

ROTTERDAM AS URBAN TIDESCAPE

Transforming Westblaak-Blaak, Rotterdam into a resilient and dynamic public space for people and animals alike, whilst contributing to the mobility transition and restoring biodiversity; all through the unique tidal characteristics of the Nieuwe Maas



Ivo Brands 4376870

Delft University of Technology – 10 January 2022

MSc Landscape Architecture – Flowscapes: Urban Ecology & Eco-Cities

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- 2 DEVELOPMENTS IN SOUTH HOLLAND
- 3 WATER SYSTEM, TIDES & POTENTIAL OF TIDAL NATURE
- 4 MOBILITY TRANSITION & TRANSFORMATION POTENTIAL
- 5 RECOVERING BIODIVERSITY THROUGH EXPANDING HABITATS
- 6 WESTBLAAK-BLAAK 3.0

INTRODUCTION

Motivation and structuring of the project

FASCINATION & GRADUATION LAB

Motivations behind the graduation project



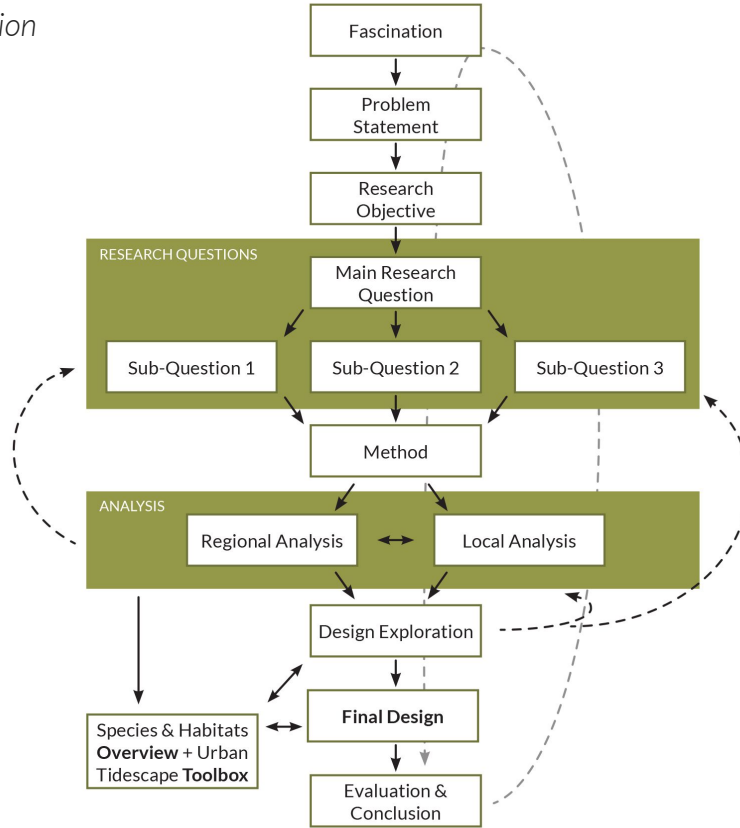
Spotting birds such as the spoonbills and geese in Tij, a design by RO&AD in Stellendam, Netherlands.



Illustrative image of an eco-city (Ecocity World Summit, 2020).

Approaching analysis, design and reflection

Approaching analysis, design and reflection



MAIN RESEARCH QUESTION

*How could the unique tidal characteristics of the Nieuwe Maas be exploited in order to transform Westblaak-Blaak, Rotterdam into a resilient and **dynamic public space** for people and animals alike, whilst contributing to the **mobility transition** and **restoring biodiversity**?*



A resilient and dynamic Rotterdam...

...what would it look like?



