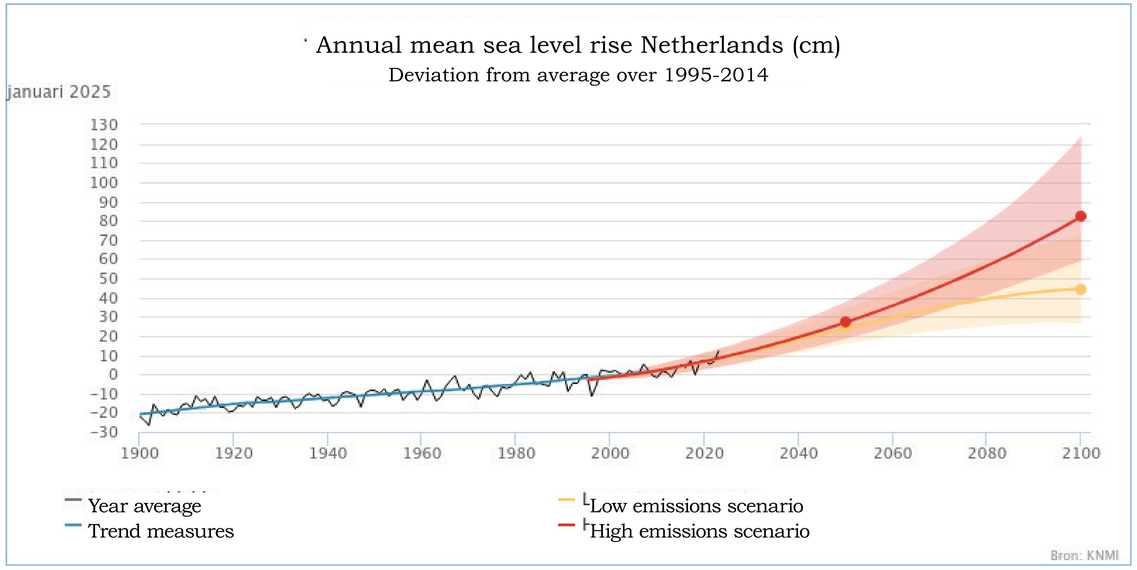
A design towards a water resilient landscape

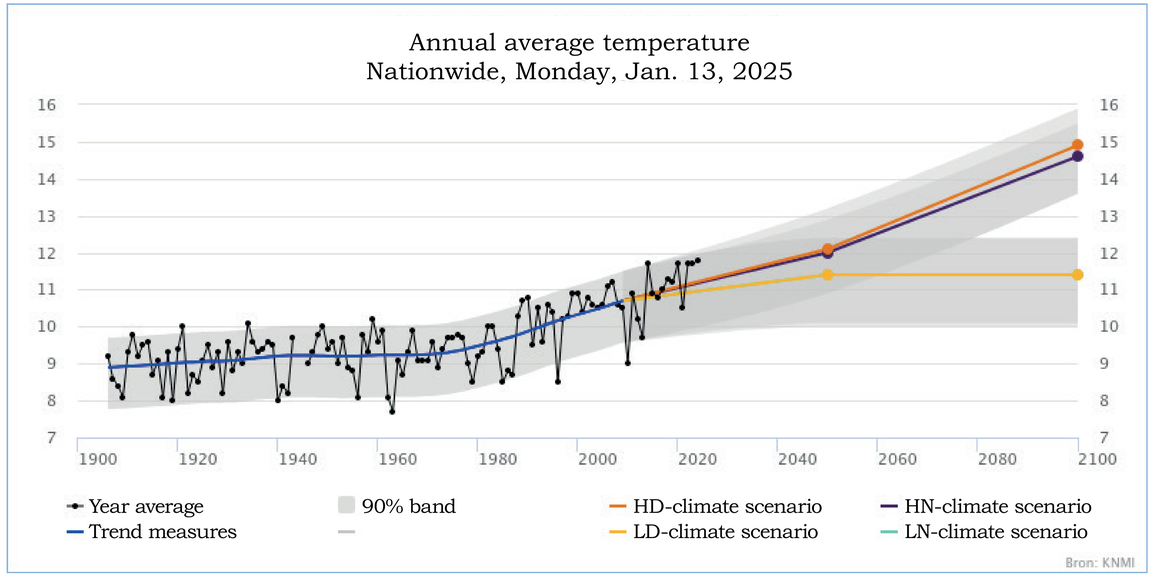
Integrating nature-based solutions for a sustainable water system in Flevoland

Maaike Dijkstra - 5951461

Threats and opportunities – climate change

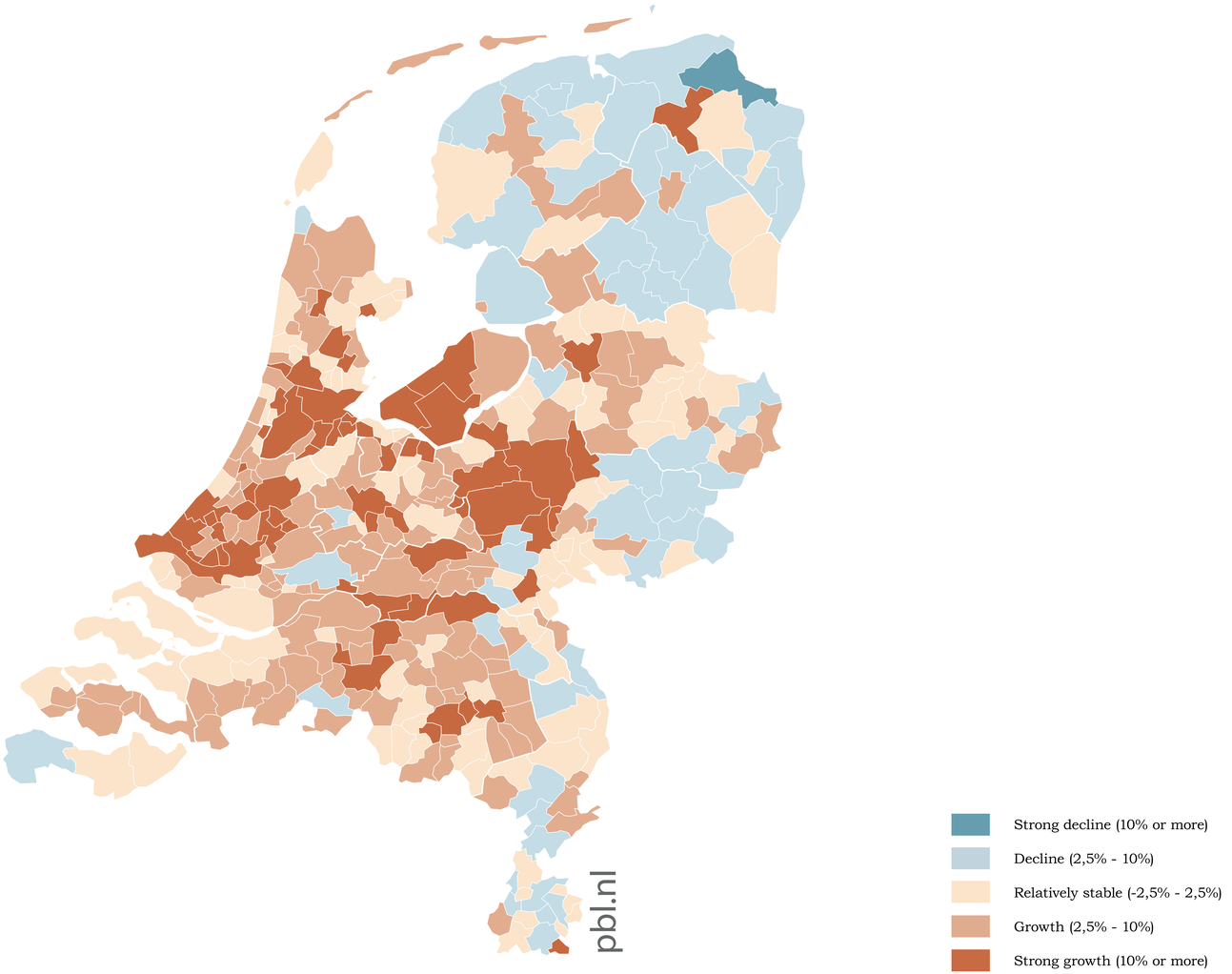


Annual mean sea level rise Netherlands (KNMI, n.d.)



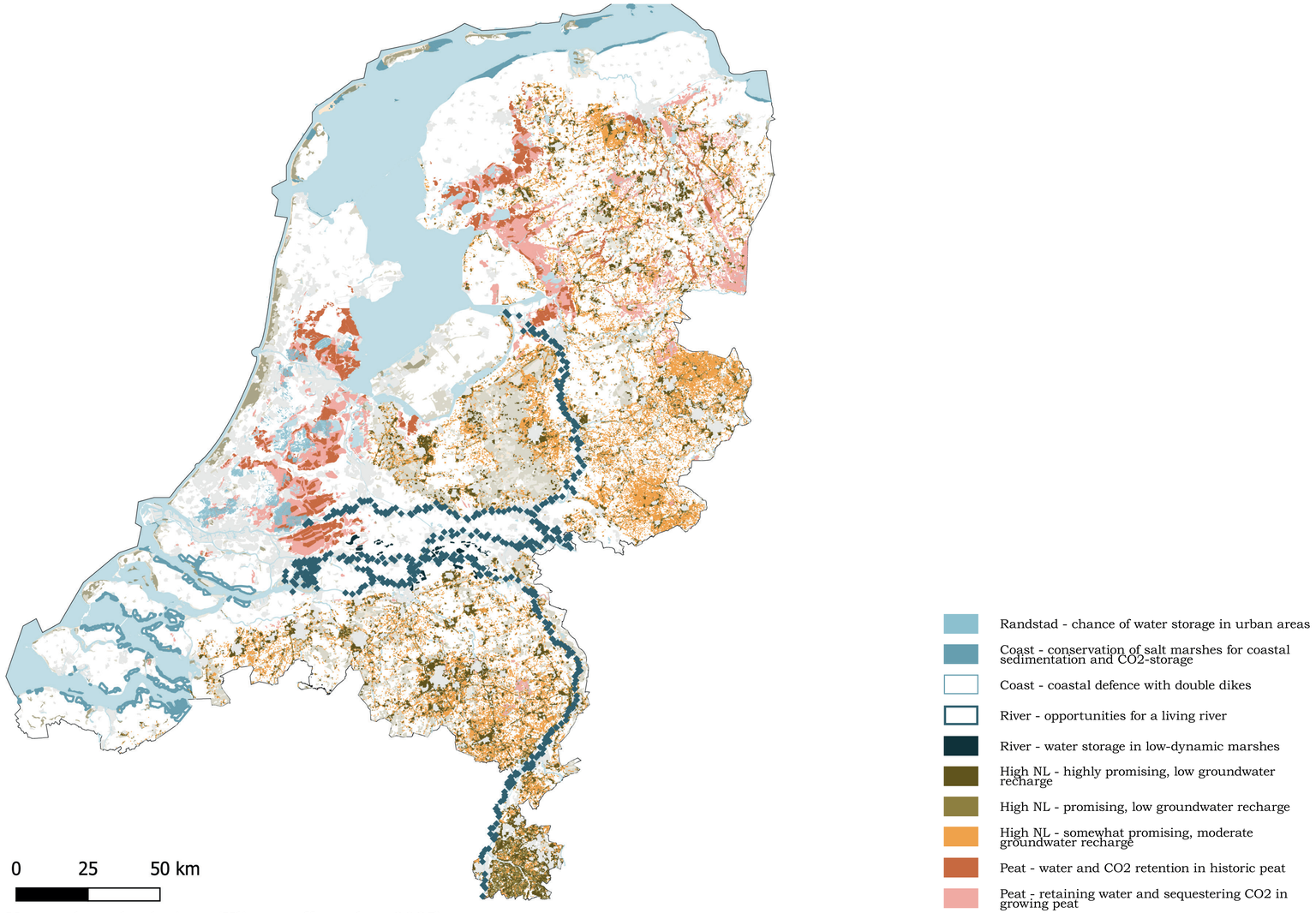
Annual average temperature (KNMI, n.d.)

Threats and opportunities – urban growth



Population development per municipality 2021-2035 (PBL, 2022)

Threats and opportunities – nature-based solutions

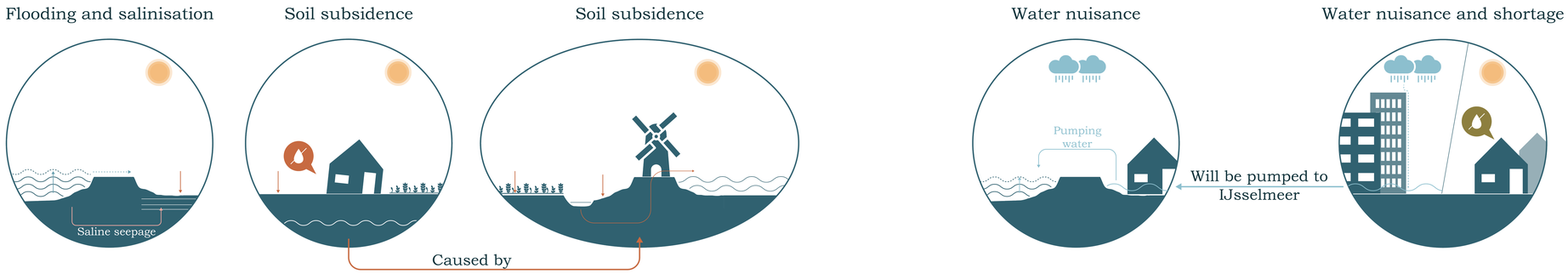


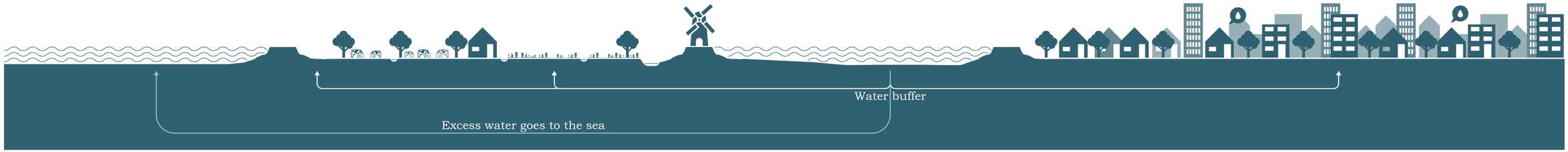
Nature-based solutions (Klimaateffectatlas, 2025)

Without nature-based solutions, Flevoland risks environmental and social consequences as water problems intensify, due to climate change,in combination with urban growth in the coming years.

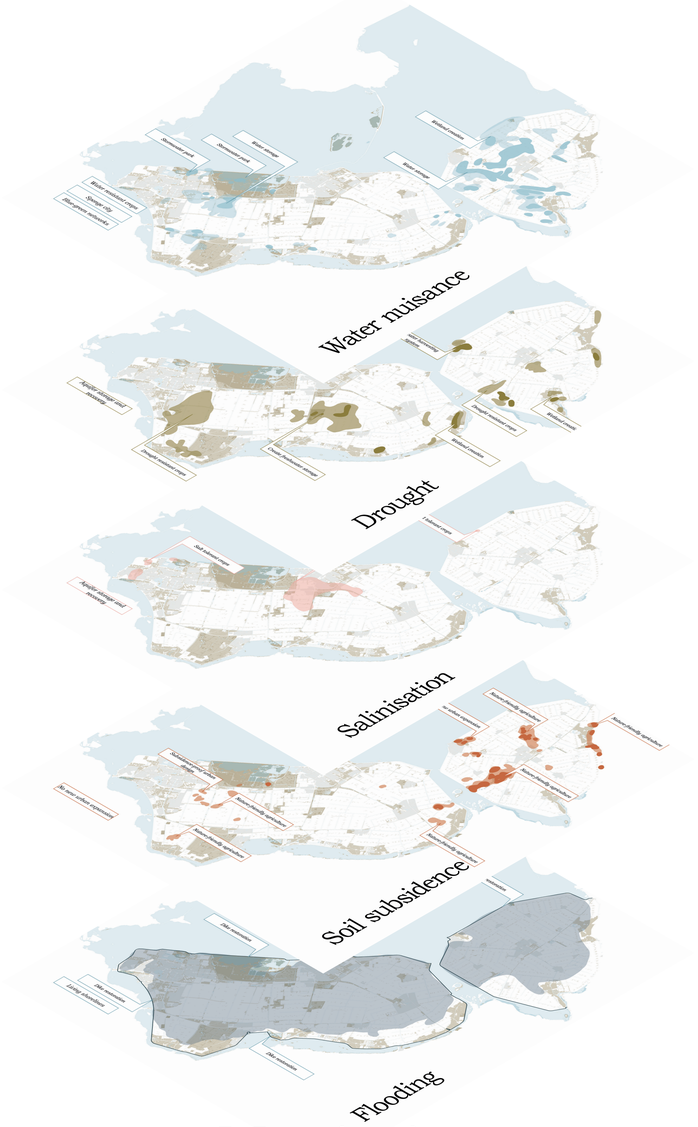
How could nature-based solutions be utilised to enhance the water system and improve the resilience of Flevoland?

