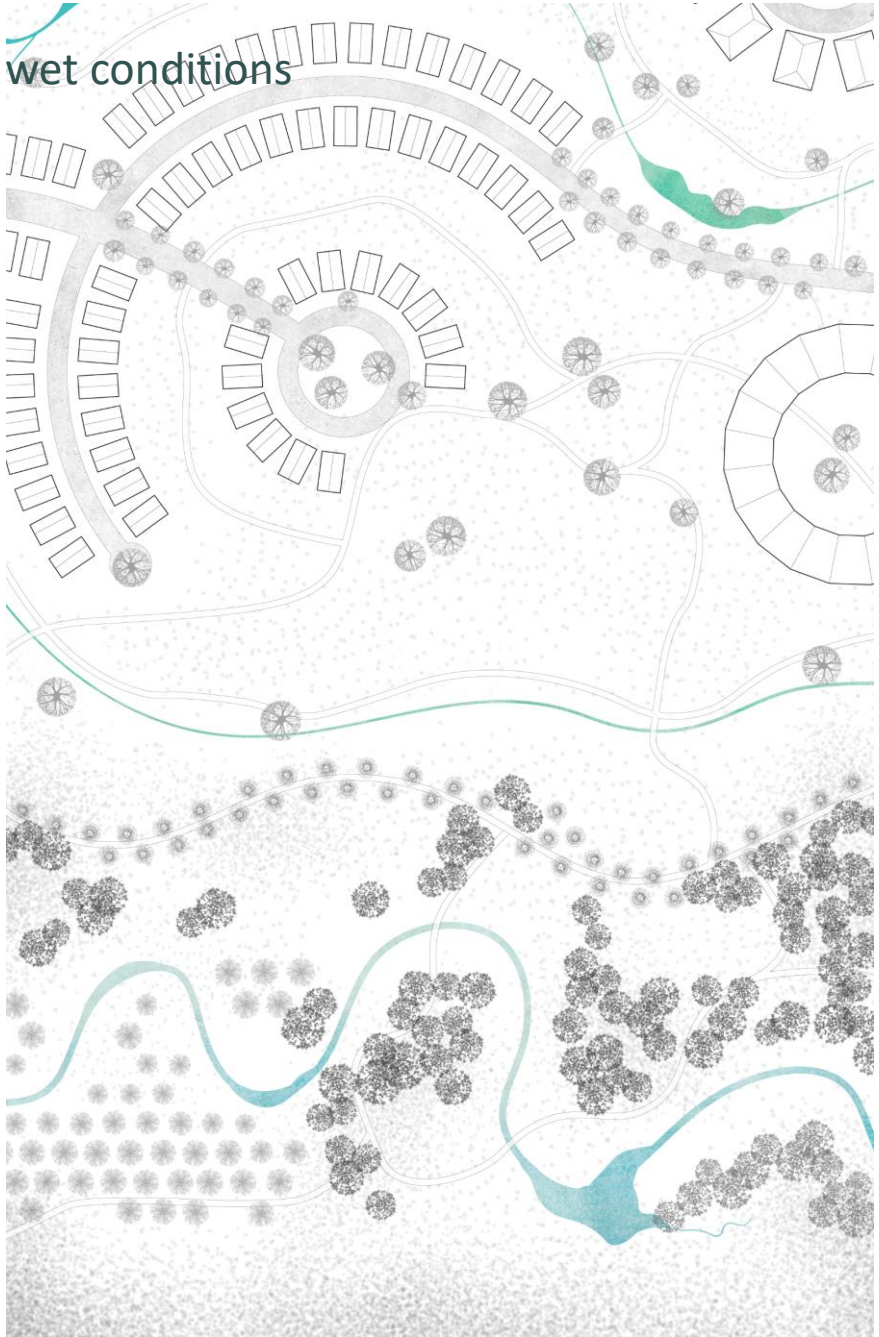
# Planting Scheme

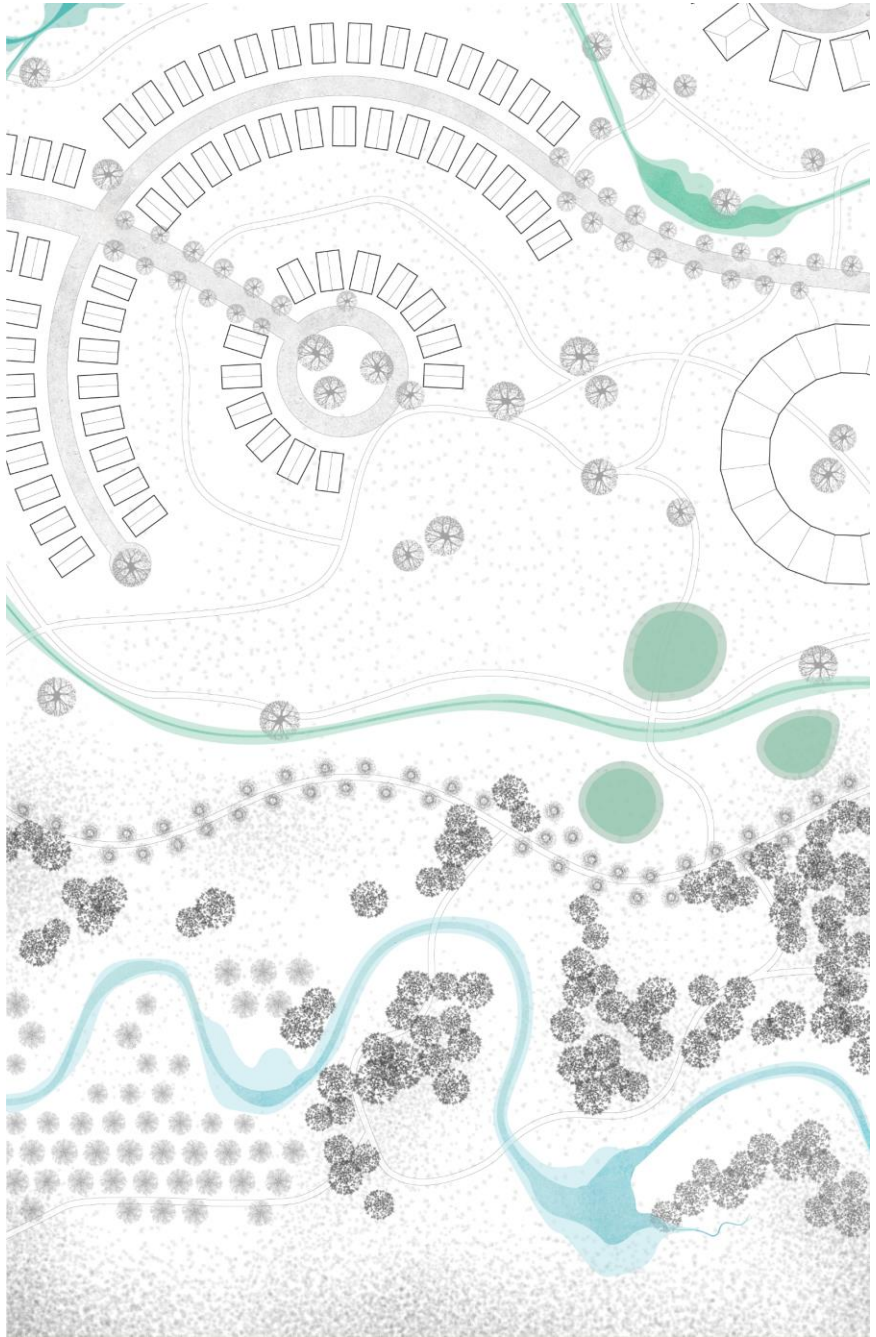



# Planting Scheme



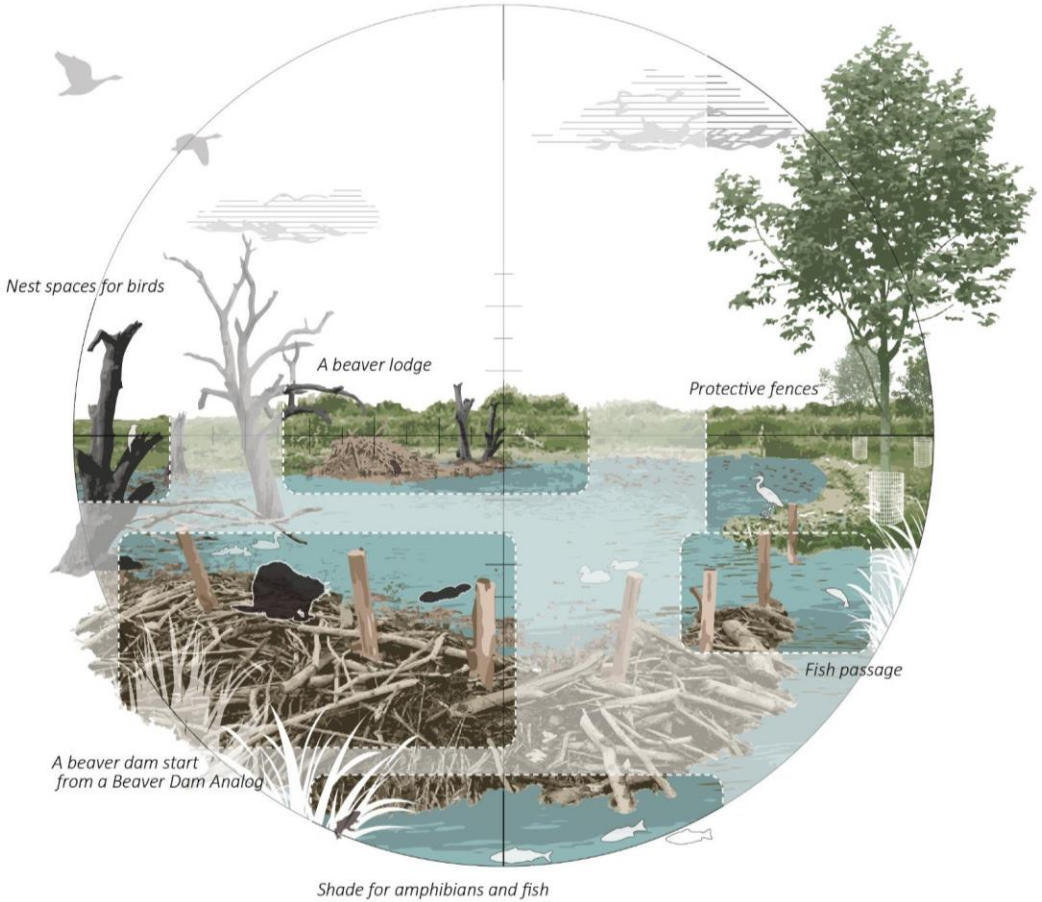

## Water Range in dry and wet conditions





# *Riparian Zone*

## *- Evolving Habitats -*




# Residential Zone

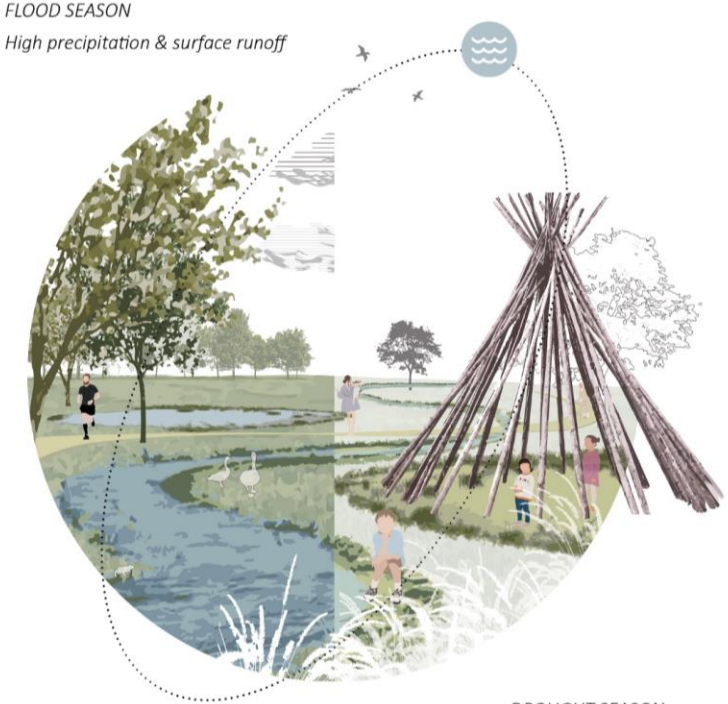
## - Flood Managing & Activity Holding-


# *Buffer Zone*

## *- Guiding Nature -*


FLOOD SEASON

High precipitation & surface runoff



DROUGHT SEASON

High temperature and evaporation

NATURAL STATE

A mix of species and habitat

WITH MAINTENANCE

Managing and directing natural succession

BEFORE

Beaver colonization

AFTER

Beaver abandonment

*Is this design good enough?*

# RESEARCH QUESTION

How to design a **resilient spatial framework** for Winnipeg in response to the flood challenge and integrate nature-based principles to achieve **long-term coexistence between man and wildlife** in a cohesive neighborhood design?