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INTRODUCTION

3

WATER SYSTEM, TIDES & POTENTIAL OF TIDAL NATURE

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MOBILITY TRANSITION & TRANSFORMATION POTENTIAL

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RECOVERING BIODIVERSITY THROUGH EXPANDING HABITATS

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WESTBLAAK-BLAAK 3.0

DEVELOPMENTS IN SOUTH HOLLAND

(Re)defining moments and ongoing challenges

ROTTERDAM: A BOOMING CITY

Increasing popularity and other factors



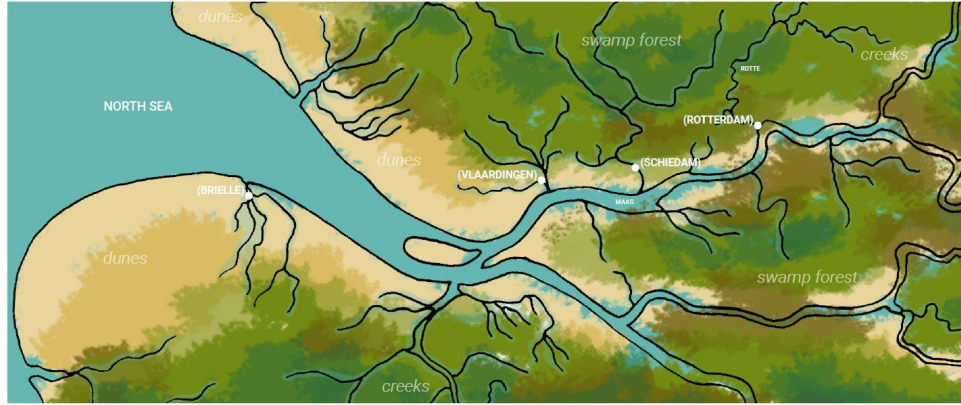
The increasing popularity of Rotterdam results in more tourists and inhabitants (Van den Broek & NBTC, 2018).



Article about Rotterdam on CNN Travel (edition.cnn.com, 2017).