Water problems





Maximisation method

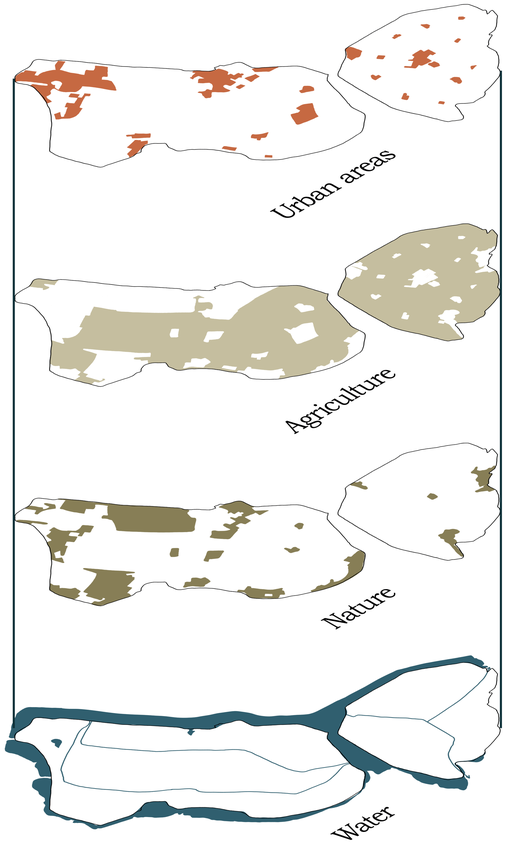


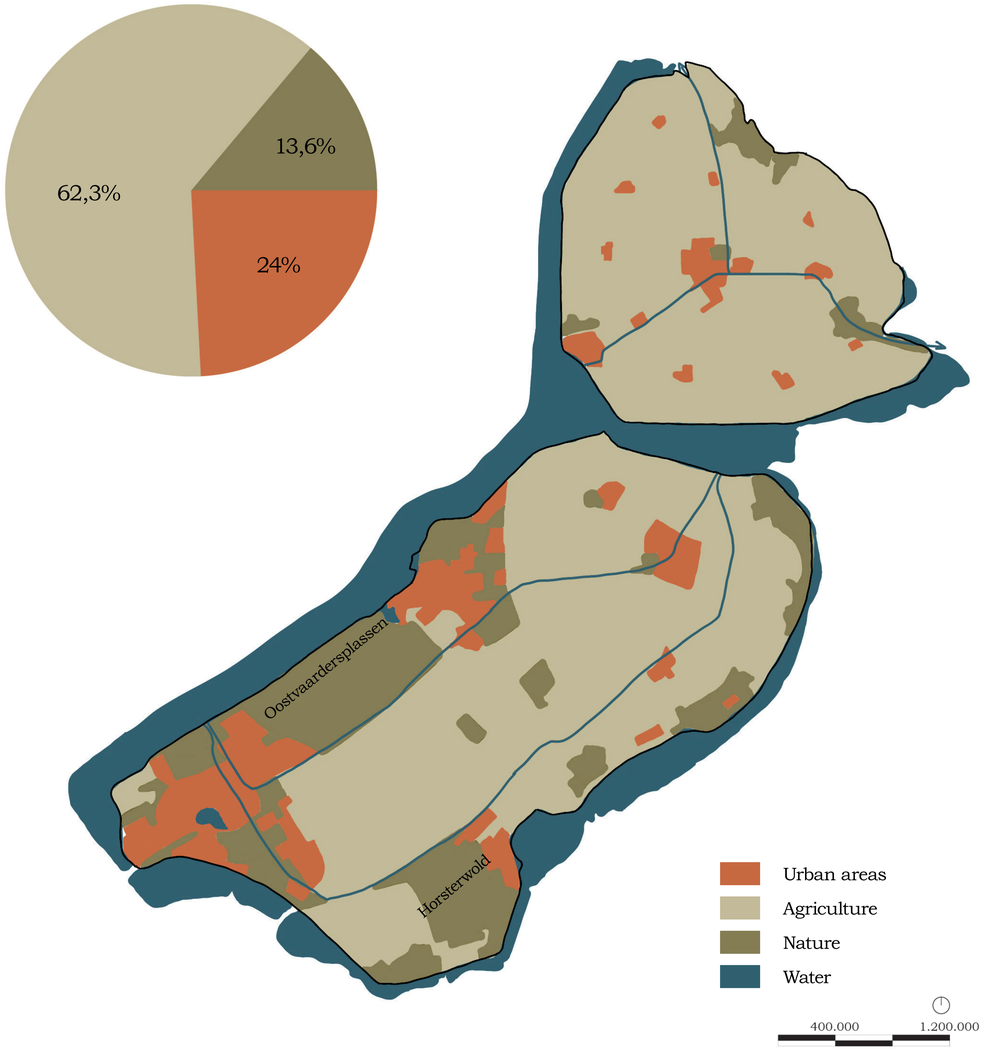
Maximise

Integrate

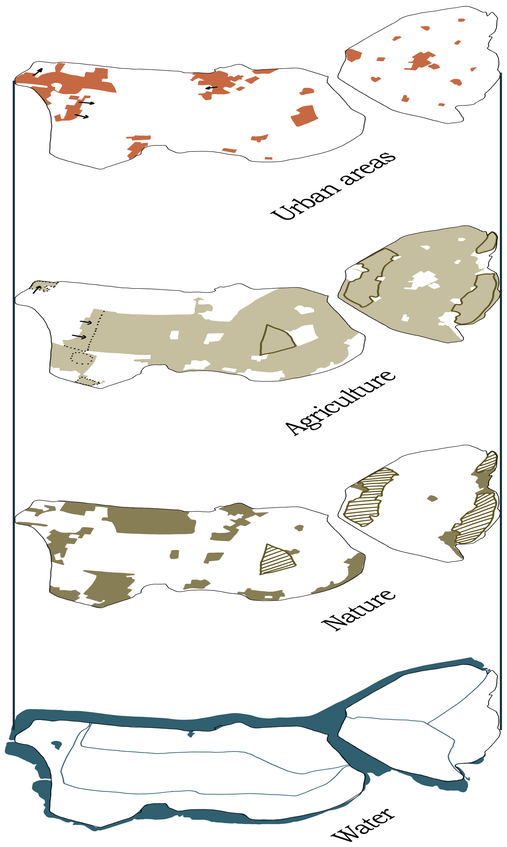
Flevoland

Analysis conclusion



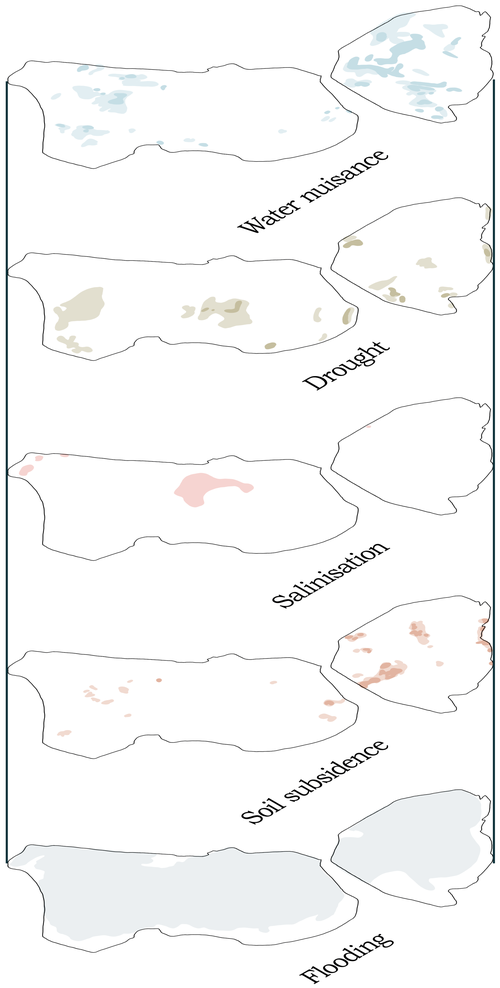


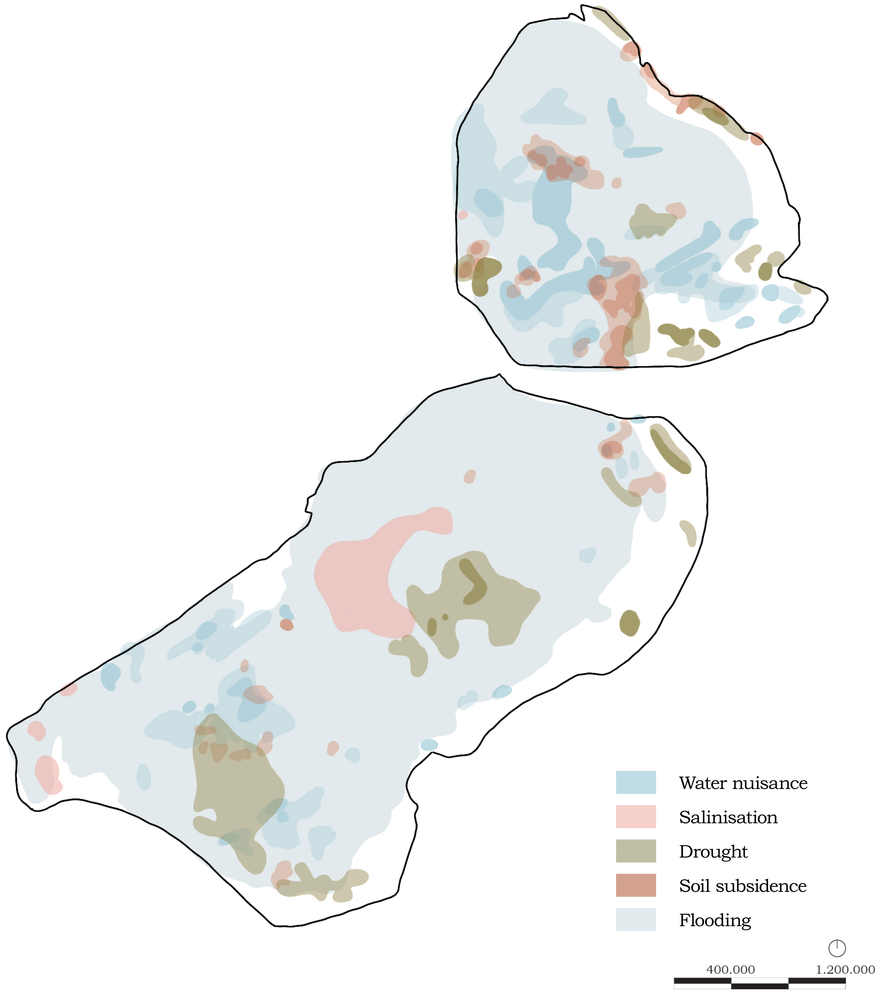
Analysis conclusion 2050



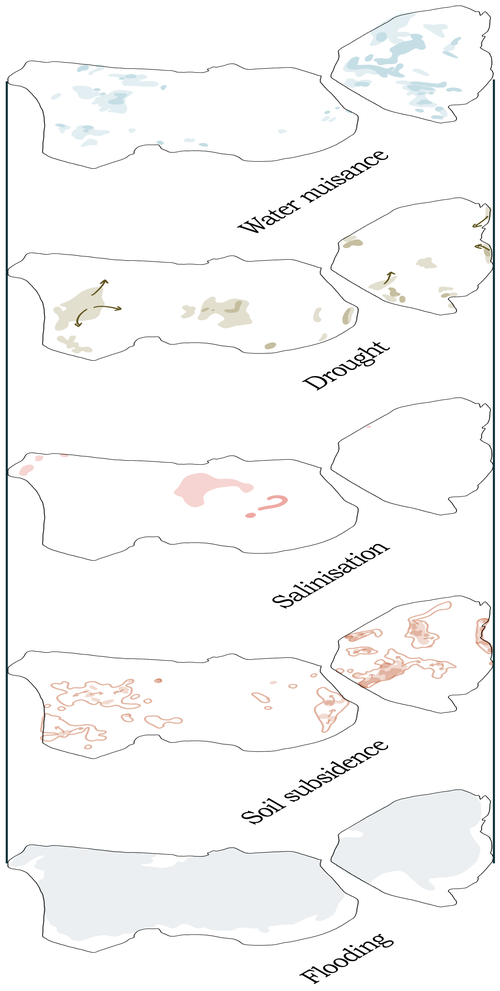
Water problems

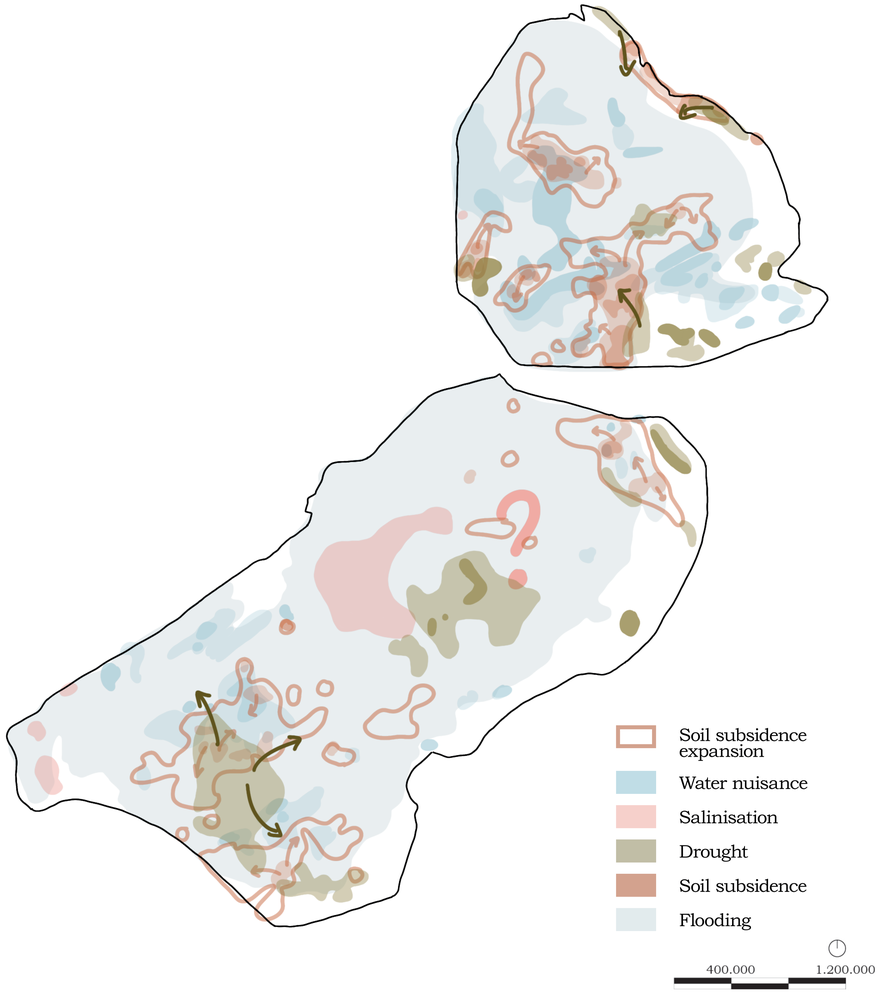
Conclusion water problems





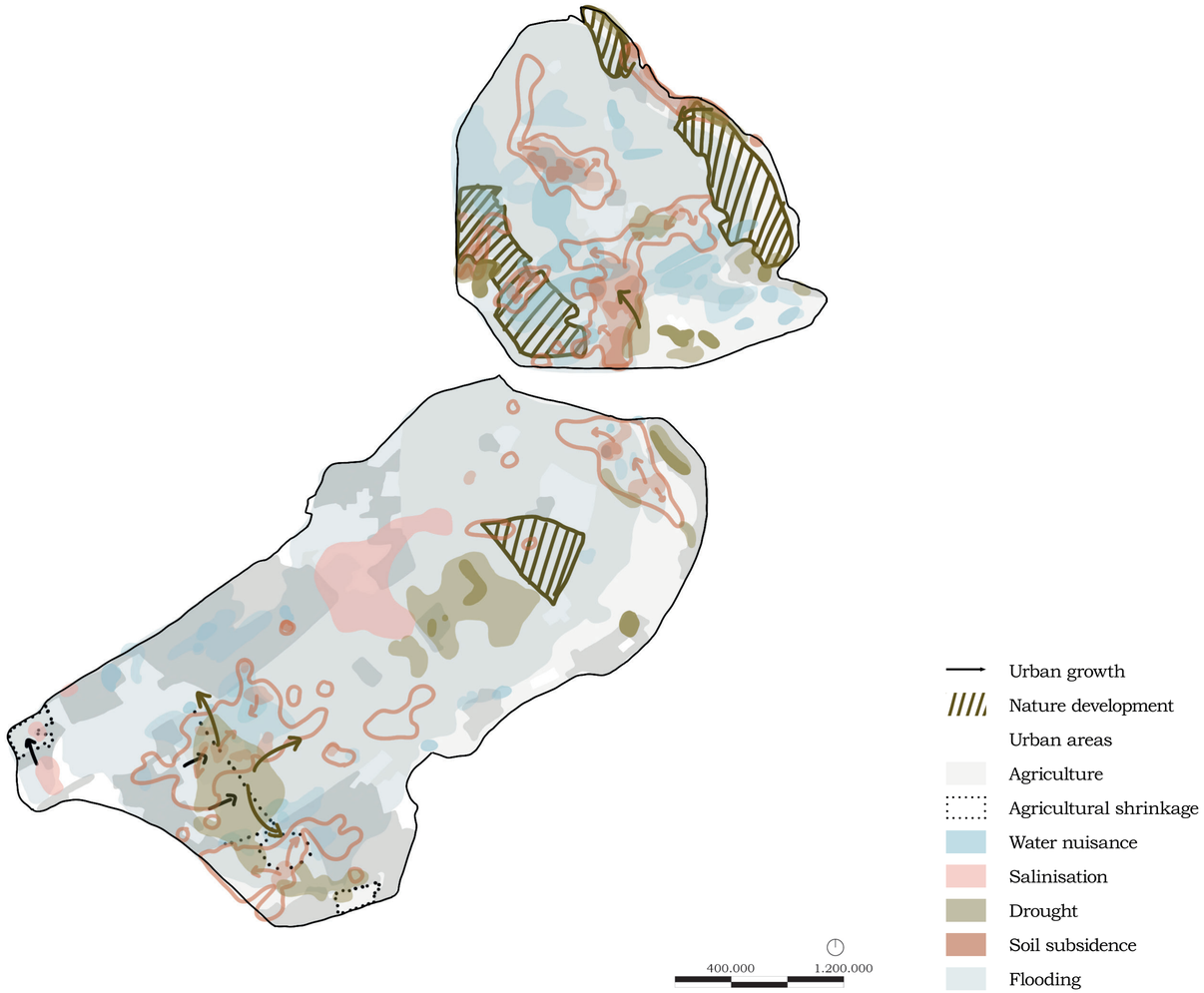
Conclusion water problems 2050





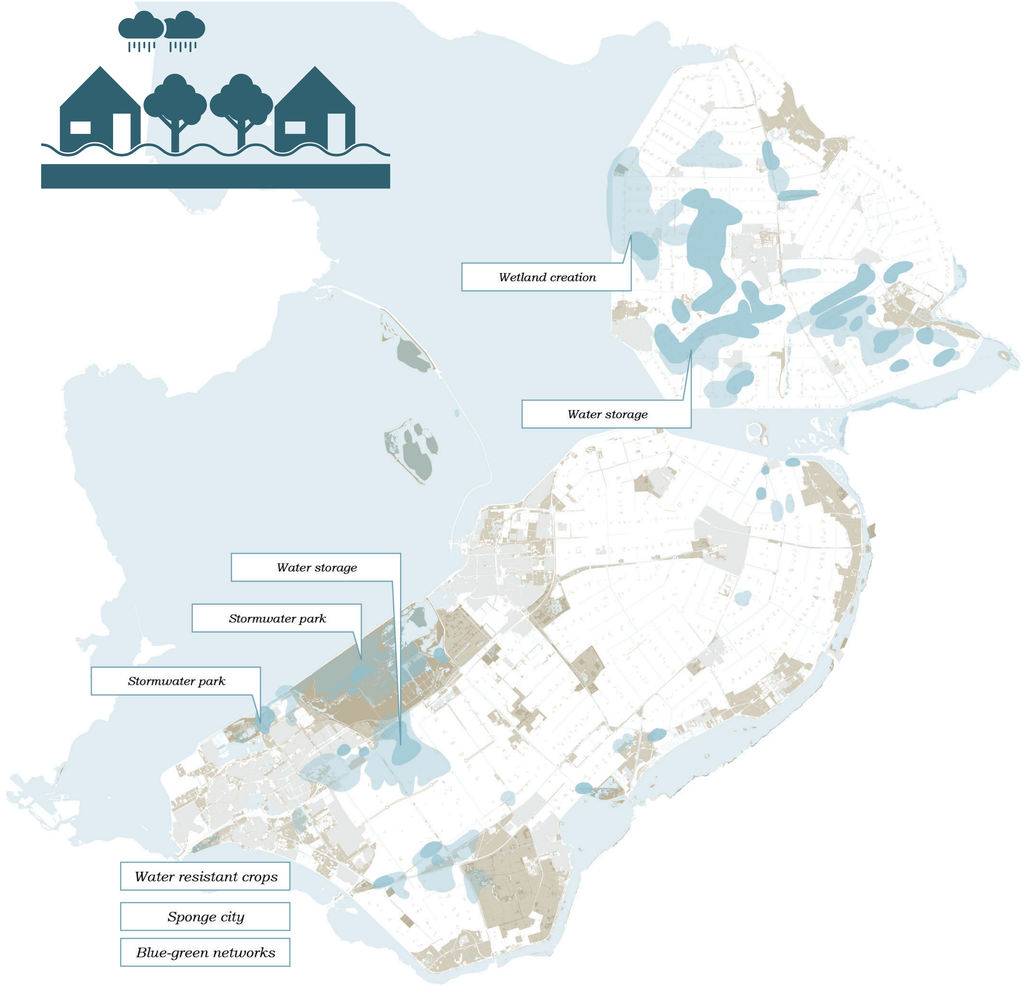
Conclusion analysis

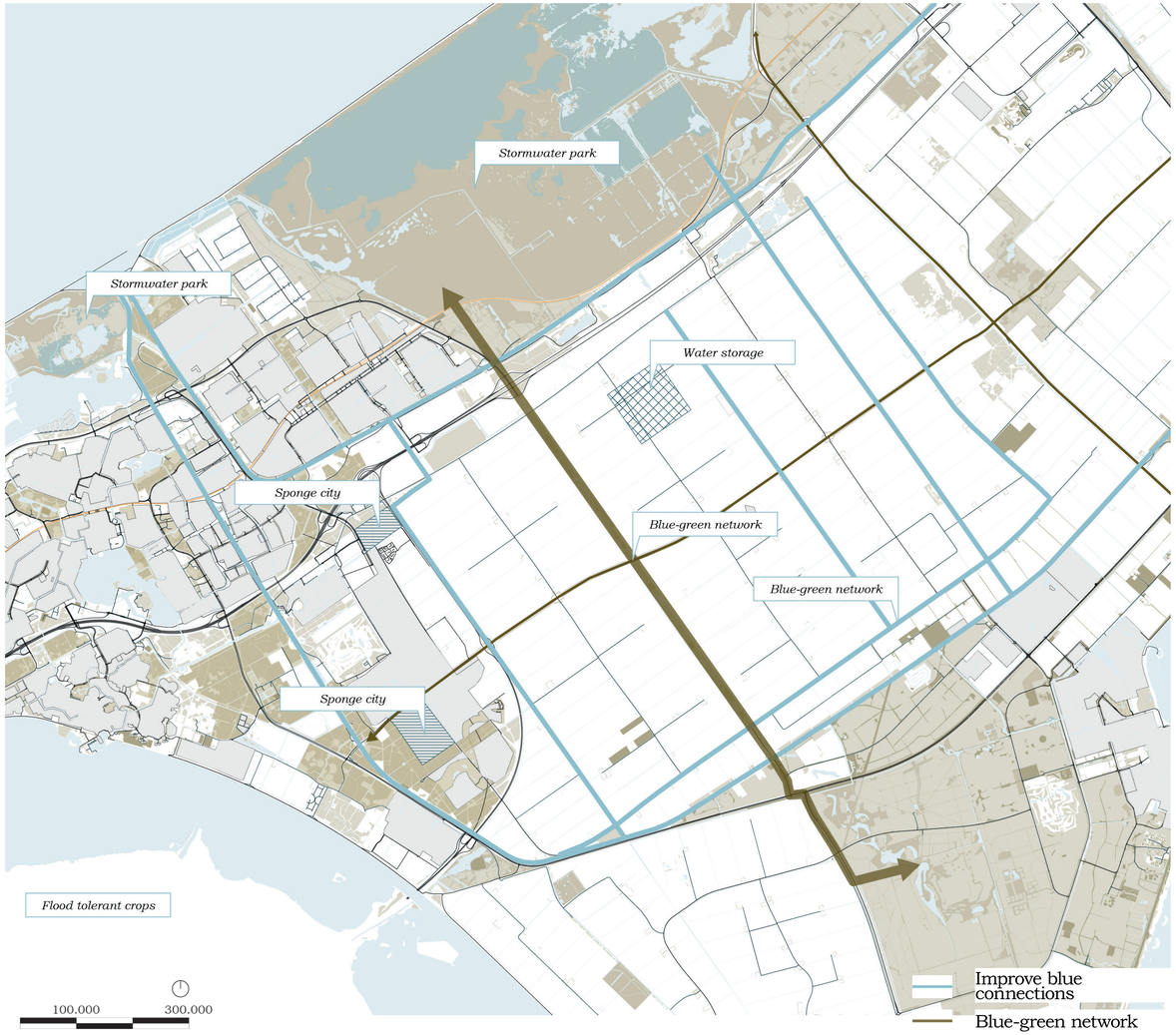
Spatial analysis and water problems - 2050