# Neighborhood Level

## Community Pattern

## Community Pattern

### Mature Communities

Street Typology
+
**Blue Network**

**Neighborhood Model 1**

### Recent Communities

Marginal Green/Blue Space
+
**Native Maintenance**

**Neighborhood Model 2**

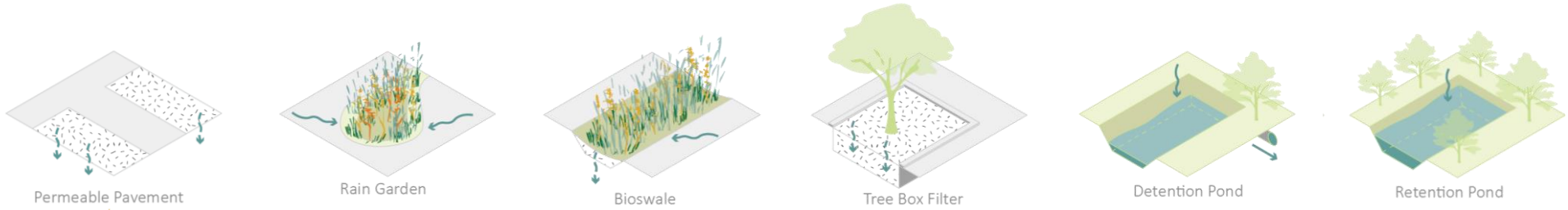
### Emerging Communities

House Typology
+
**Symbiotic Lifestyle**

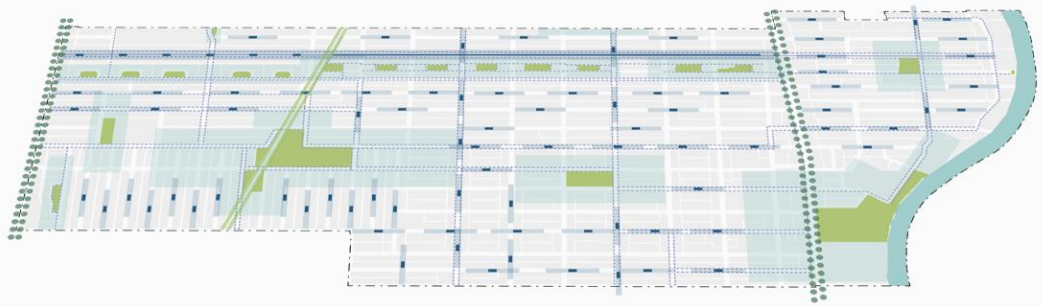