EMBANKMENT OF THE ROTTE

South Holland and initial human interventions



Drawn by author; based on drawing by Palmboom, 1990

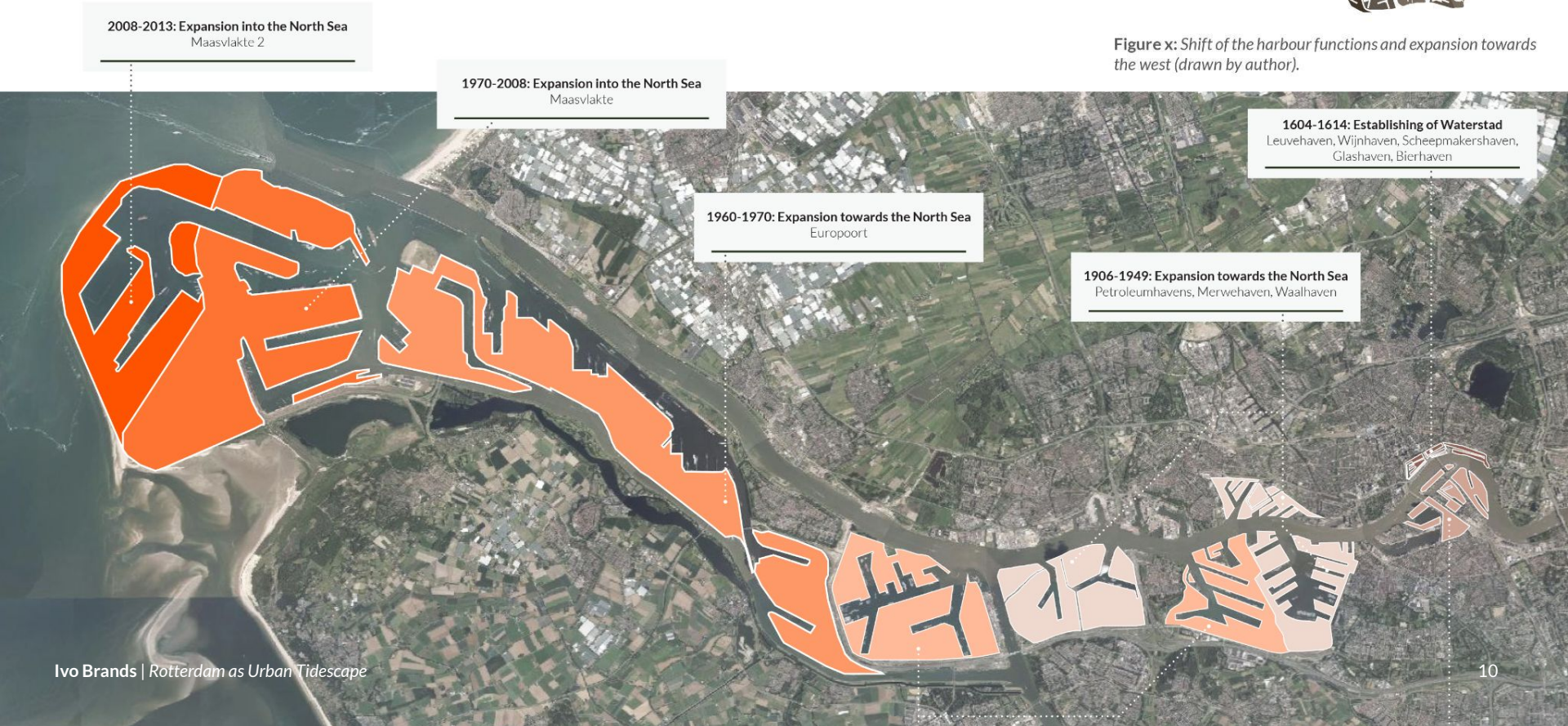


HARBOUR DEVELOPMENT

Major expansions; activities gradually moving towards the North Sea

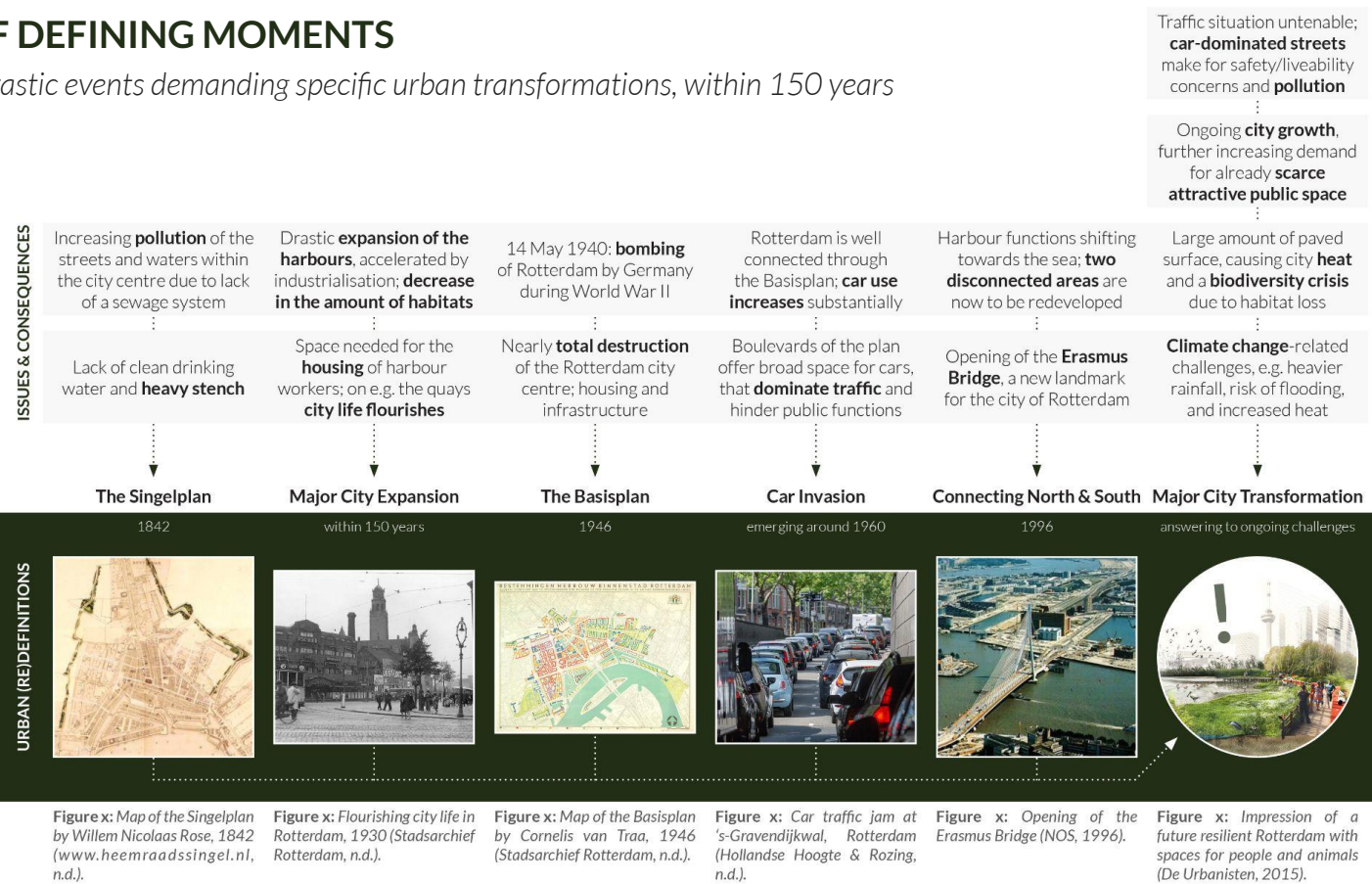


Figure x: Shift of the harbour functions and expansion towards the west (drawn by author).