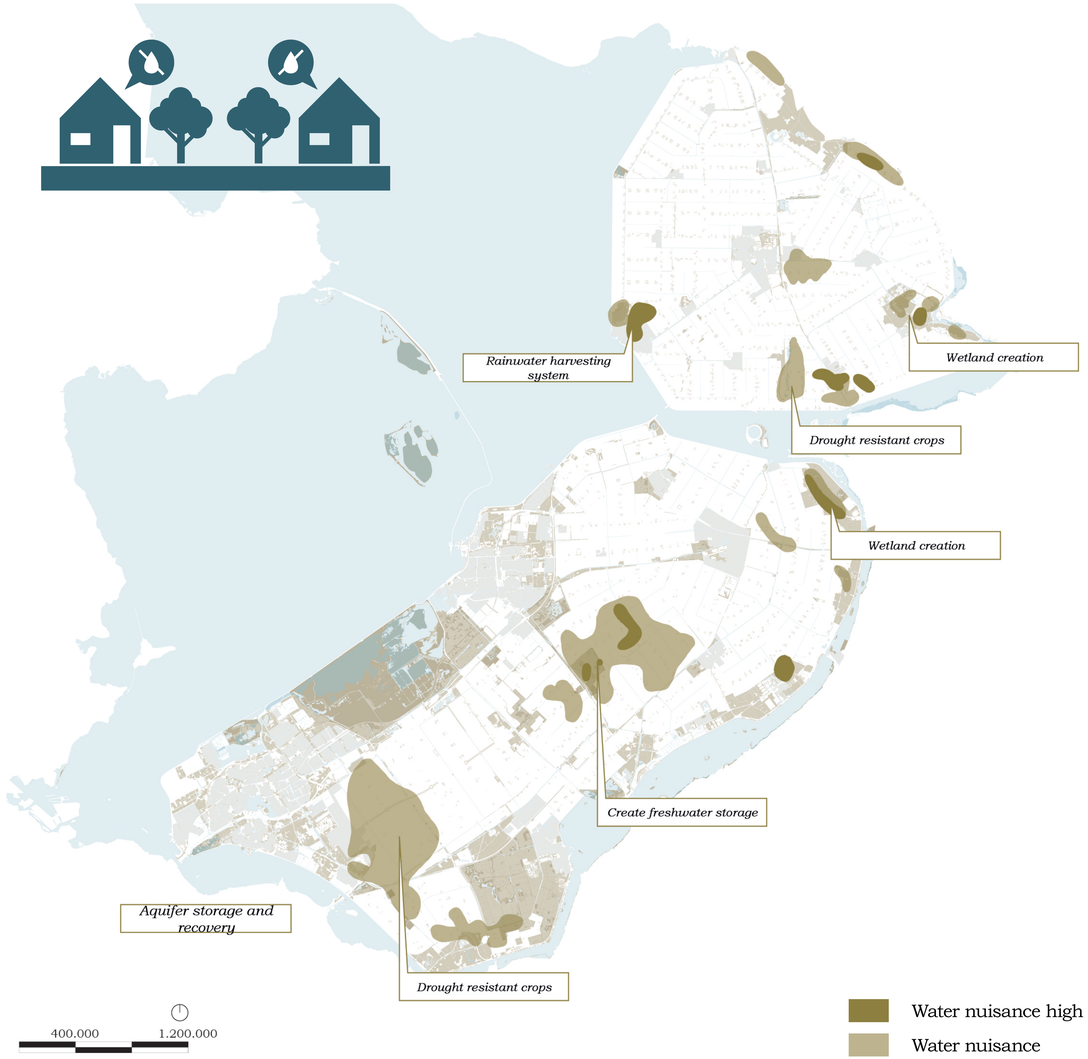
Maximisation

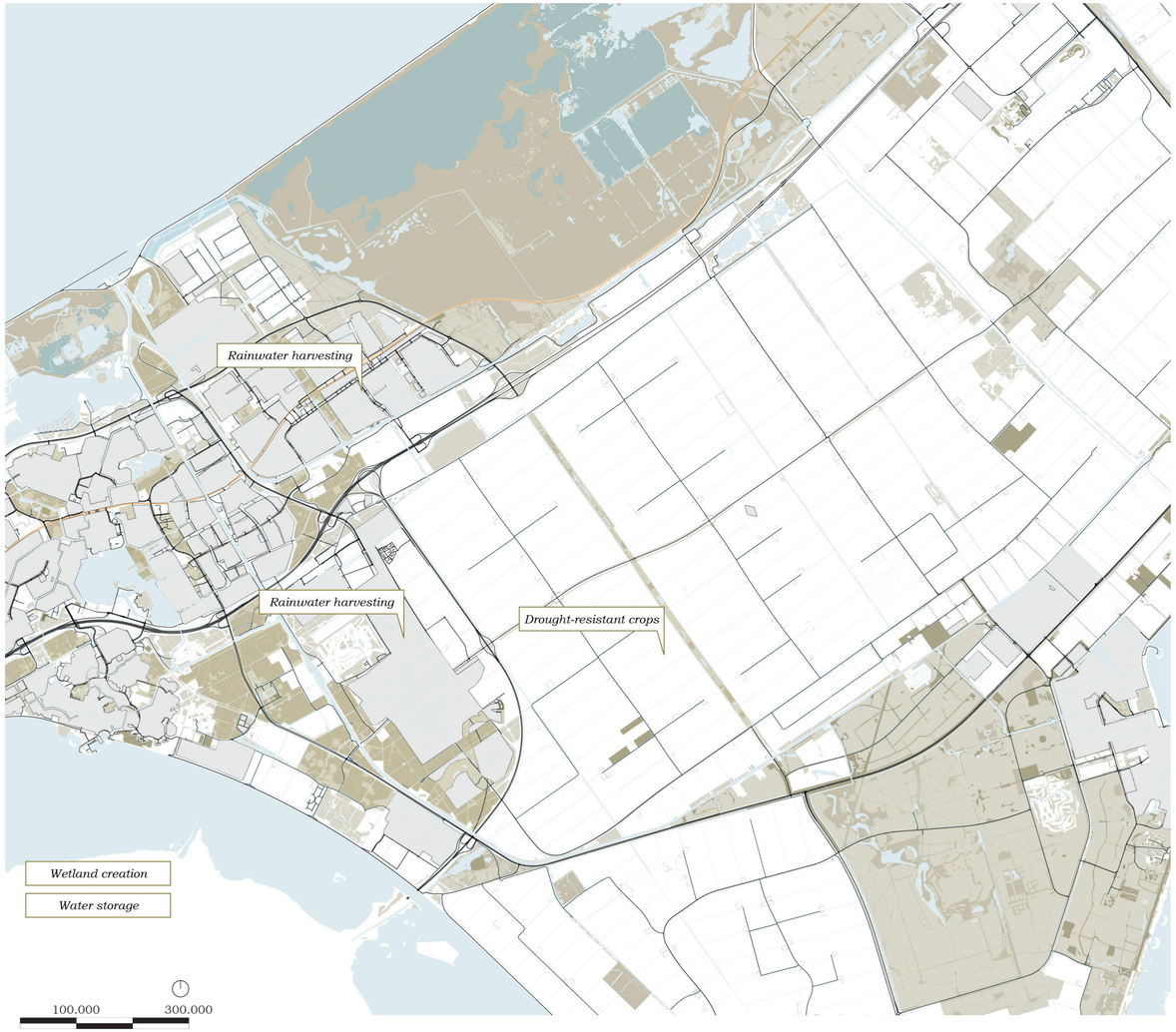
Water quantity - water nuisance



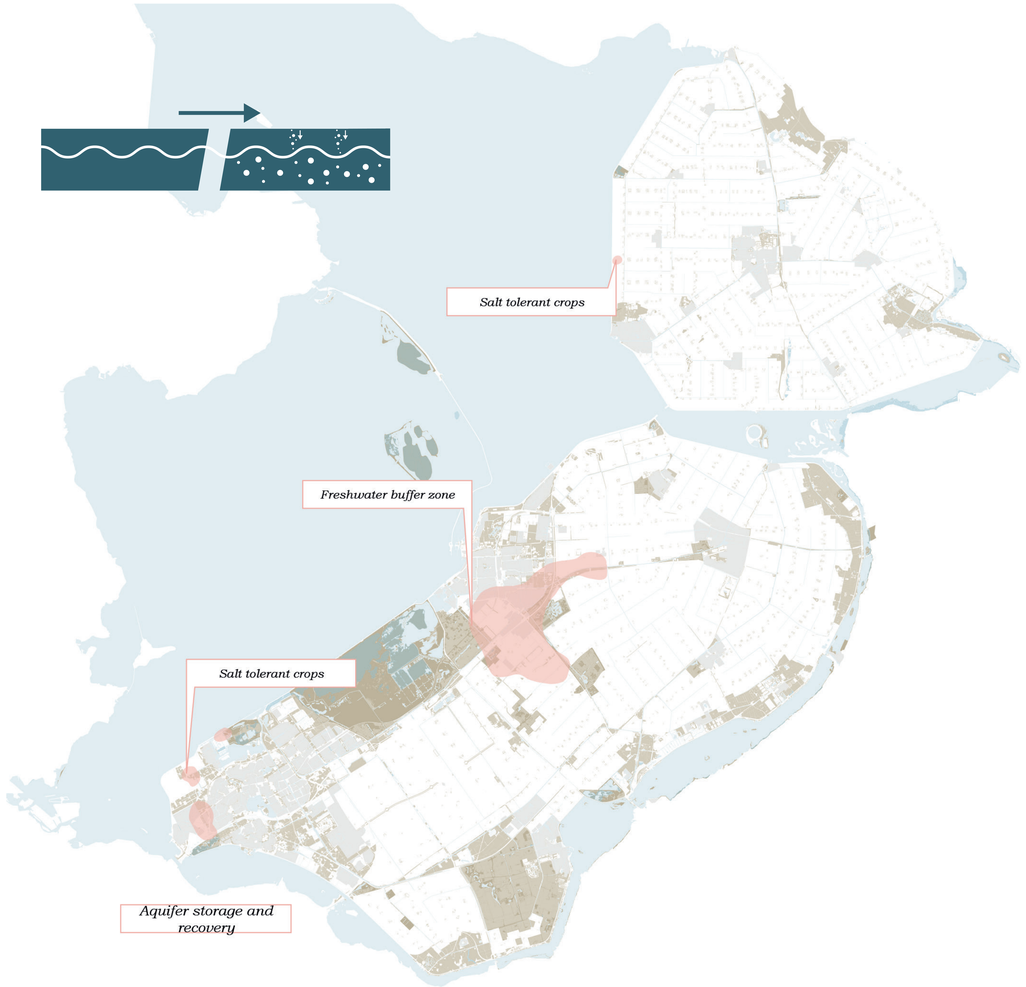


Water quantity - drought stress

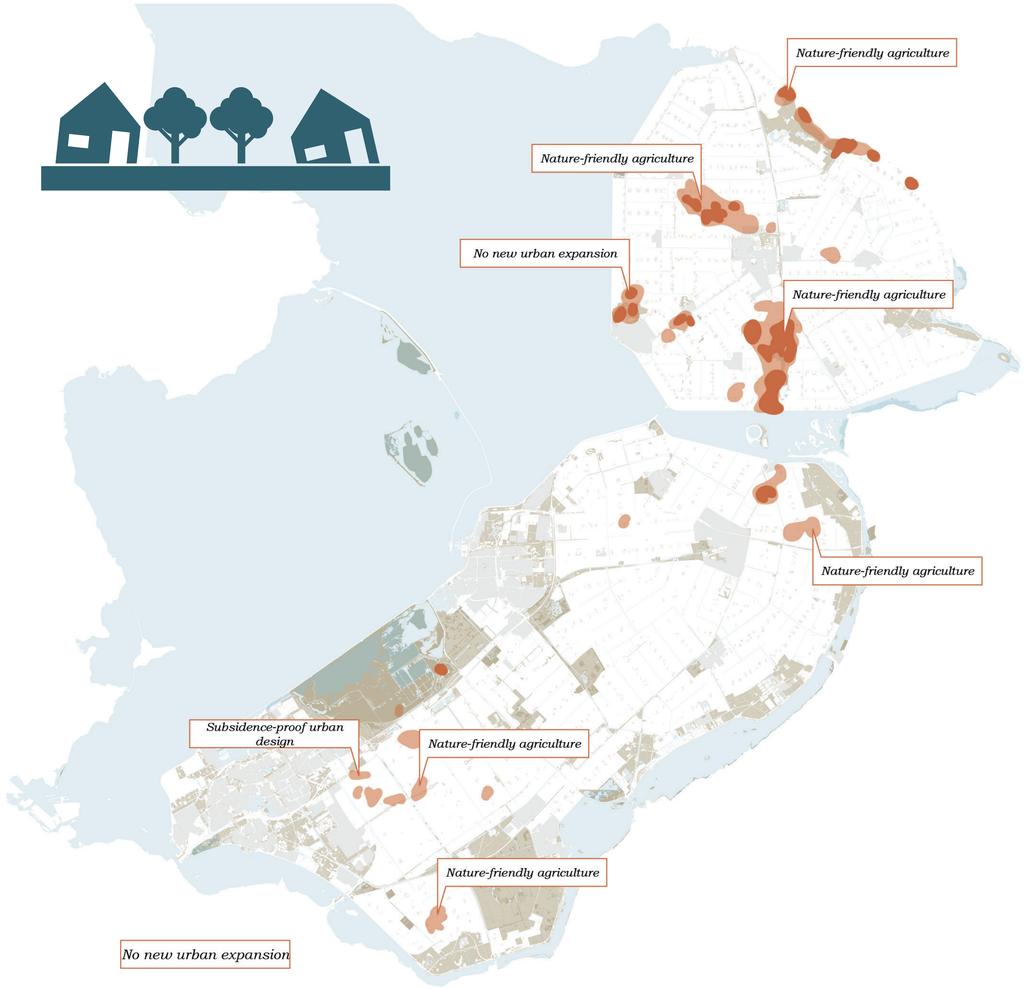




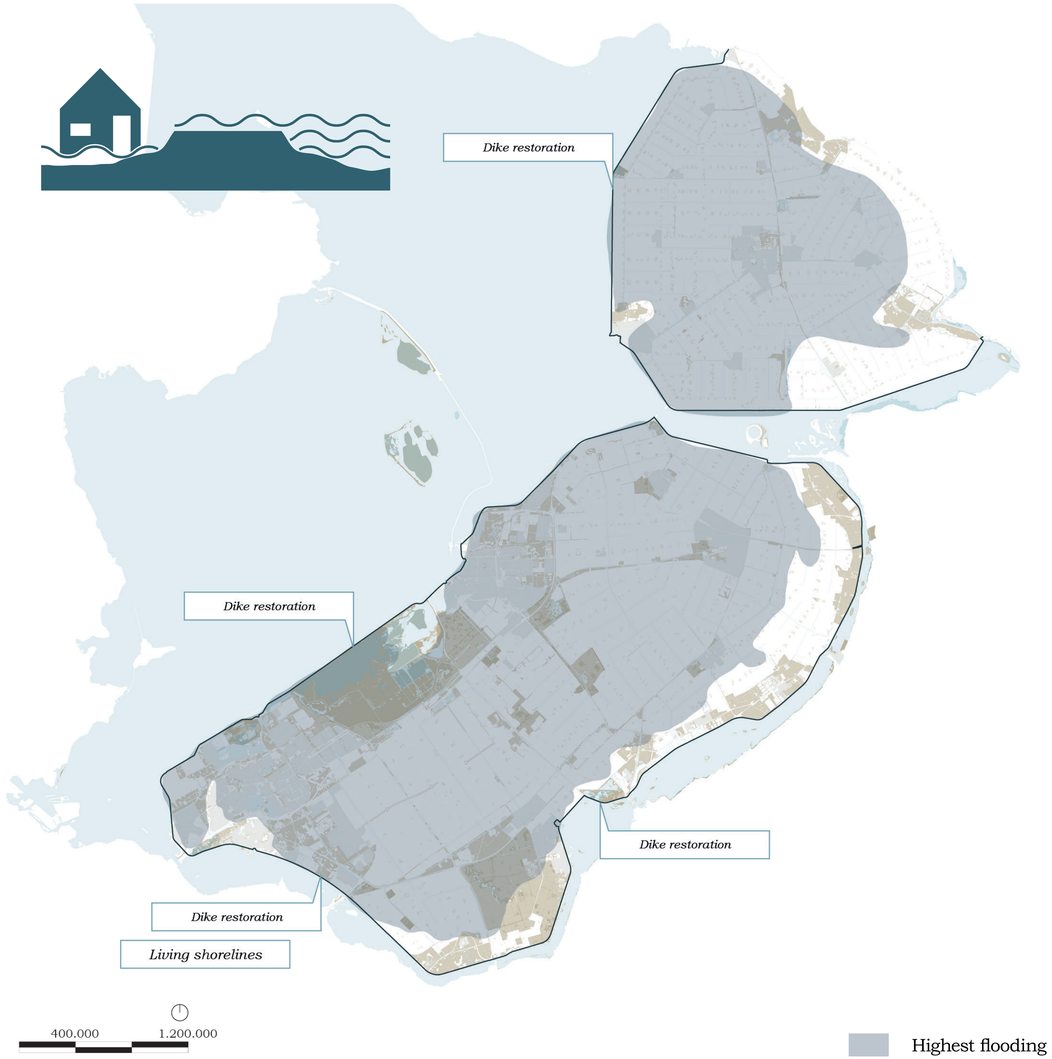
Soil health - salinisation

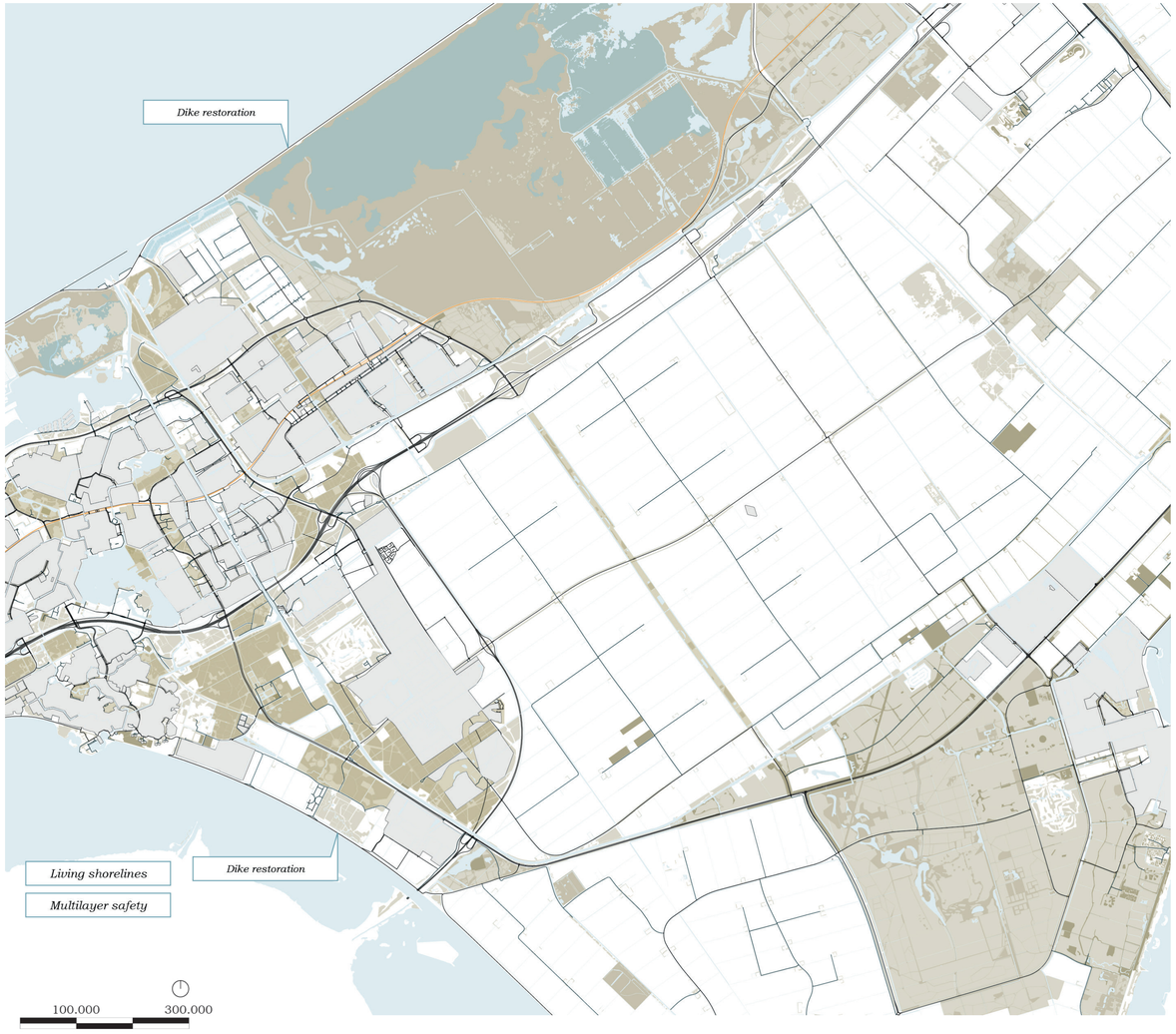


Soil health - soil subsidence

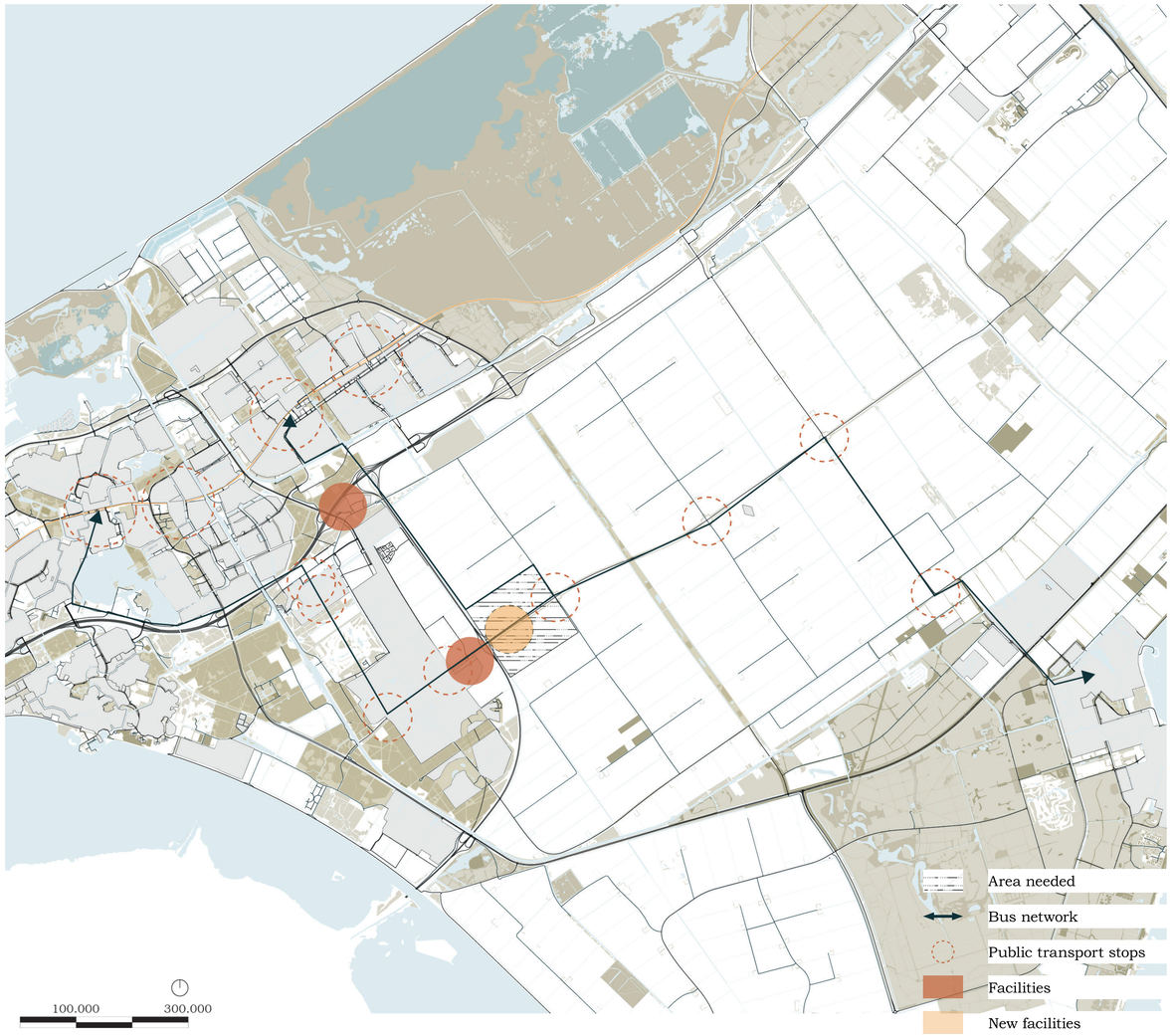


Water safety - flooding

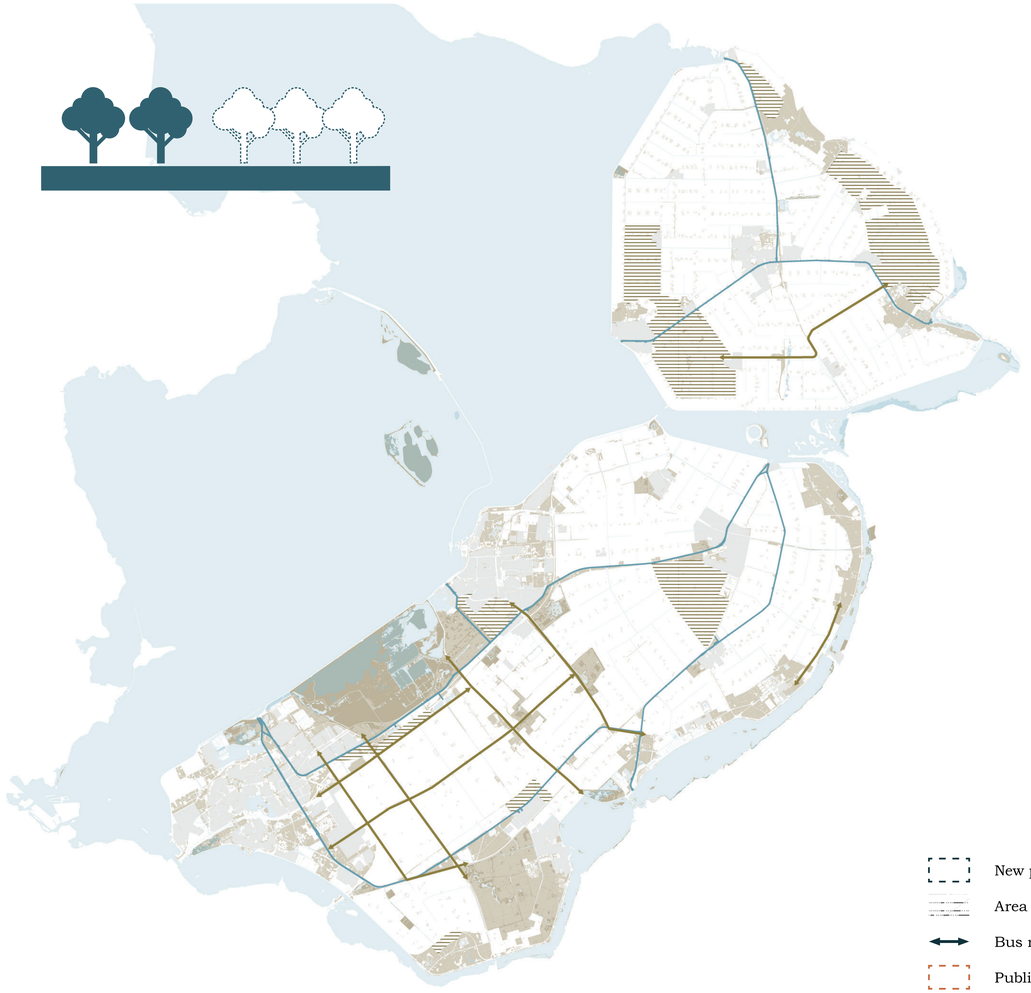




Urban expansion

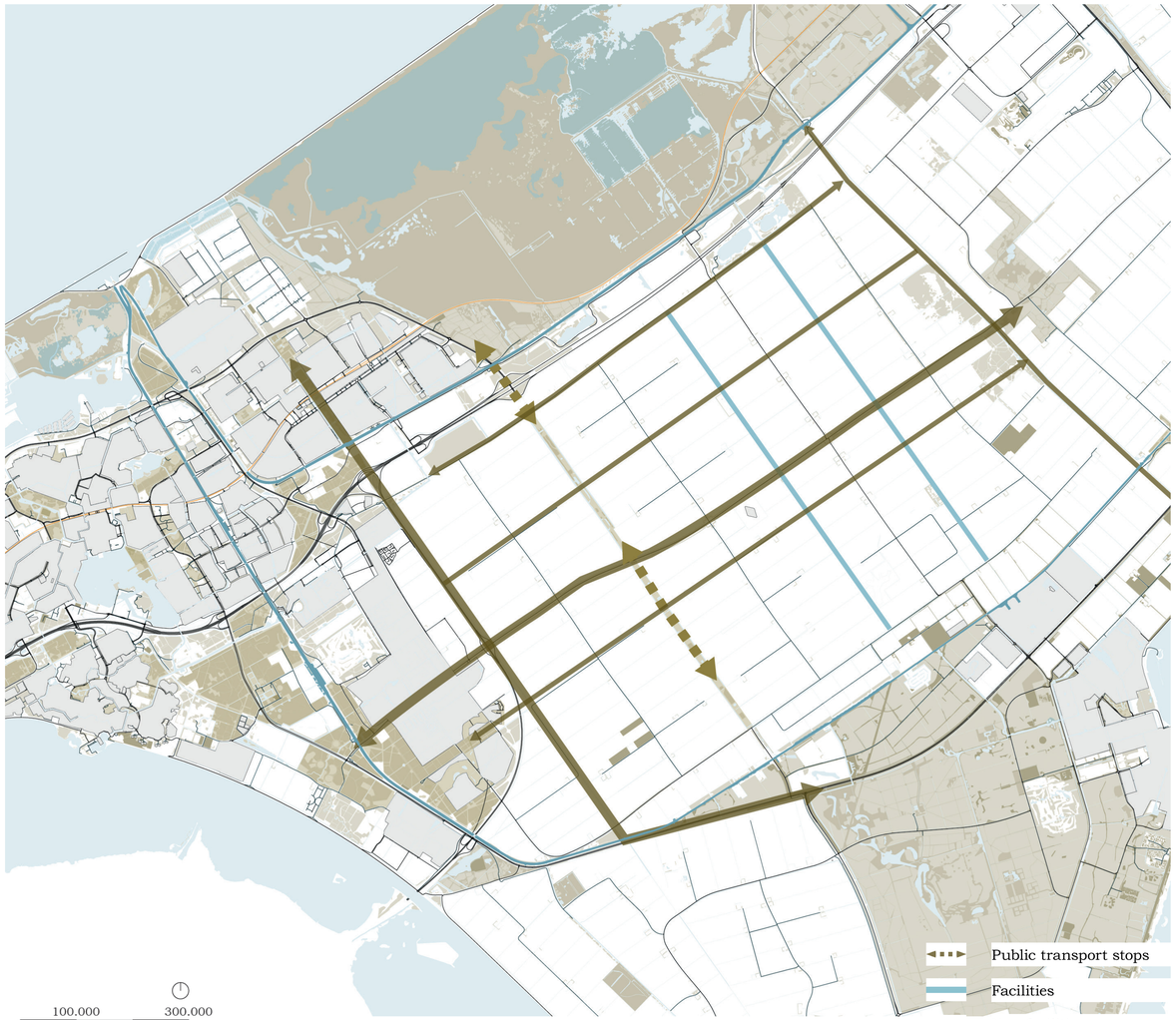


Nature



New public transport
Area needed
Bus network
Public transport stops
Facilities
New facilities

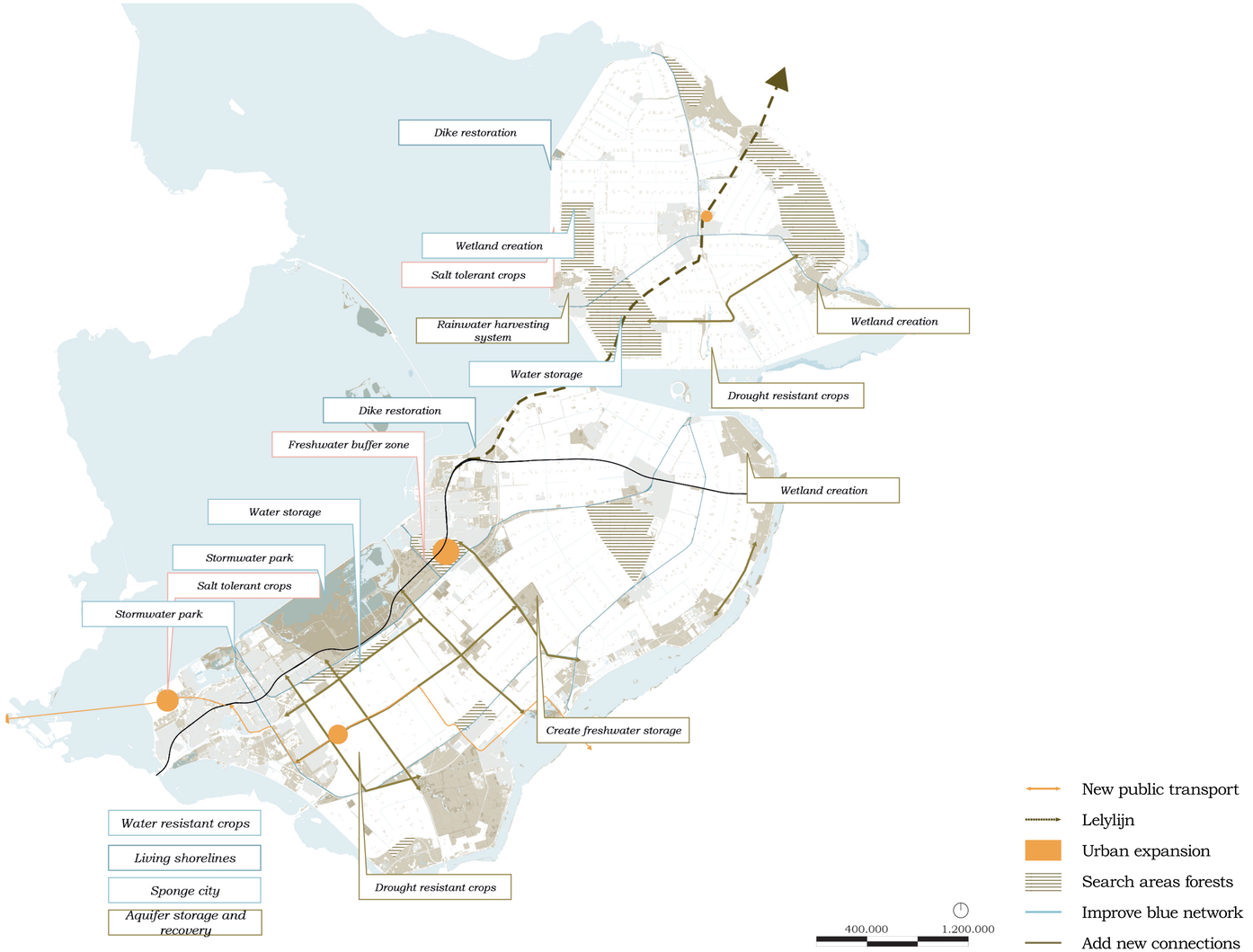
400.000 1.200.000



Public transport stops
Facilities
New facilities

100.000 300.000

Integration



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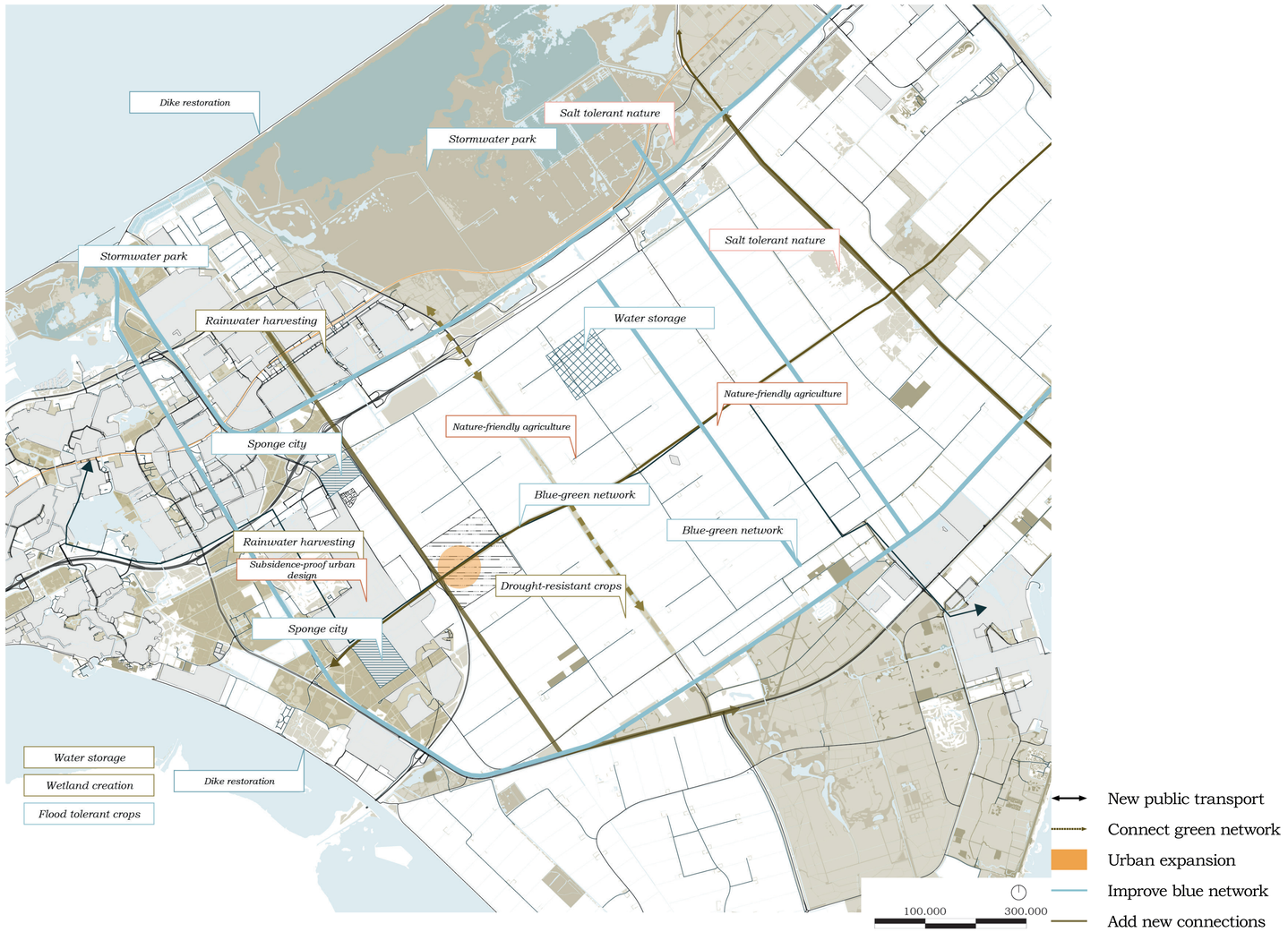
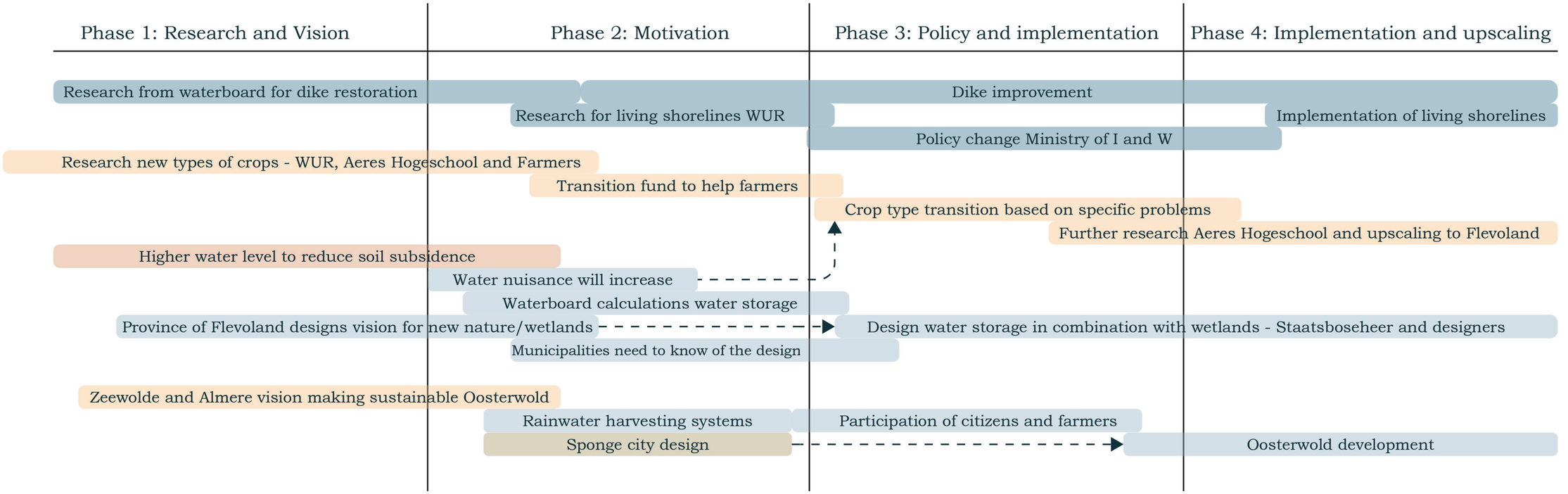


Governance


Phase 1: Research and Vision
Phase 2: Motivation
Phase 3: Policy and implementation
Phase 4: Implementation and upscaling