**Neighborhood Model 3**

## Integrated Configuration
[Human-Nature]

# 2 Applicable Models

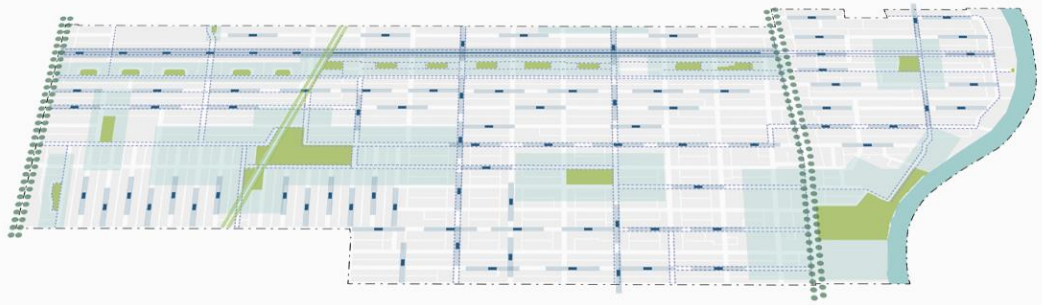


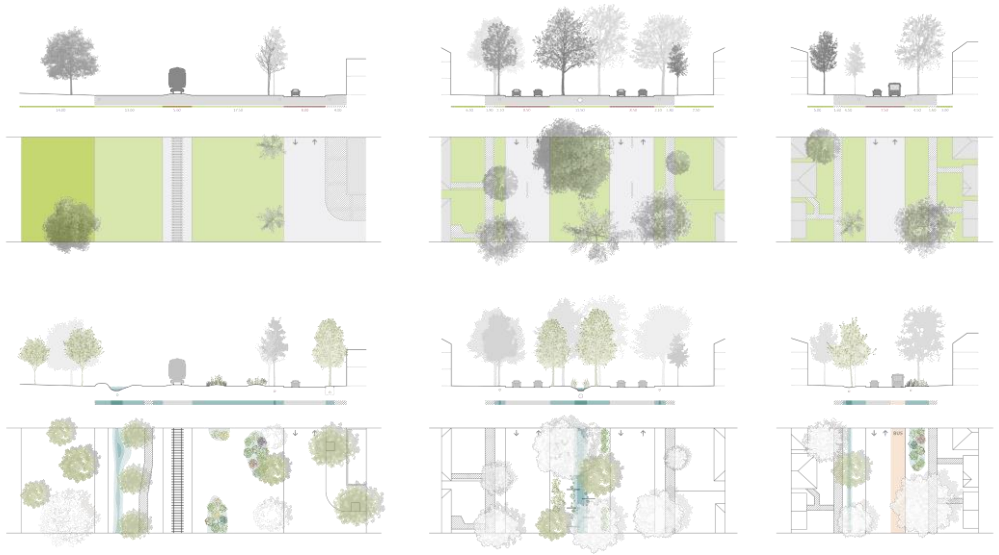

**For Mature Communities**



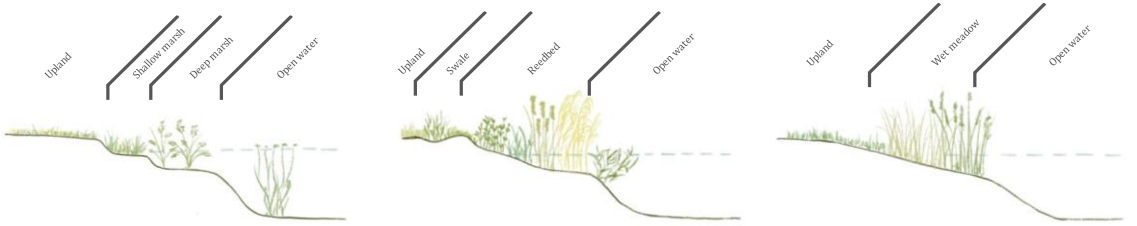
**For Recent Communities**

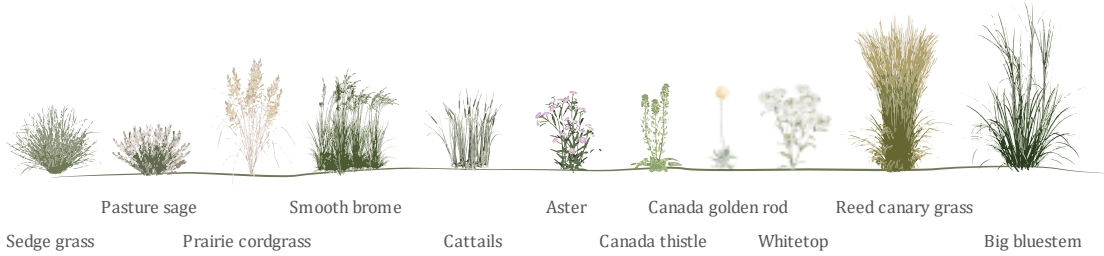
## For Mature Communities





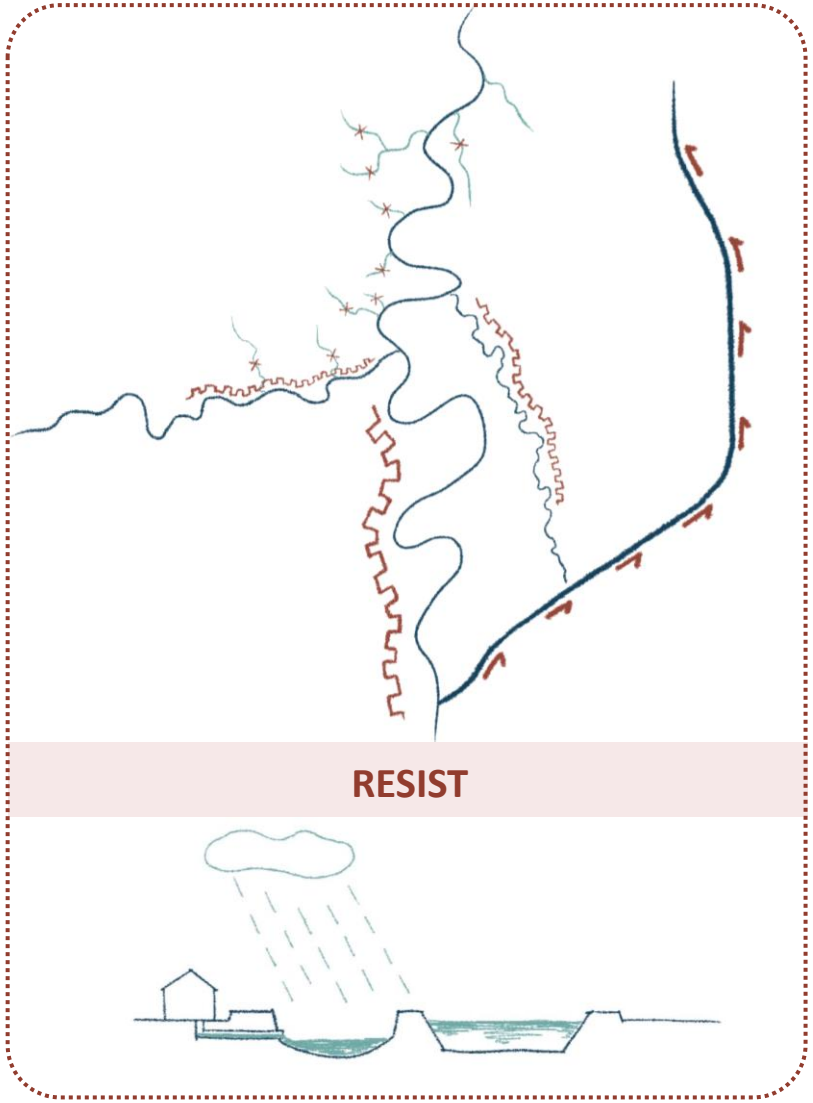
## For Recent Communities



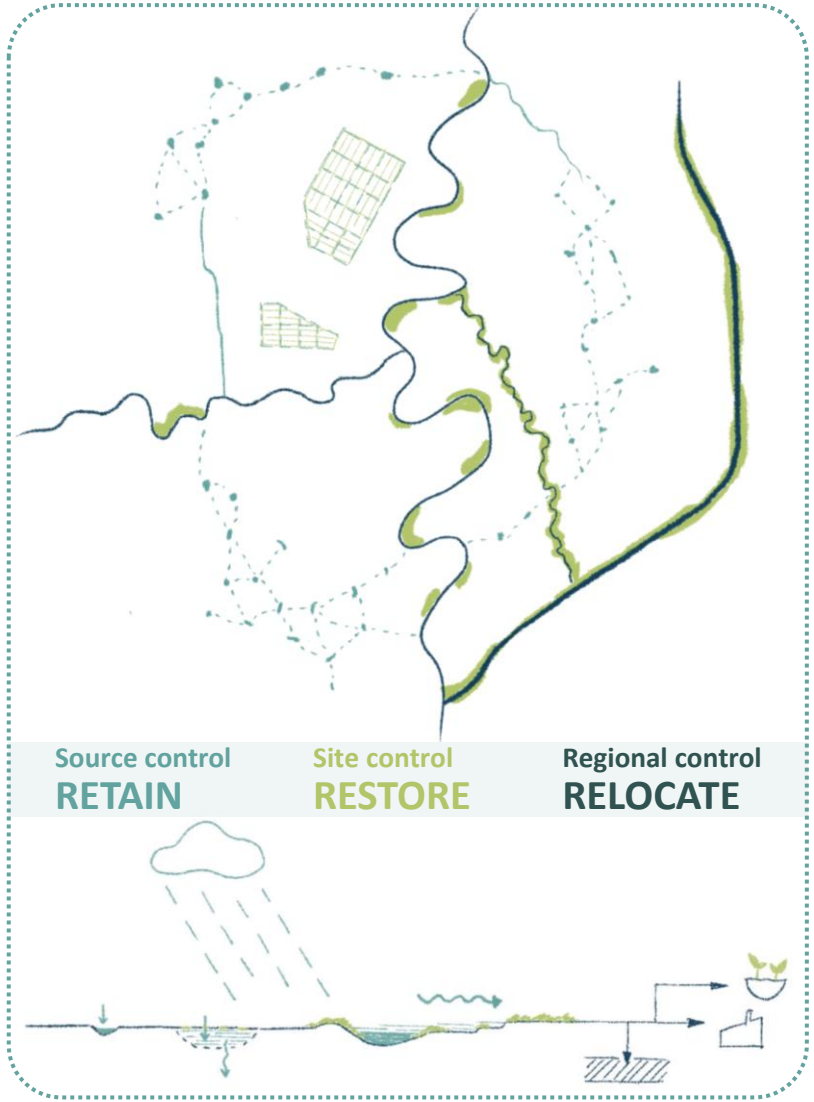