SERIES OF DEFINING MOMENTS

Timeline of drastic events demanding specific urban transformations, within 150 years



MAJOR CITY TRANSFORMATION

Answering to ongoing challenges



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1 INTRODUCTION

2 DEVELOPMENTS IN SOUTH HOLLAND



4 MOBILITY TRANSITION & TRANSFORMATION POTENTIAL

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SUB-QUESTION 1.1

What are the characteristics and benefits of a tidal river?

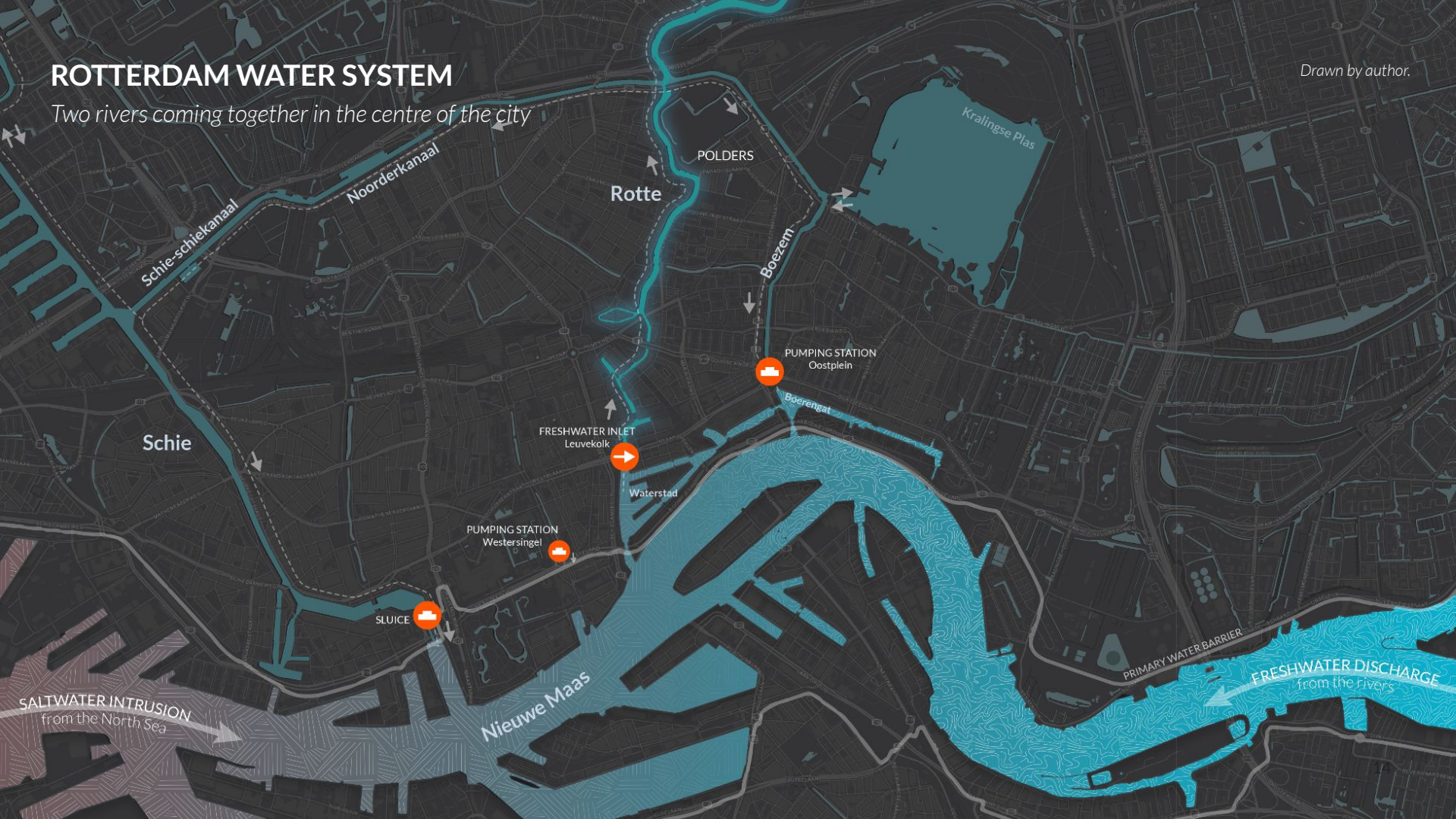
SUB-QUESTION 1.2

How could these benefits result in unique and dynamic public space?

ROTTERDAM WATER SYSTEM

Two rivers coming together in the centre of the city

Drawn by author.



SHIFT OF THE TIDES

The phenomenon of tides, and climate change

- Gravity on the Earth & Moon (Sir Isaac Newton, 1687);
- The Earth's rotation;
- Cycle takes 12 hours and 25 minutes;
- 1.50 m between mean high water & mean low water;
- Climate change: caution due to extreme weather conditions in combination with high tide;
- 1.1 m sea level rise up till 2100.