Research from waterboard for dike restoration
Dike improvement
Research for living shorelines WUR
Implementation of living shorelines
Policy change Ministry of I and W
Research new types of crops - WUR, Aeres Hogeschool and Farmers
Transition fund to help farmers
Crop type transition based on specific problems
Further research Aeres Hogeschool and upscaling to Flevoland
Higher water level to reduce soil subsidence
Water nuisance will increase
Waterboard calculations water storage
Province of Flevoland designs vision for new nature/wetlands
Design water storage in combination with wetlands - Staatsboseheer and designers
Municipalities need to know of the design
Zeewolde and Almere vision making sustainable Oosterwold
Rainwater harvesting systems
Participation of citizens and farmers
Sponge city design
Oosterwold development

Governance phase 1

Phase 1: Research and Vision

Phase 2: Motivation

Phase 3: Policy and implementation

Phase 4: Implementation and upscaling

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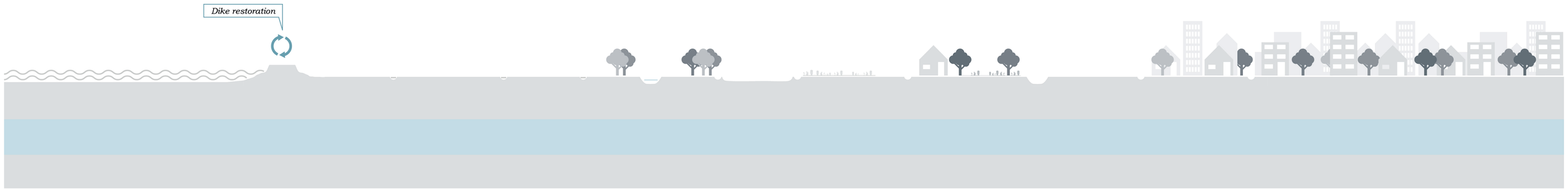

Governance phase 2

Phase 1: Research and Vision