## Concept

Engineering Flood Solutions




Nature-Based Solutions



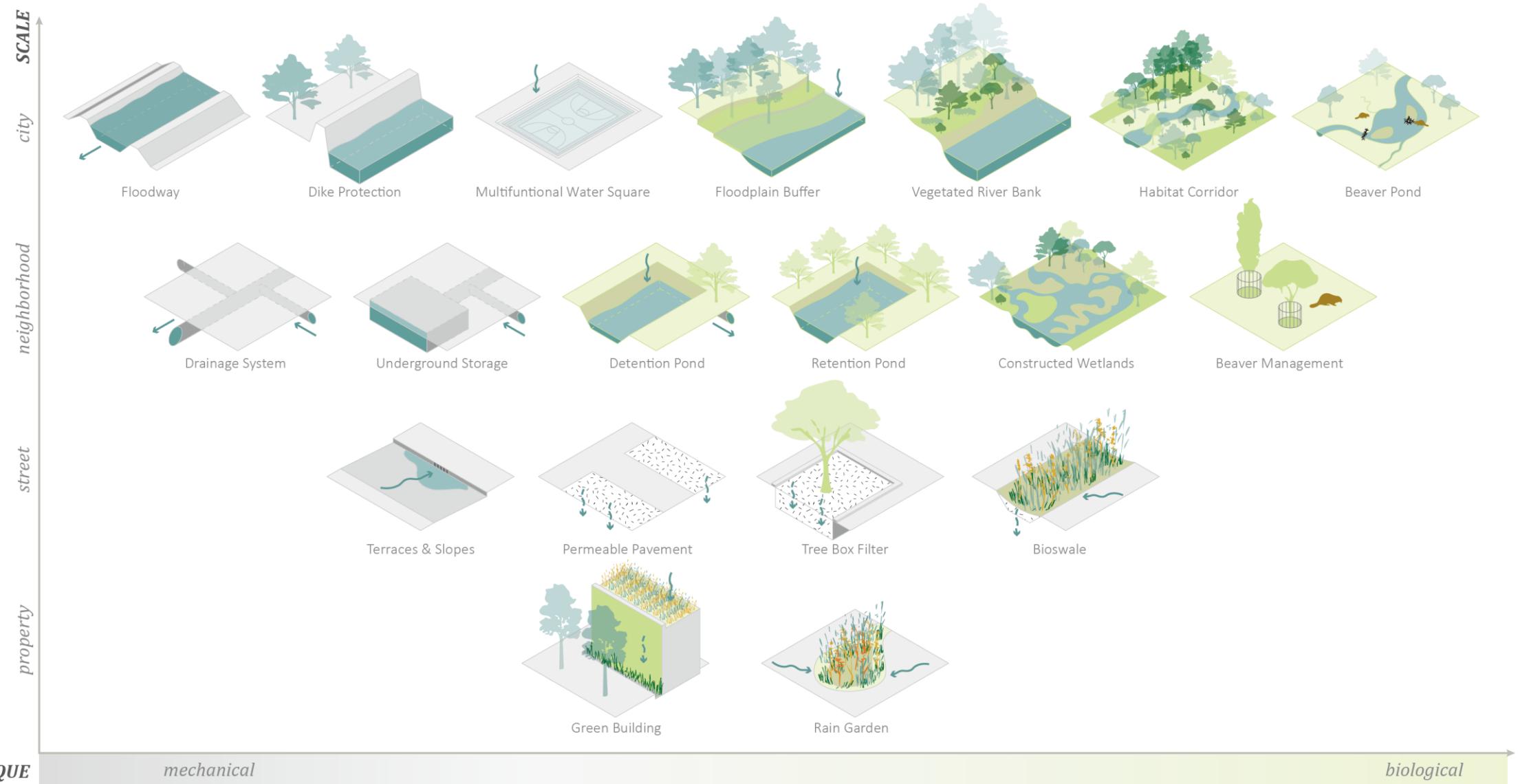

**Resilient Urban Water System**

*Enhance Water availability*

*Improve Water quality*

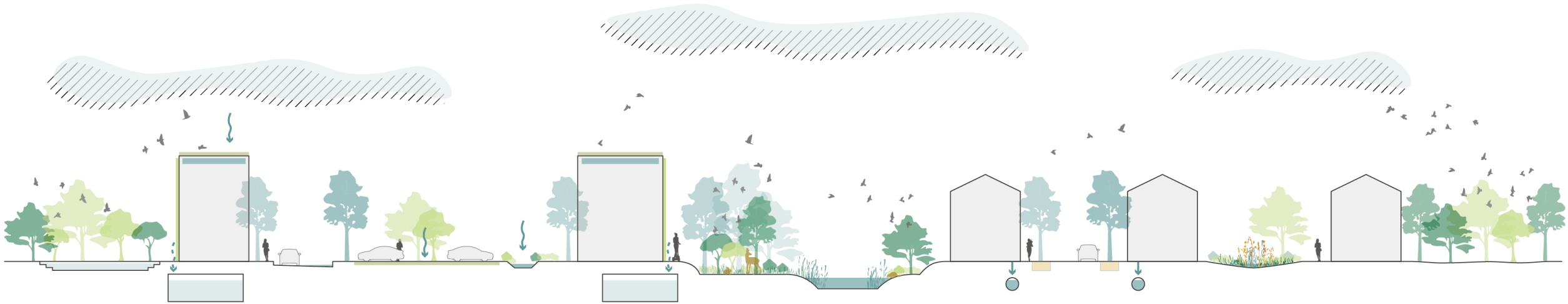
*Reduce Water hazard*

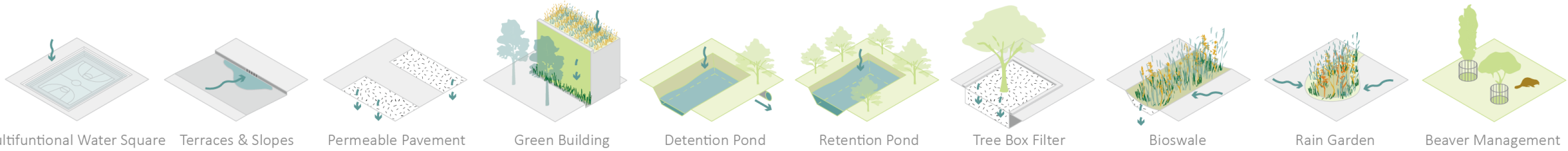
# Urban Flood Resilience Toolbox



# Urban Flood Resilience Scheme

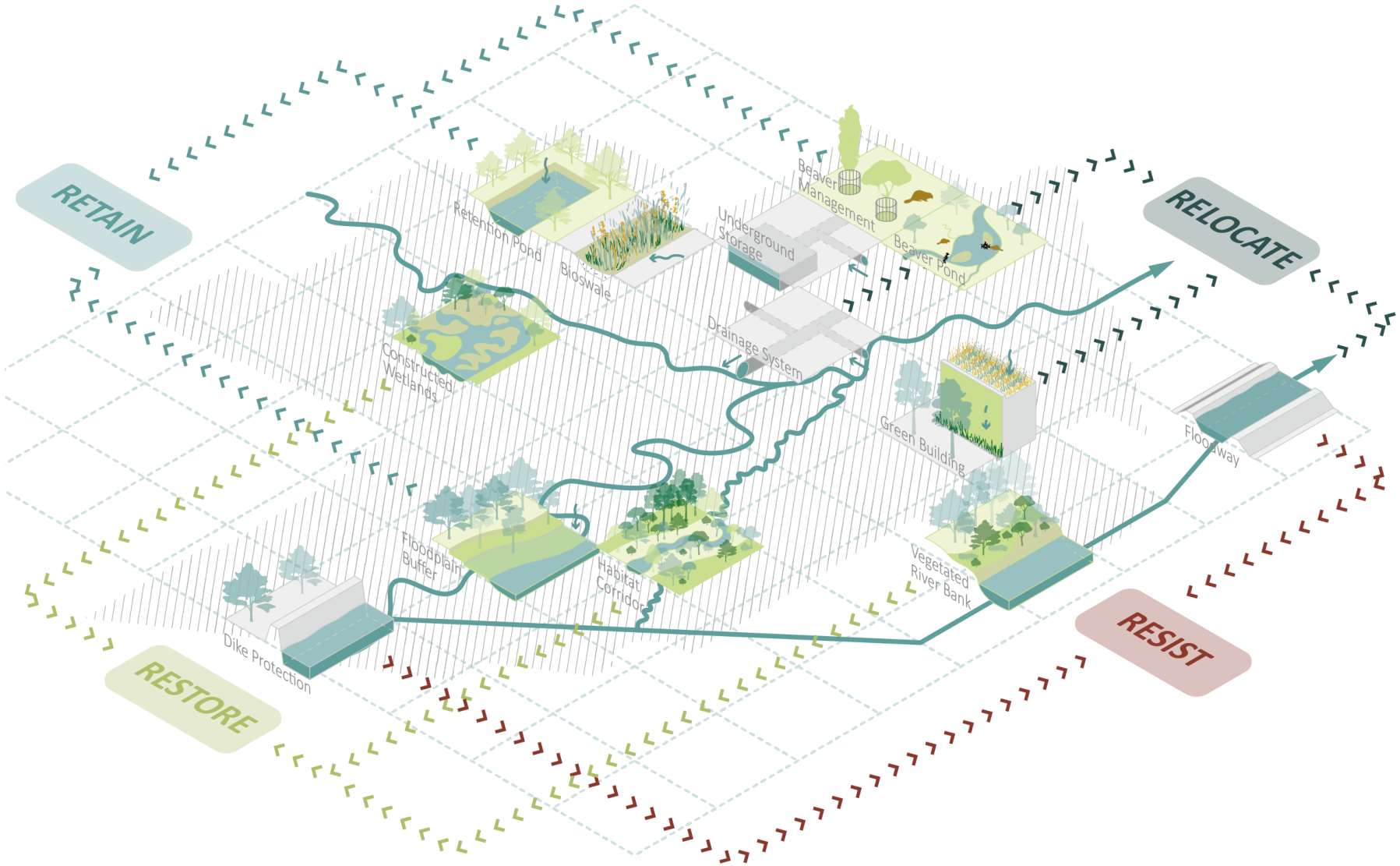