Current Water Levels:

Mean High Water: 1.15 m +NAP

Mean Low Water: 0.35 m -NAP

Estimated Sea Level Rise in 2100:

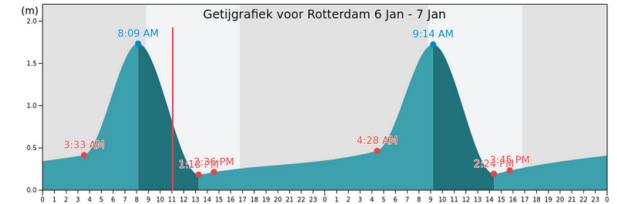
1.1 m

(Le Bars, 2019; based on the IPCC publication *Special Report on the Ocean and Cryosphere in a Changing*)

Estimated Water Levels in 2100:

Mean High Water: 2.25 m +NAP

Mean Low Water: 0.75 m +NAP

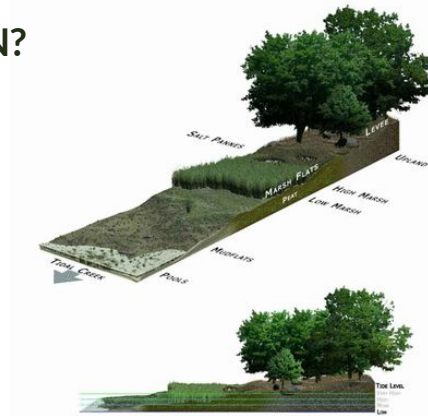


www.tideschart.com, n.d.

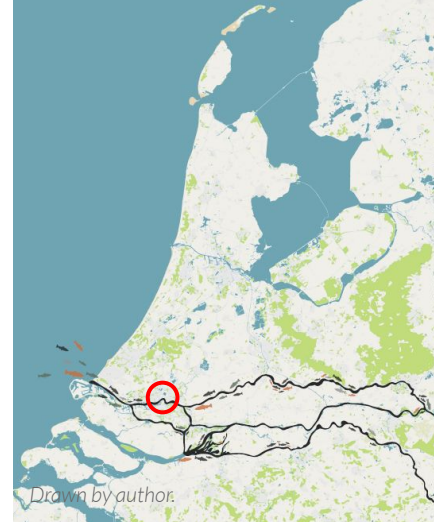
WHY INTEGRATE TIDAL NATURE IN URBAN DESIGN?

Uniqueness in the Netherlands and potential

- Tidal gradient at the edges of a water body;
- Intertidal zone: richness in habitats;
- Attracts endangered/tidal species;
- Ecological stepping stone in the larger picture;
- Unique dynamic public space;
- Biodiversity recovery, city cooling;
- Uplifts economic value.



Retrieved from https://commons.wikimedia.org/wiki/File:Salt_pannes_and_pools_high_and_low_tide.gif



Drawn by author.