Phase 2: Motivation

Phase 3: Policy and implementation

Phase 4: Implementation and upscaling

Research from waterboard for dike restoration

Dike improvement

Research for living shorelines WUR

Implementation of living shorelines

Policy change Ministry of I and W

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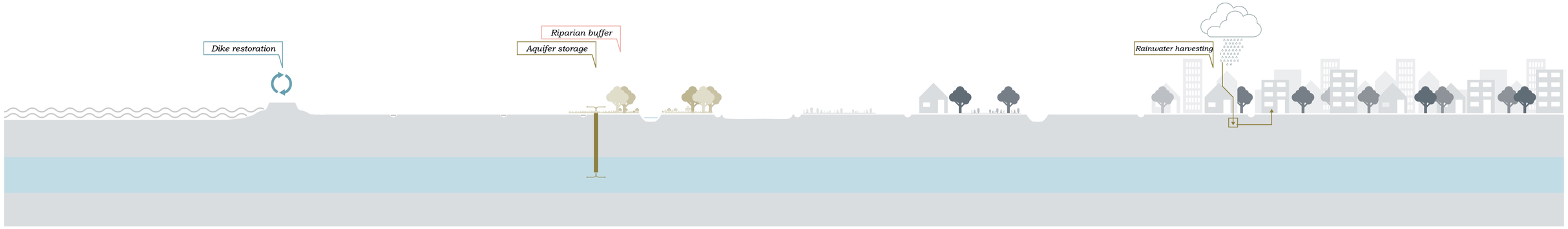
Zeewolde and Almere vision making sustainable Oosterwold

Rainwater harvesting systems

Participation of citizens and farmers

Sponge city design

Oosterwold development



Governance phase 3

Phase 1: Research and Vision

Phase 2: Motivation

Phase 3: Policy and implementation

Phase 4: Implementation and upscaling

Research from waterboard for dike restoration

Dike improvement

Research for living shorelines WUR

Implementation of living shorelines

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Zeewolde and Almere vision making sustainable Oosterwold

Rainwater harvesting systems

Participation of citizens and farmers

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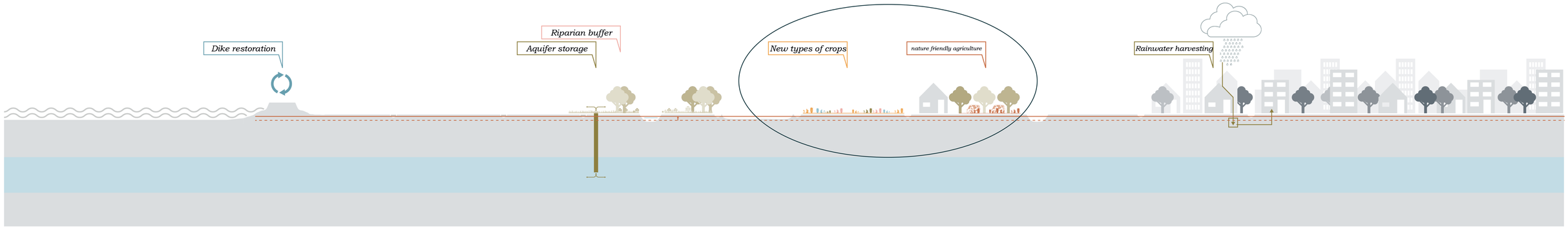
Oosterwold development