*At Neighborhood Scale*





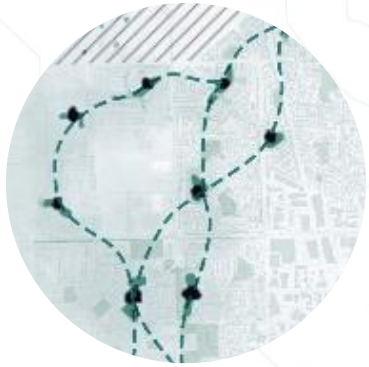
# Urban Flood Resilience Scheme

*At City Scale*



# Strategic Plan

2050 prospect



Key Design Area

Bioswale

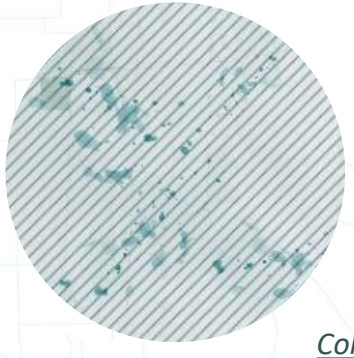
Retention Pond

Bioretention Strip

Raingarden

Permeable Pavement

Underground Storage

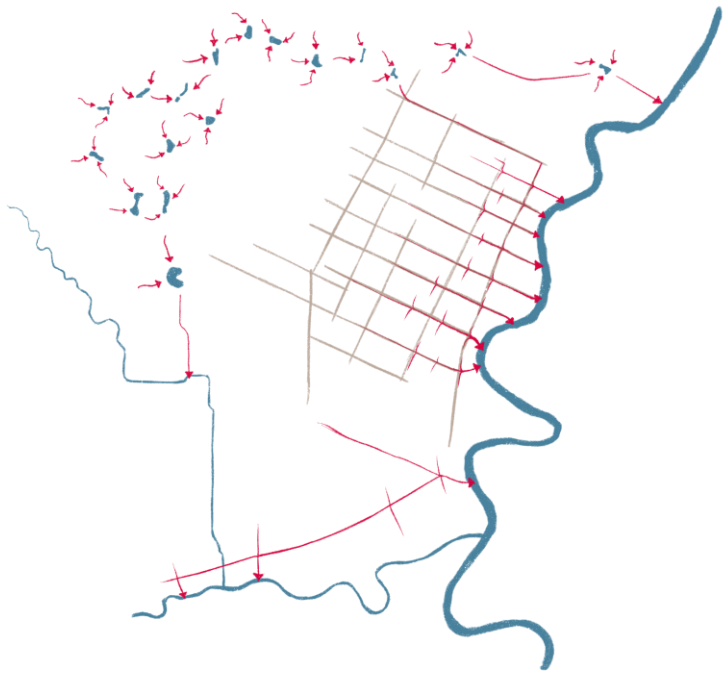


Collective Green Roof

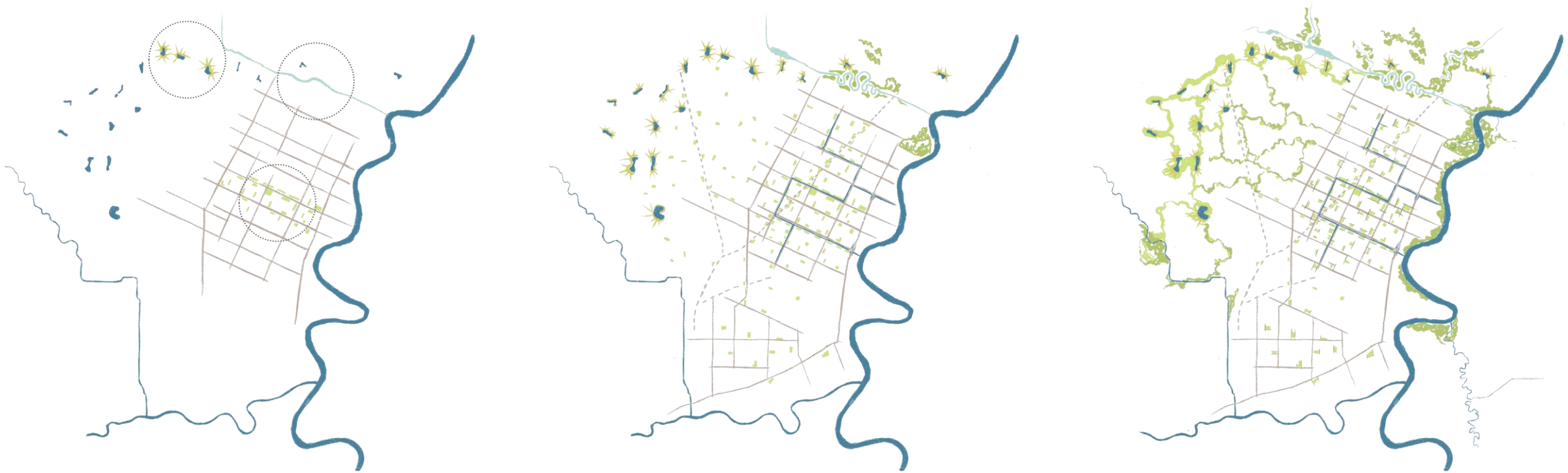