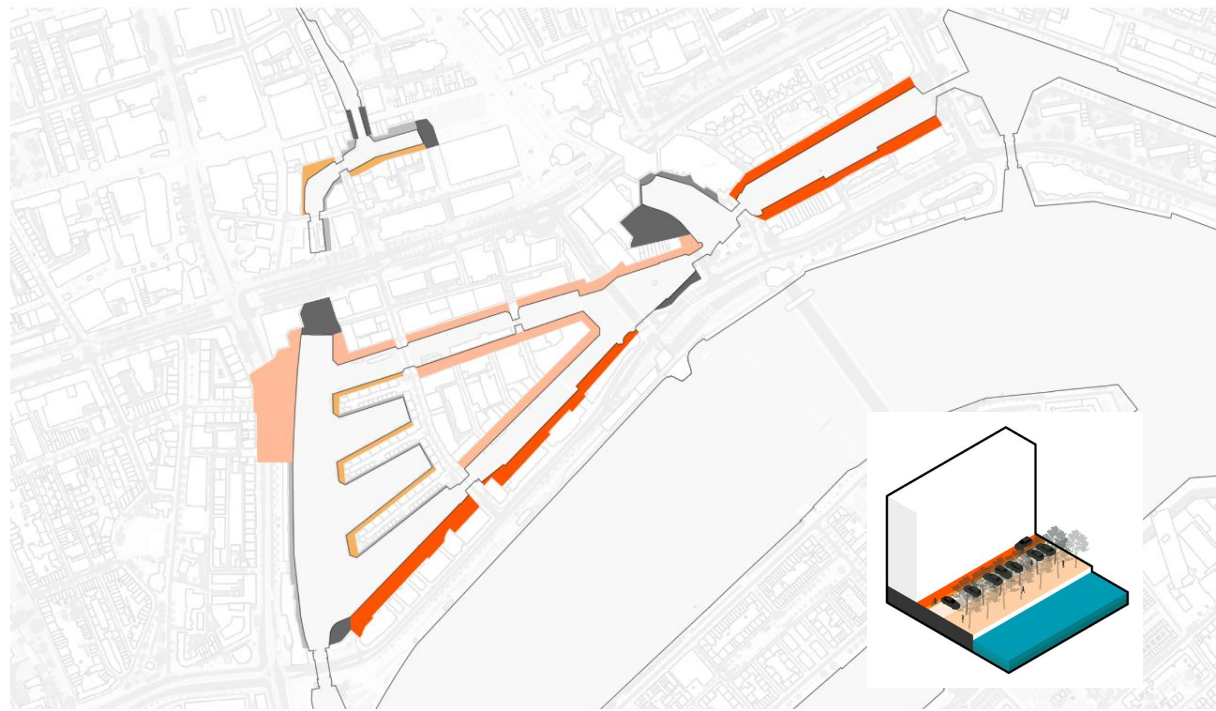
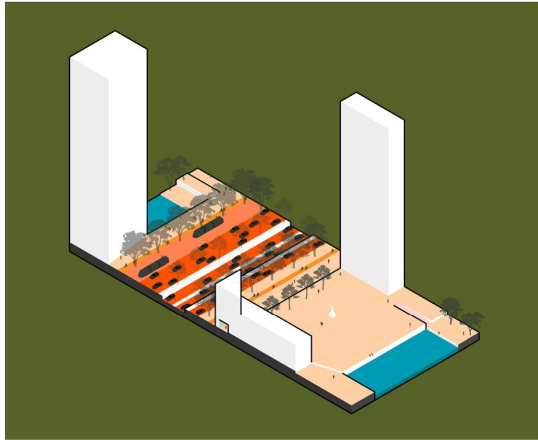


Drawn by author.

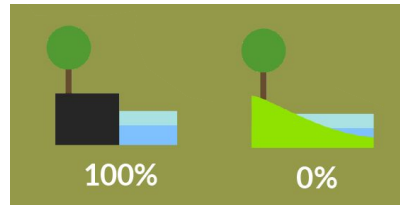
SITUATION ON THE QUAYS

Traffic and lack of gradients on historic quays

- Lack of habitats;
- Traffic & no destinations;
- Nieuwe Maas is completely constrained!

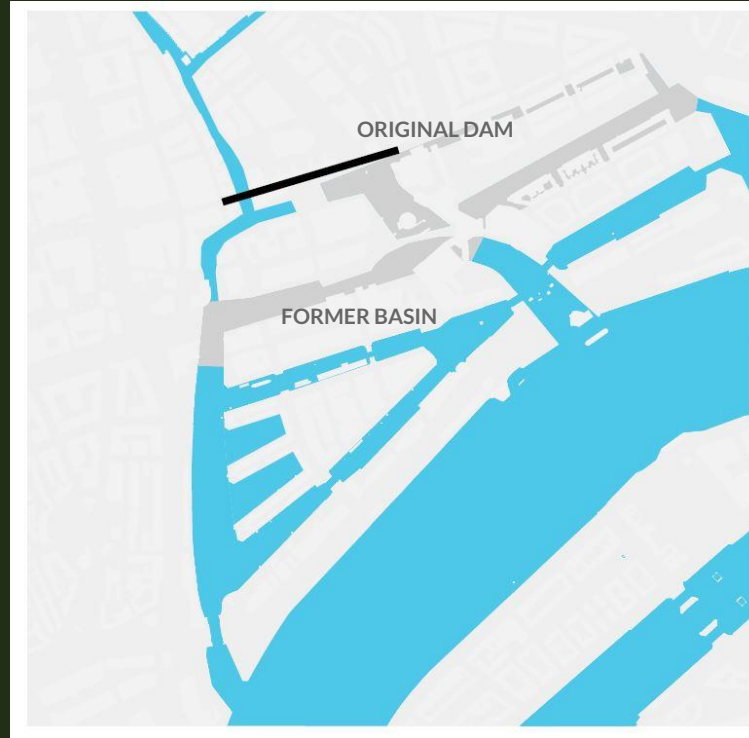
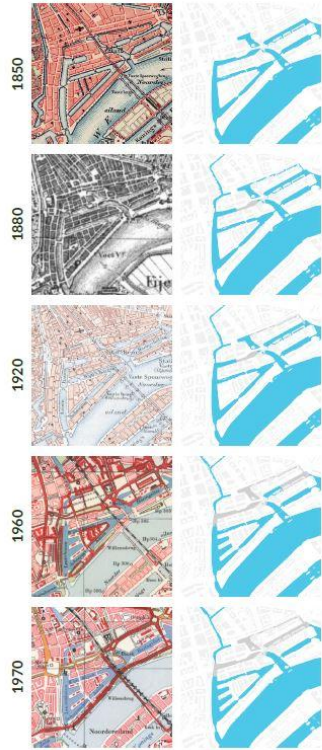