Governance phase 4

Phase 1: Research and Vision

Phase 2: Motivation

Phase 3: Policy and implementation

Phase 4: Implementation and upscaling

Research from waterboard for dike restoration

Dike improvement

Research for living shorelines WUR

Implementation of living shorelines

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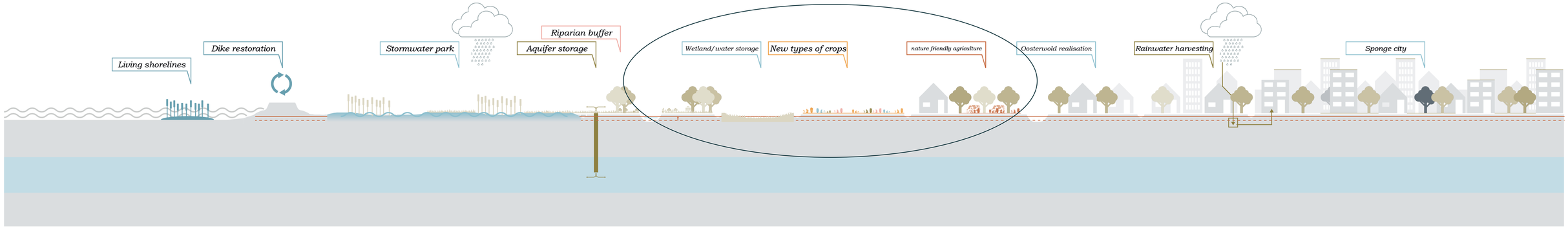
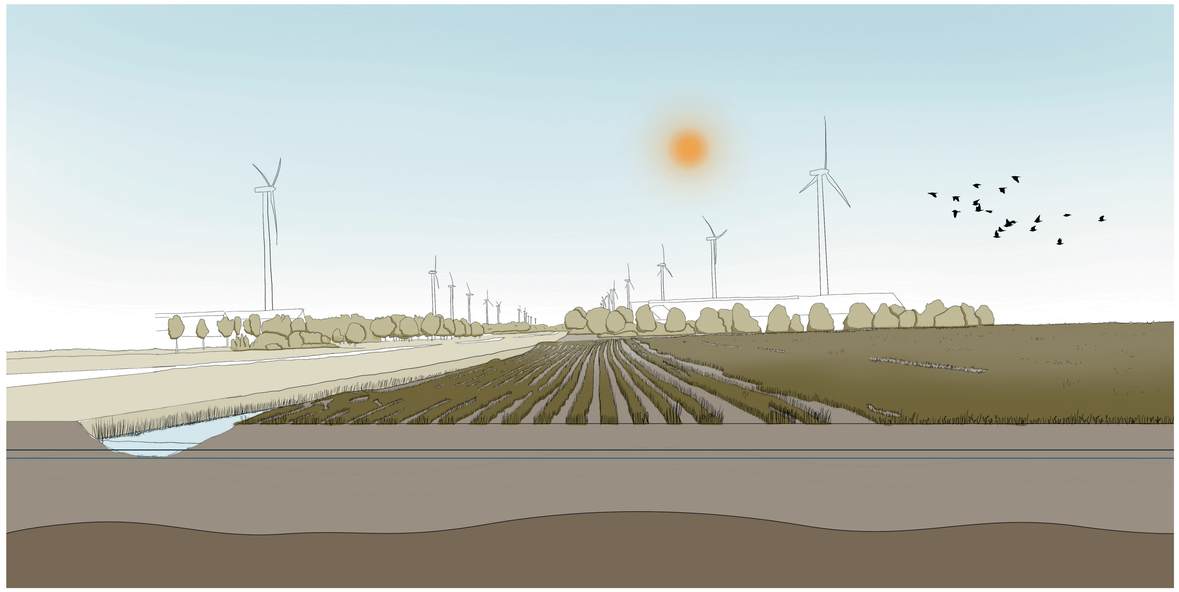
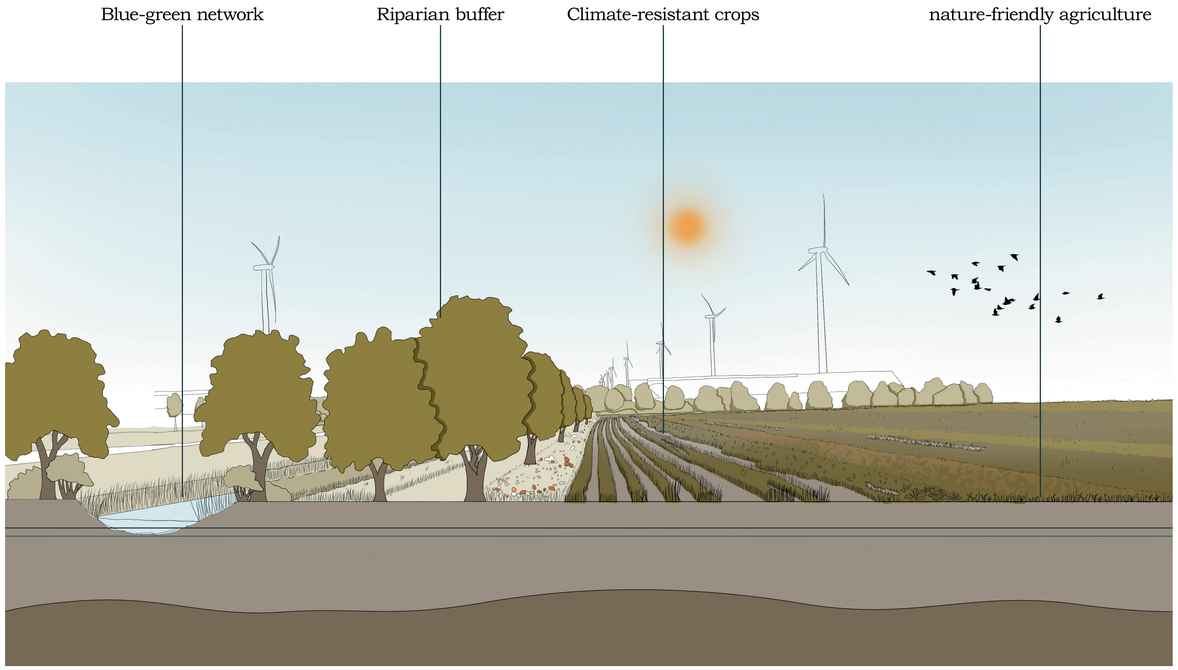


vision Flevopolder

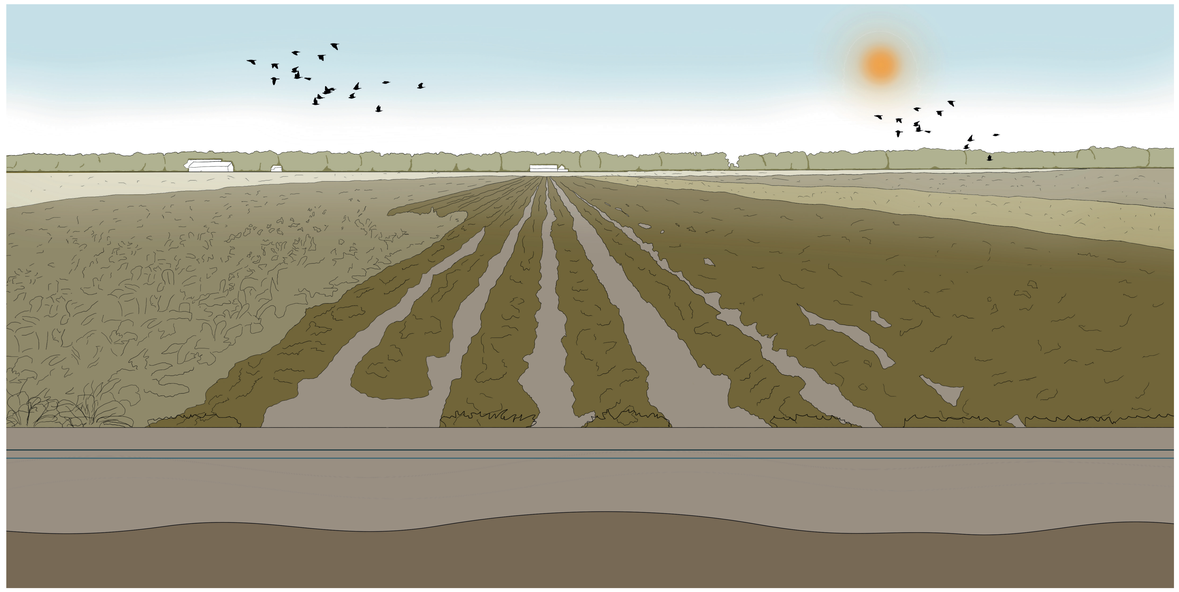


Now

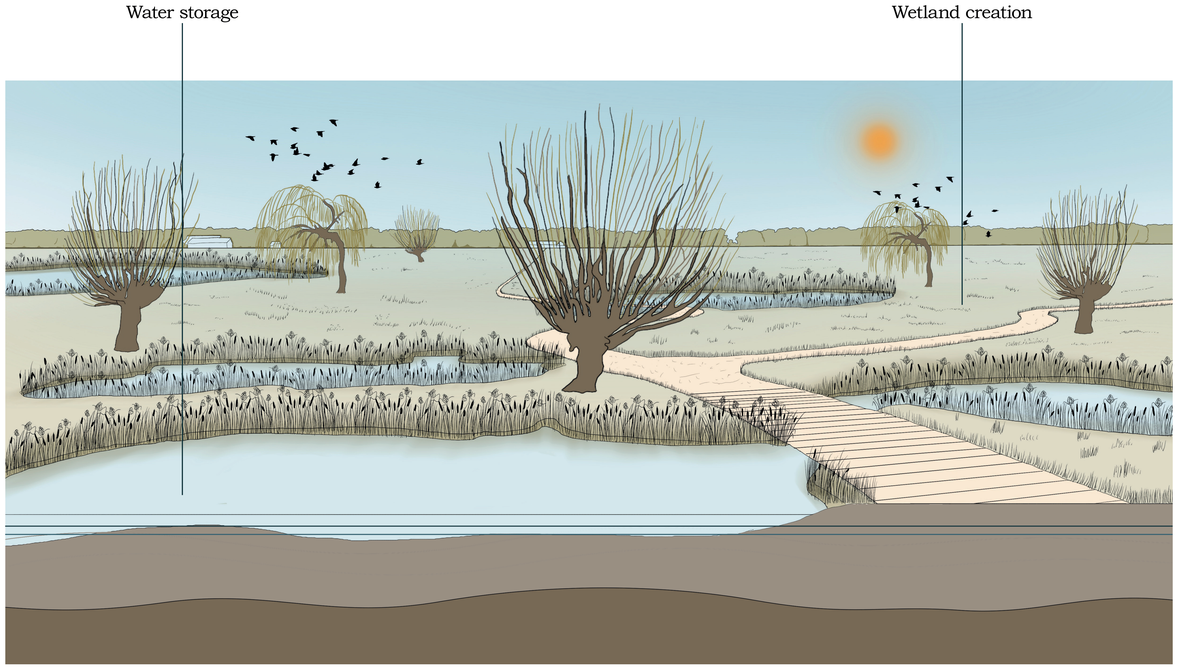


2050

Vision Noordoostpolder

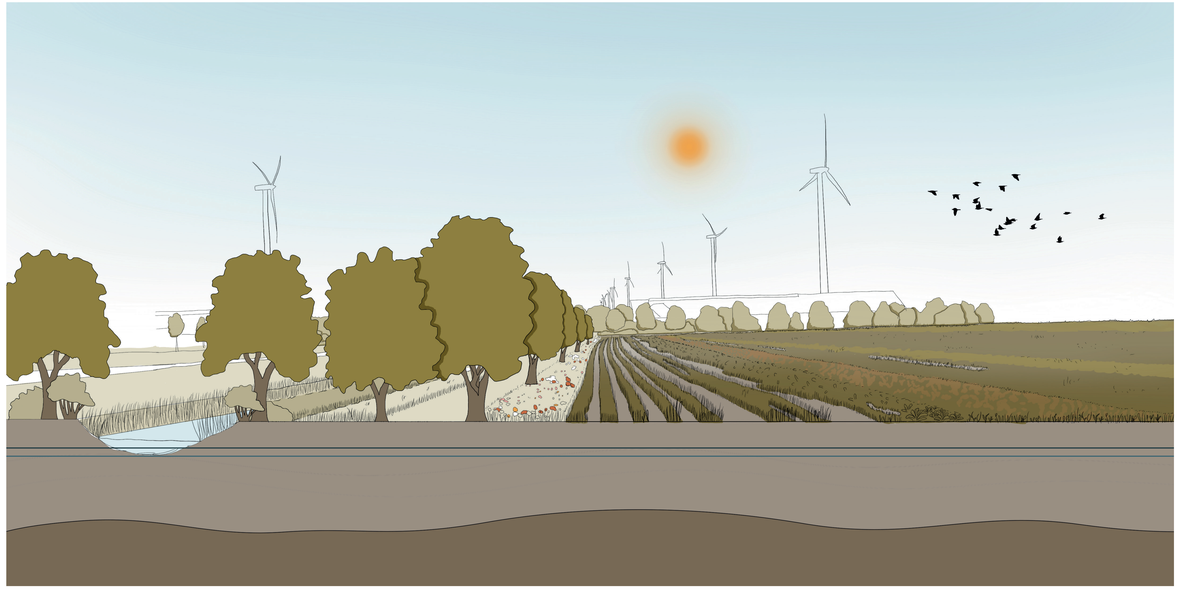


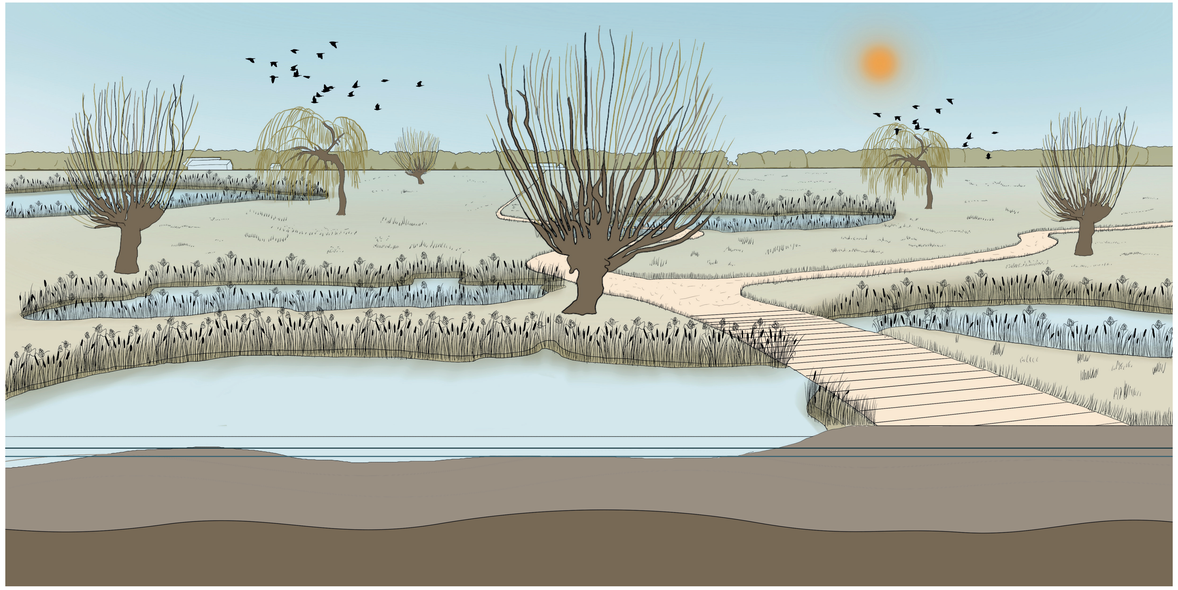
Now



2050

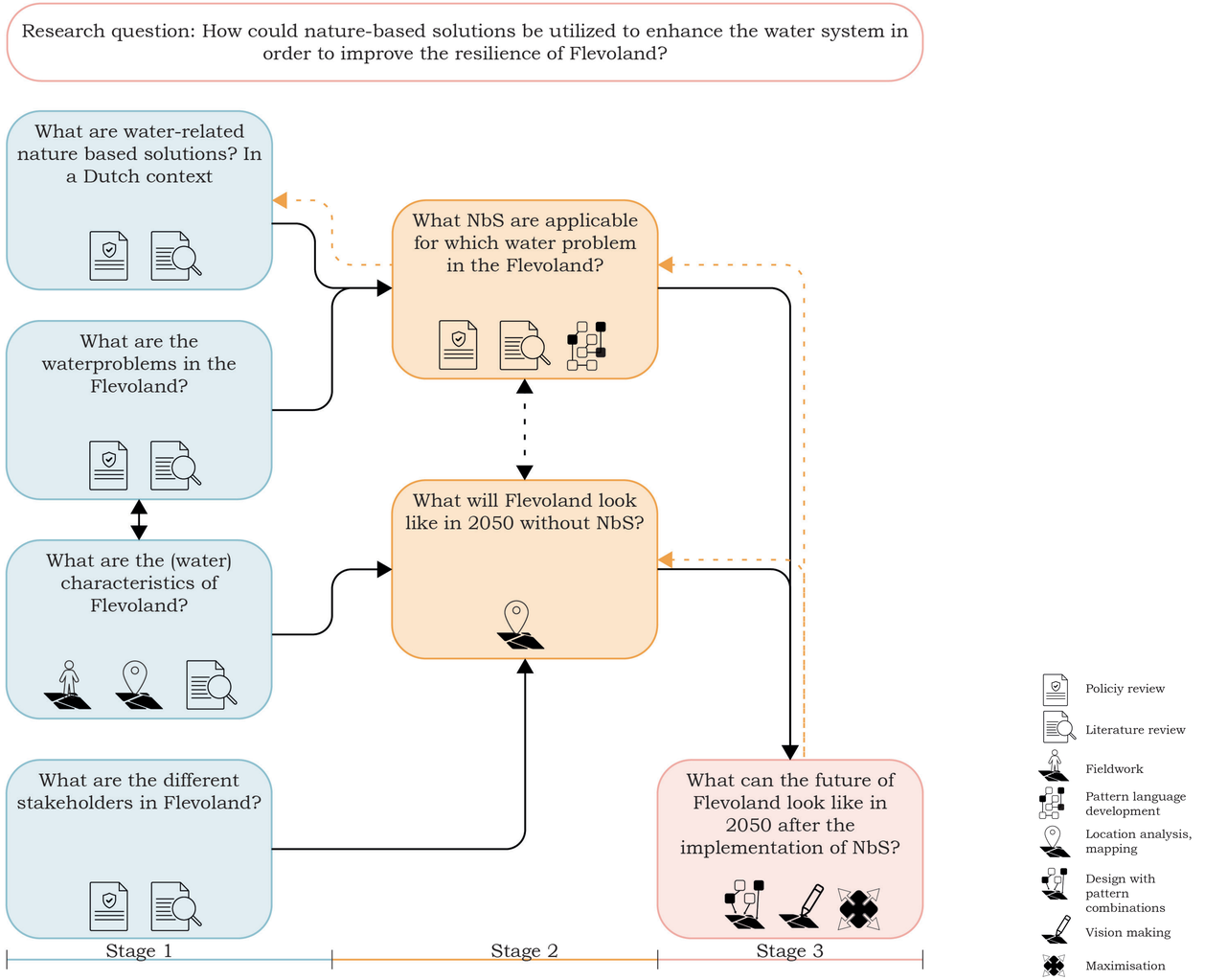
How could nature-based solutions be utilised to enhance the water system and improve the resilience of Flevoland?