Symbiotic Riparian Neighborhood

Riparian Buffer Zone

Riparian Habitat Corridor



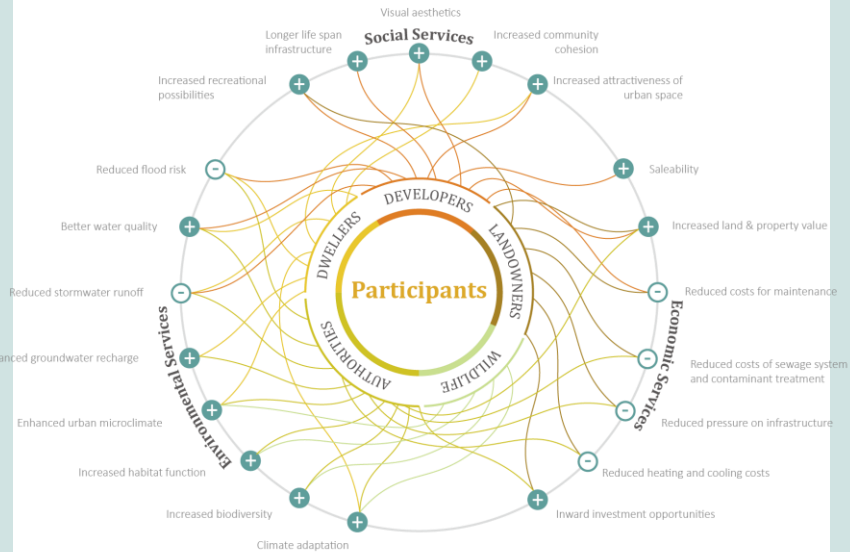
present



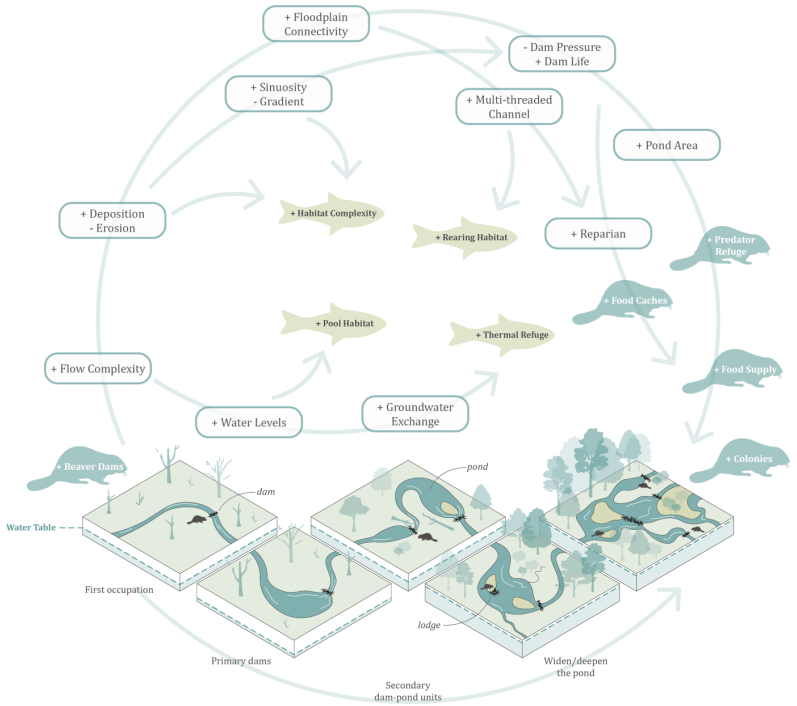
3~5 y ---------- 25 y

## A Futureproof Spatial Framework

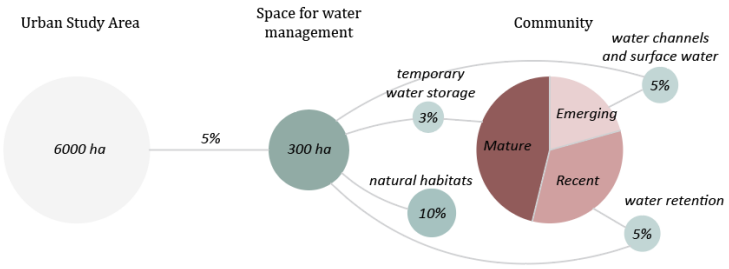
## Societal




## Ecological




## Technical



# EMBRACE THE FLOOD

*Nature-Based Solutions: Insights and a Future-Proof Framework*

*Modified Hydrological Cycle: Adapting to Real Environments*

*Symbiotic Neighborhood Model: Blending Indigenous Culture and Living with Nature*

*Role of Beavers: Mimicking Beaver Ecosystems in Urban Environments*

*Adaptable Schemes: Embracing Unpredictability for Changing Landscapes and Flood Resilience*

DIALOGUE BETWEEN HUMAN & NATURE
BRIDGE FROM THE PAST to THE FUTURE


*Thank you for your attention!*