All drawn by author.



BLAAK HARBOUR BASIN

Historic trade area now hidden under traffic



Drawn by author.

TIDAL PARKS IN ROTTERDAM

Existing and planned parks

- Eiland van Brienenoord, Quarantaineterrein, Rijnhaven, Maashaven;
- All in the south!



Gemeente Rotterdam, 2020.



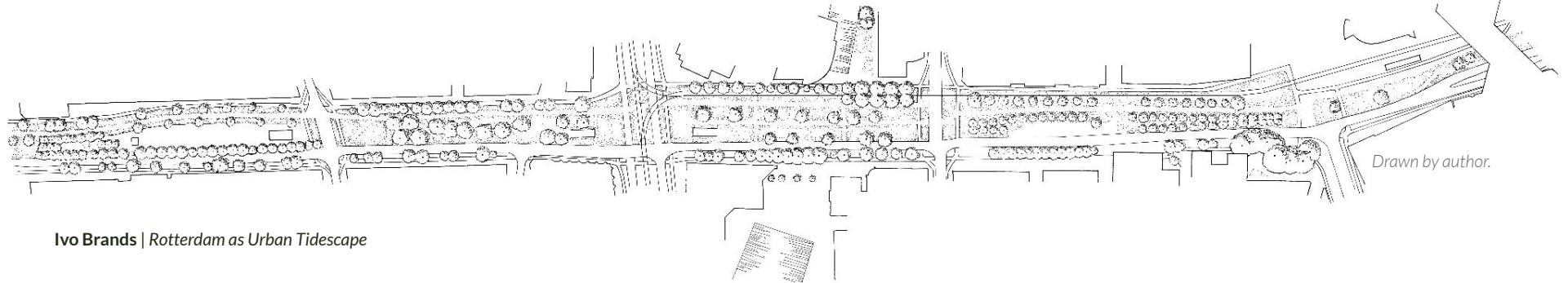
Zuid-Hollands Landschap, n.d.

TOWARDS A SOLUTION

Plans to transform the boulevards by the municipality of Rotterdam

- City as a lounge;
- Mobility transition frees up space;
- Focus on pedestrians, bikes & public transport;
- Reducing noise & air pollution;
- But still no connection with the river!

Gemeente Rotterdam o.l.v.
Emiel Arends, 2019.



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WATER SYSTEM, TIDES & POTENTIAL OF TIDAL NATURE



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RECOVERING BIODIVERSITY THROUGH EXPANDING HABITATS

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WESTBLAAK-BLAAK 3.0

SUB-QUESTION 2

What are the possibilities for reducing car use in order to contribute to the mobility transition in Rotterdam?

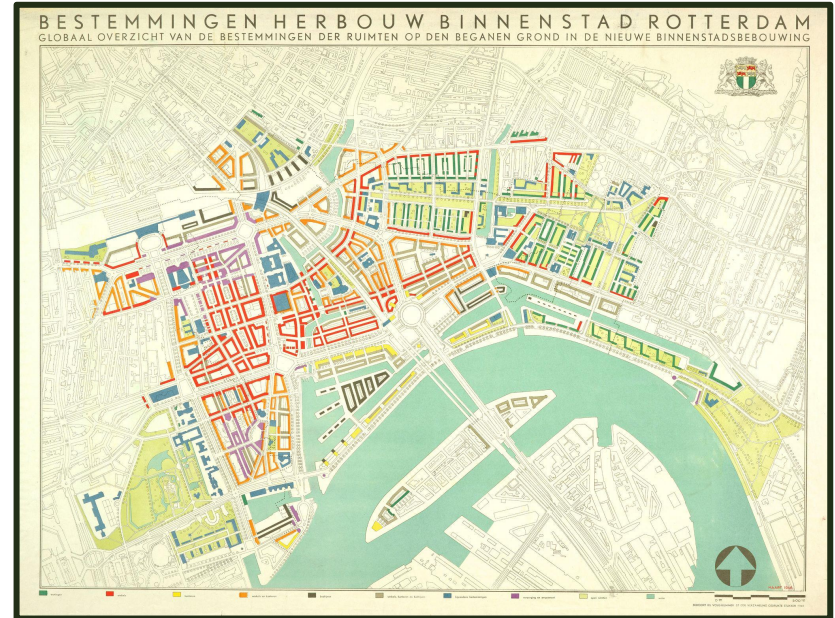
THE BASISPLAN

Van Traa's plan from 1946 has largely influenced the spatial planning, still felt today



HH/SV-Bilderdienst, n.d.