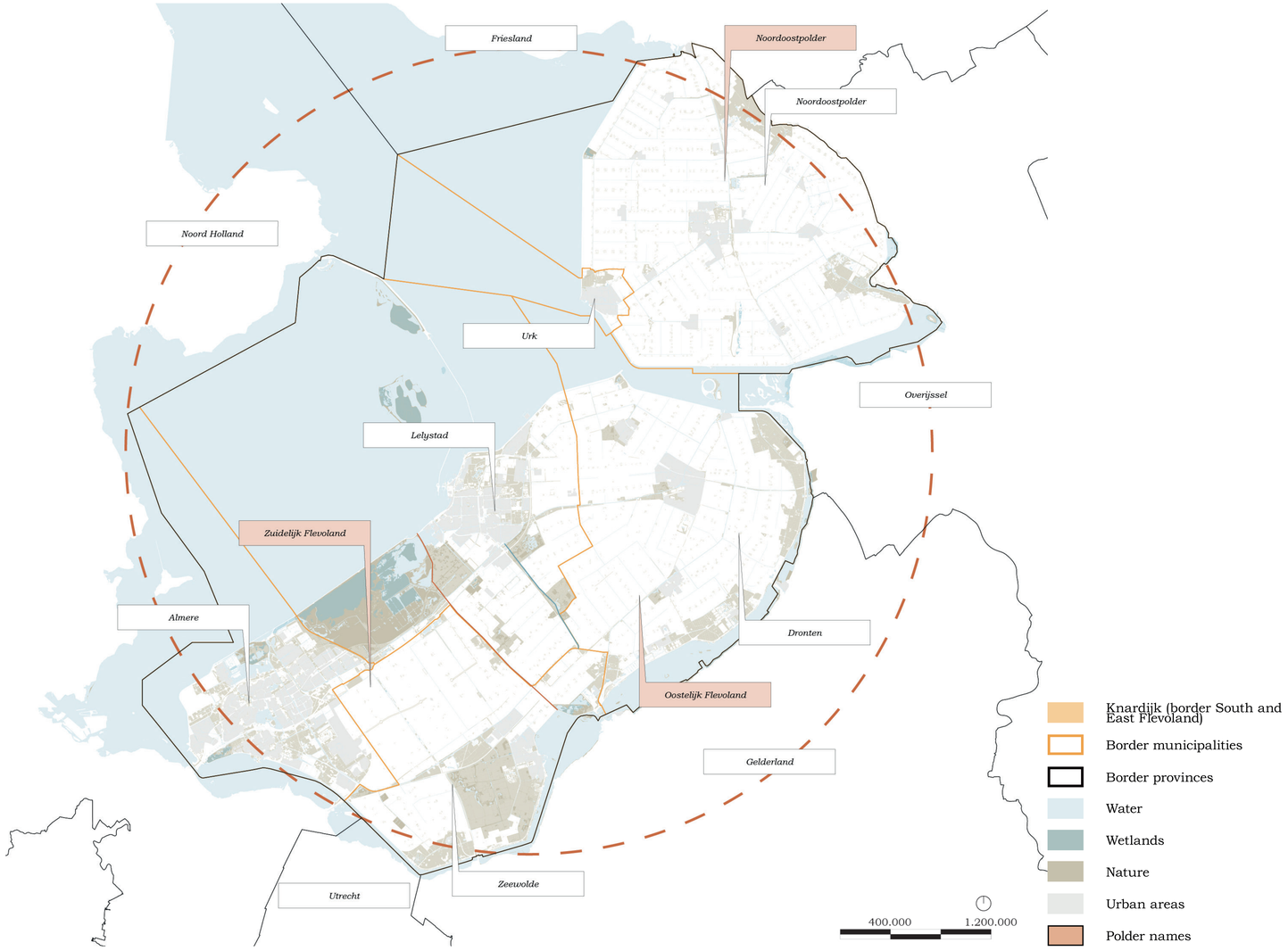


2050

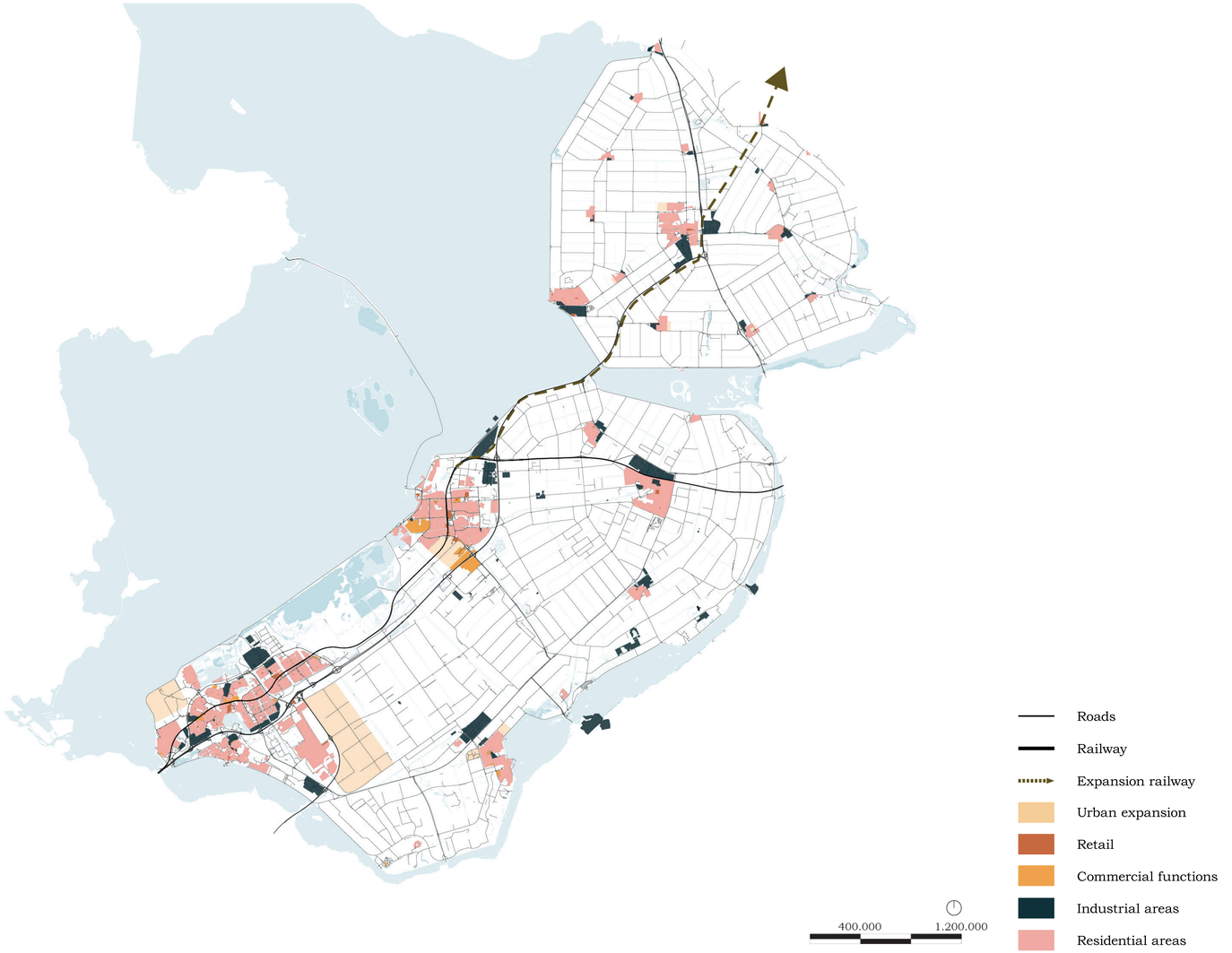
Methodological framework



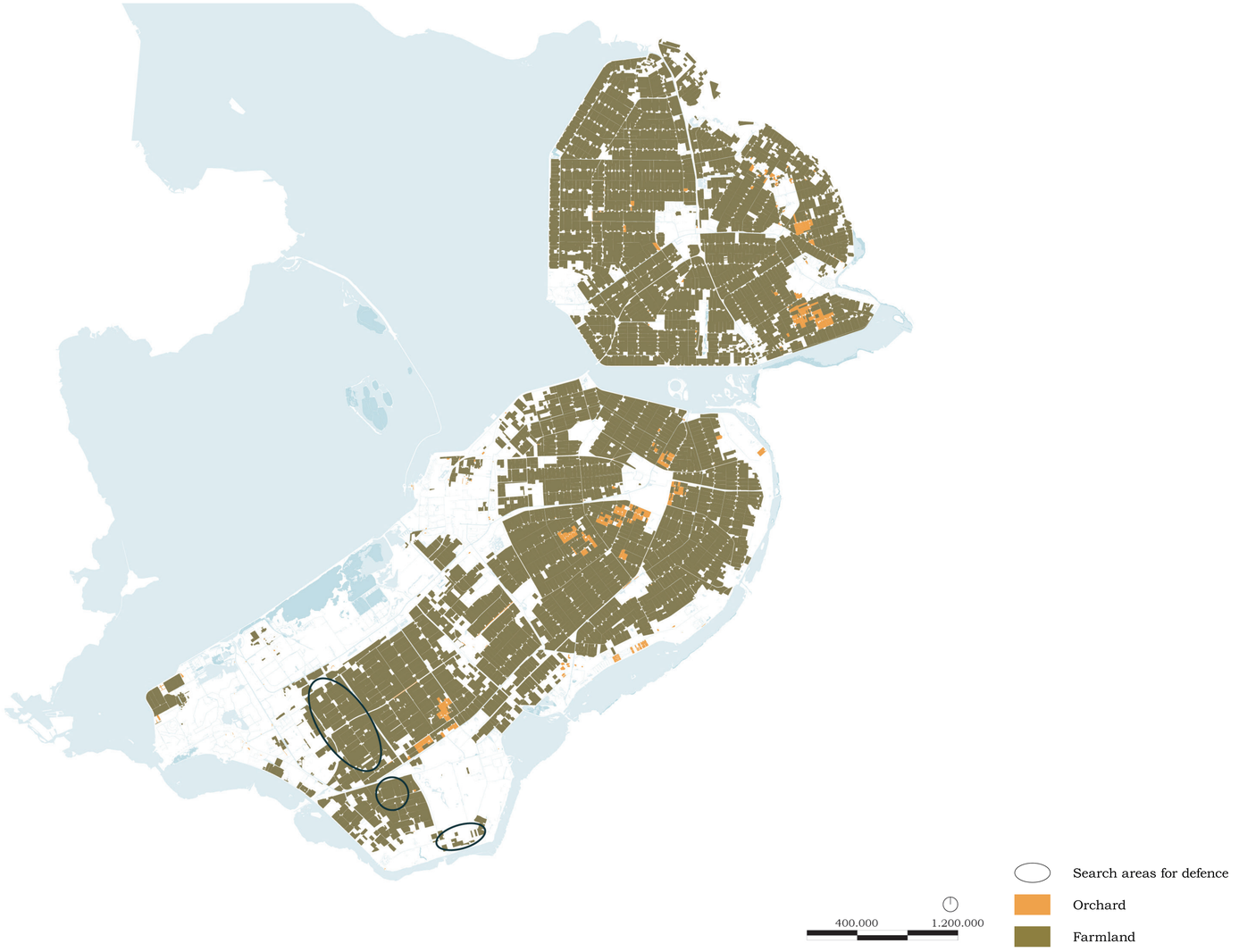
Characteristics and historical background



Urban areas

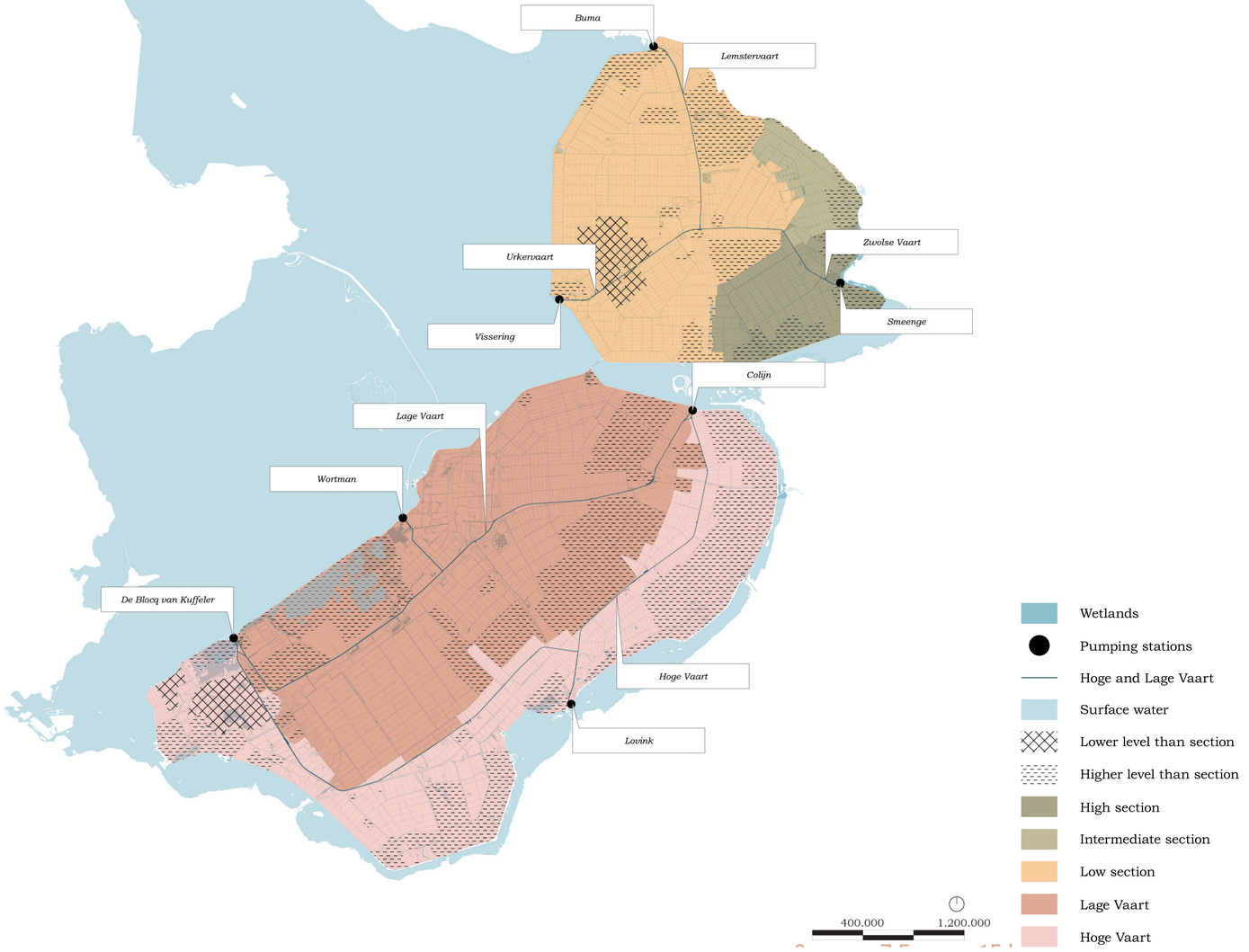

Roads
Railway
Expansion railway
Urban expansion
Retail
Commercial functions
Industrial areas
Residential areas
400.000
1.200.000

Rural areas - agriculture

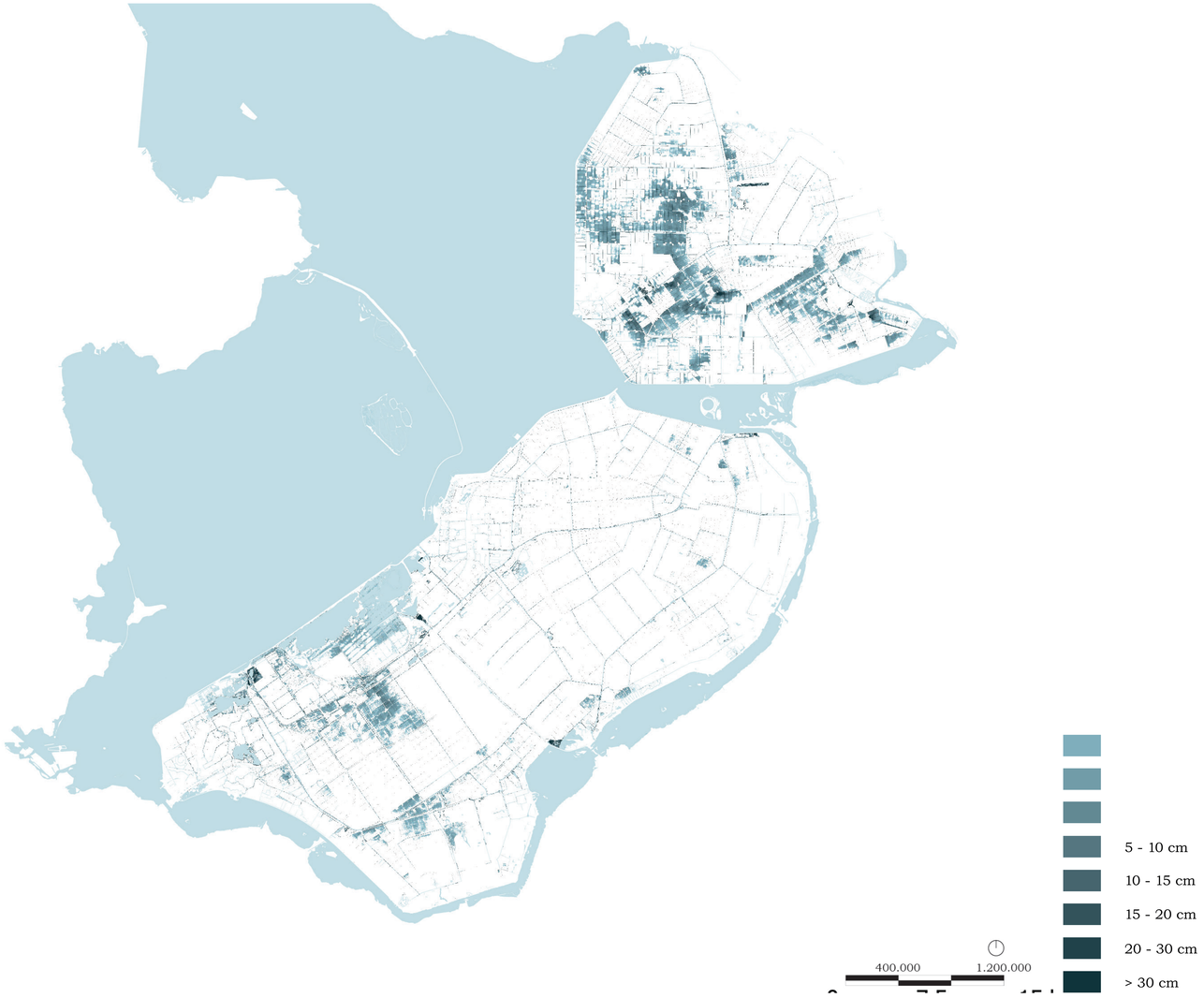


Rural areas - nature

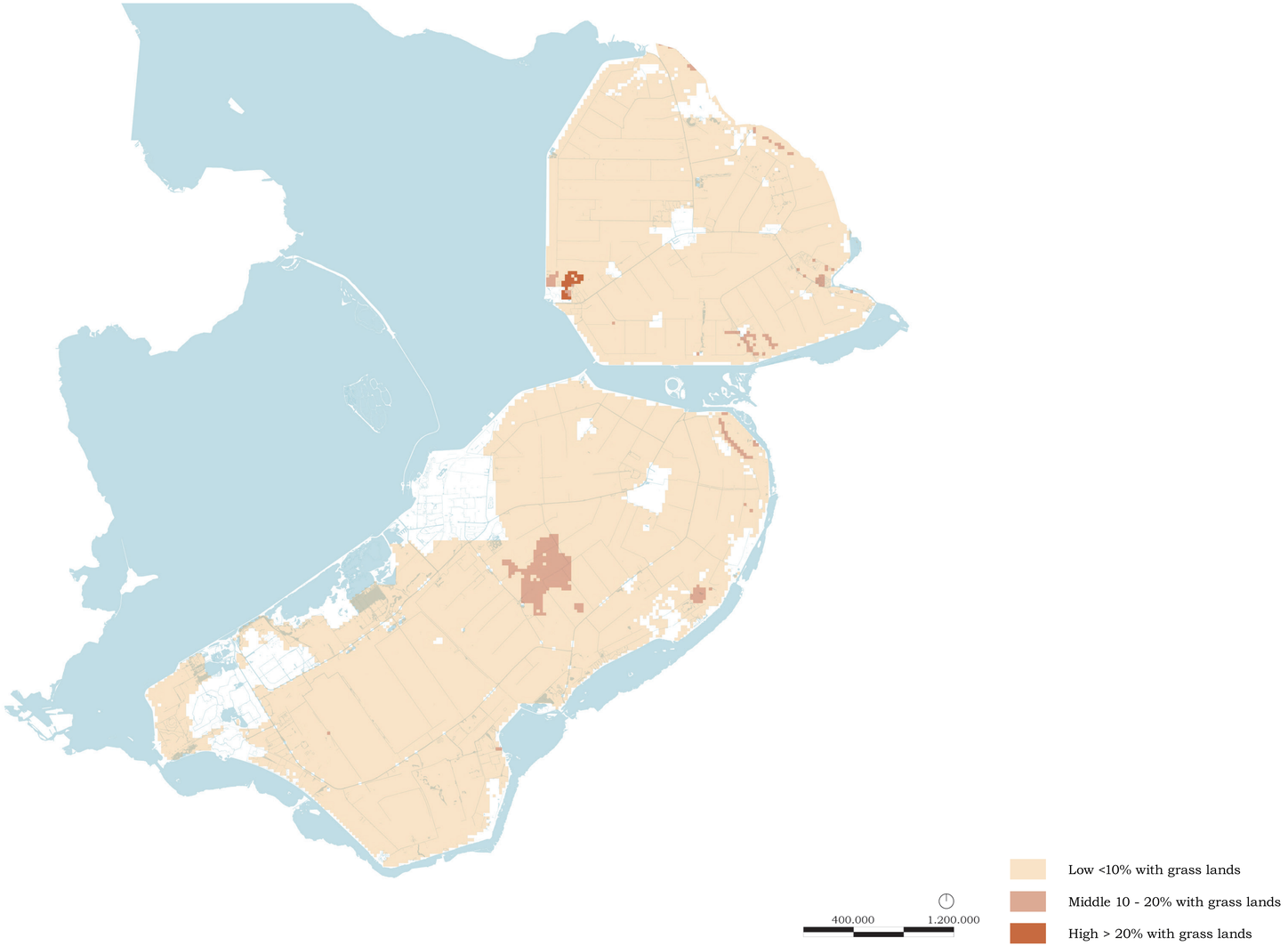
Water system



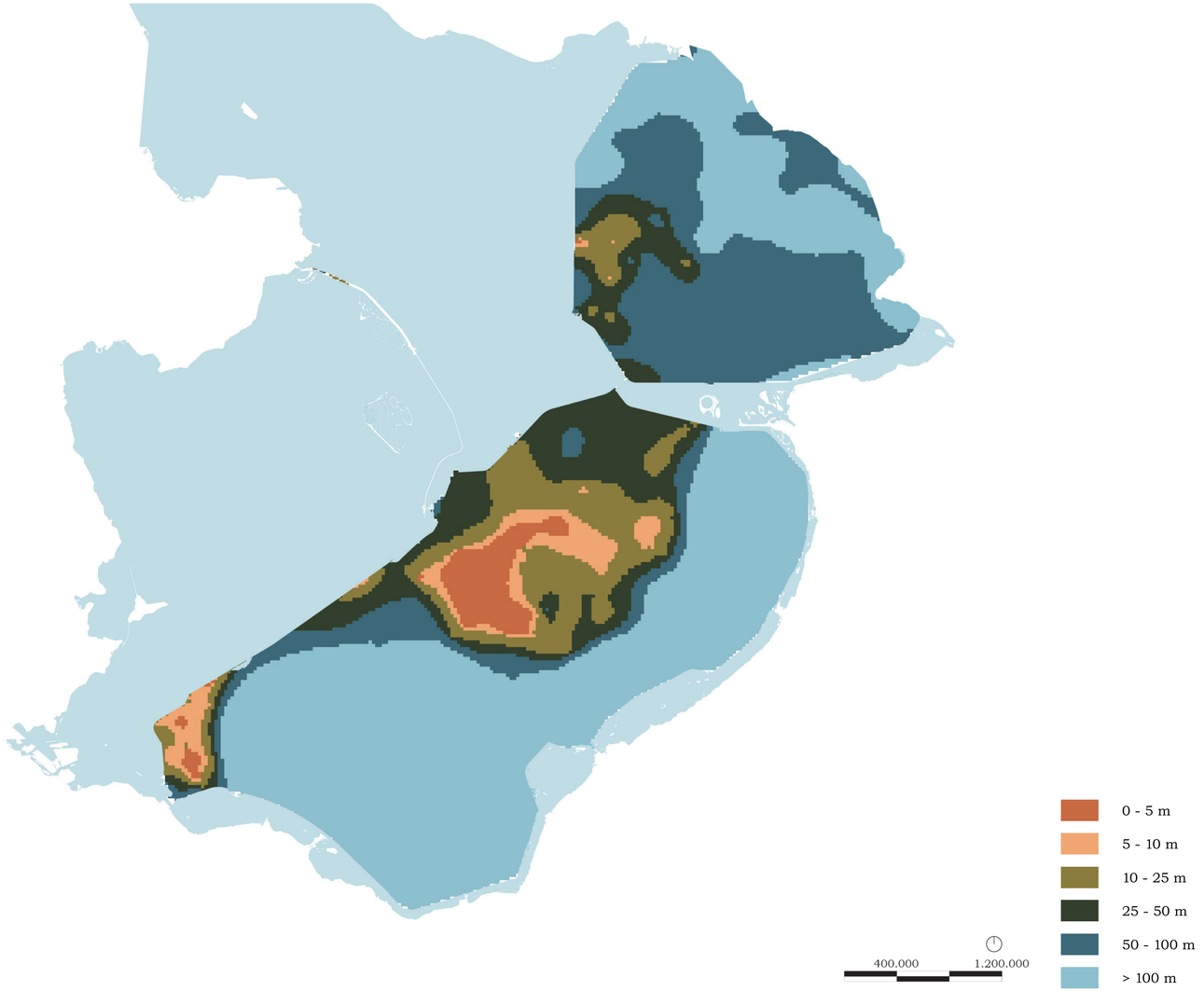
Water nuisance



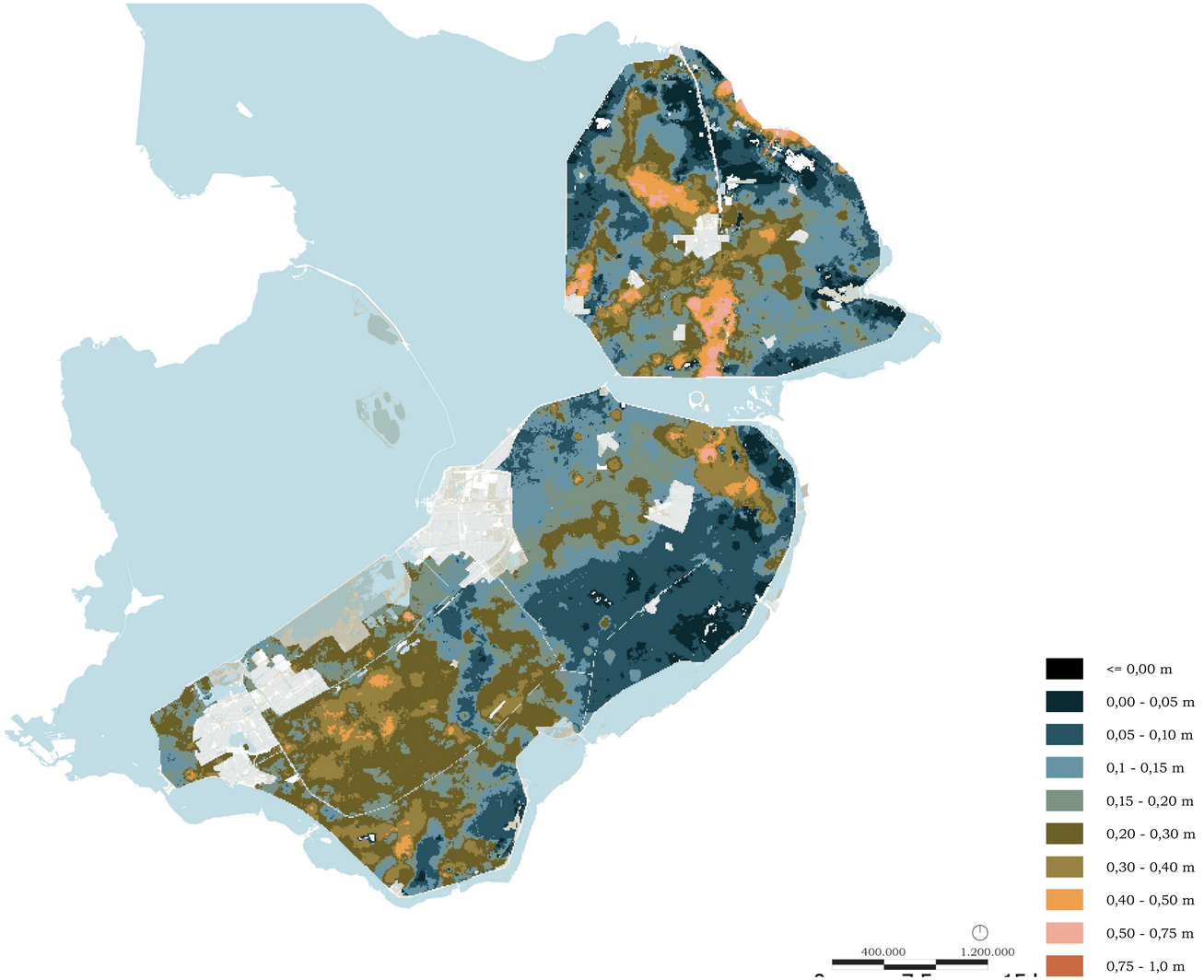
Drought


Low <10% with grass lands
Middle 10 - 20% with grass lands
High > 20% with grass lands
400.000
1.200.000

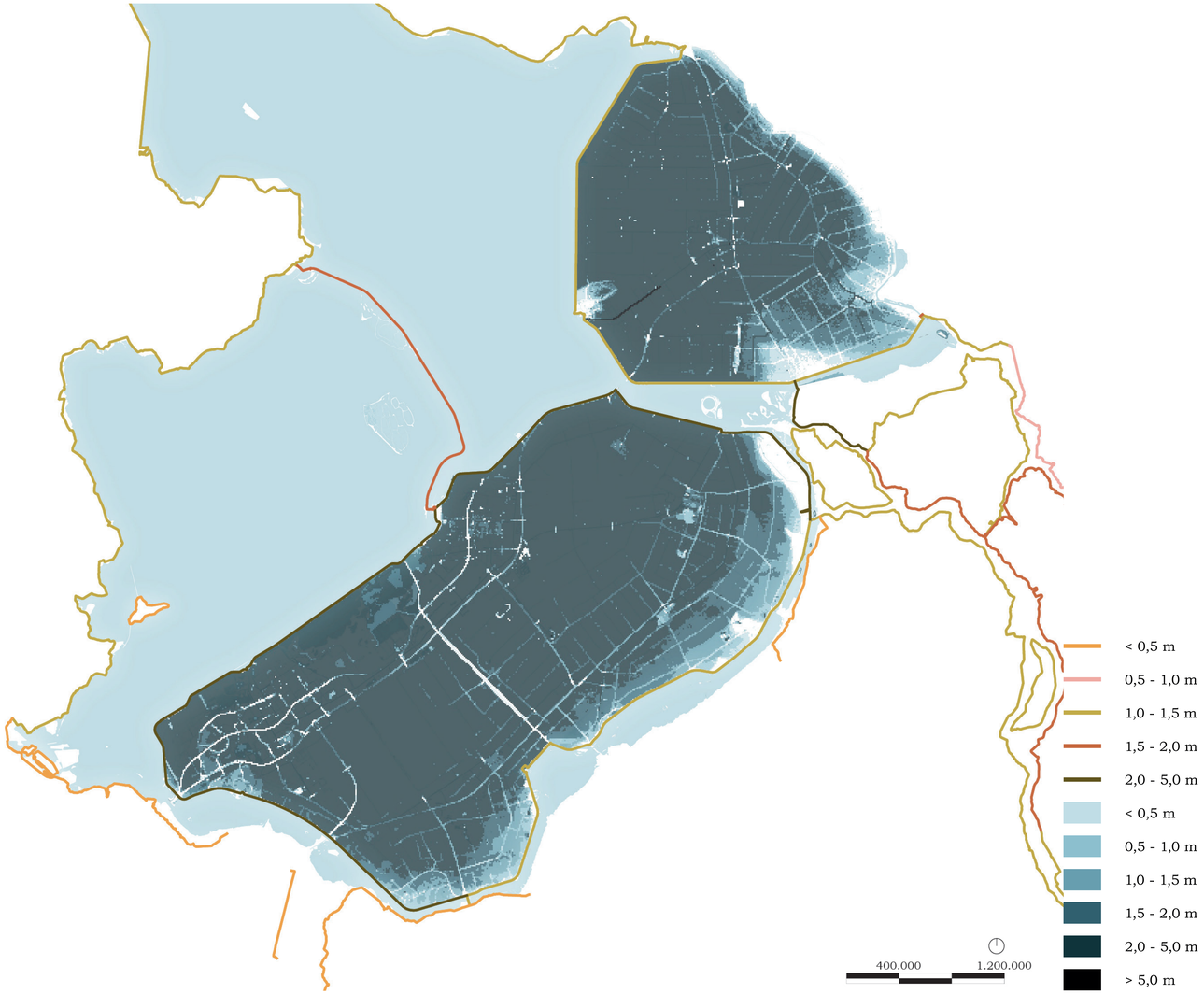
Salinisation



Soil subsidence



Flooding


< 0,5 m
0,5 - 1,0 m
1,0 - 1,5 m
1,5 - 2,0 m
2,0 - 5,0 m
< 0,5 m
0,5 - 1,0 m
1,0 - 1,5 m
1,5 - 2,0 m
2,0 - 5,0 m
> 5,0 m
400.000
1.200.000