Stadsarchief Rotterdam, n.d.



INTERSECTED BOULEVARDS

Consequences of the Basisplan are felt today

- Main city boulevards Westersingel, Coolingsingel and Binnenrotte intersected by Westblaak-Blaak;
- 4/6/8 adjacent car traffic lanes;
- e.g. Eendrachtsplein = 'black spot';
- Congests movement flows, pollutes, and prevents people from visiting the river.



Drawn by author.

CARS DOMINATE THE CITY CENTRE

City boulevards transformed into car-friendly areas



Van Leer, 1928.



Stadsarchief Rotterdam, n.d.

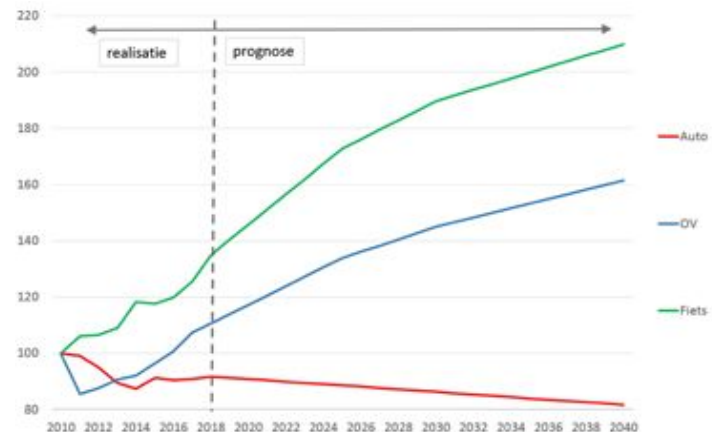


Hollandse Hoogte & Rozing, n.d.

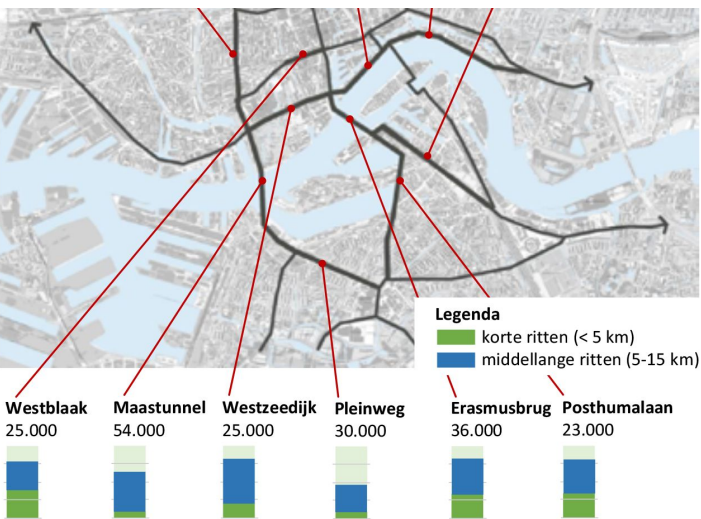
TOWARDS A SOLUTION

The ongoing mobility transition within Rotterdam

DEVELOPMENT OF MOBILITY TYPES



30-40% OF CAR TRAFFIC AT WESTBLAAK: < 5 KM



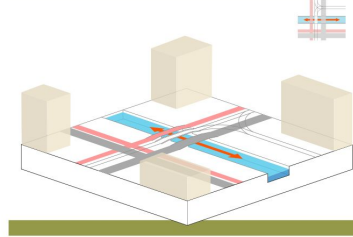
IMPROVING INTERSECTIONS

Finding the optimal way to realise unhindered pedestrian flows through Westblaak-Blaak

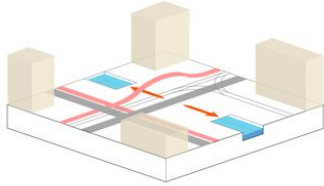
- Vehicular traffic from perpendicular boulevard over bridges;
- Existing tunnel structure can be utilised.

OPTION 7 - MOST PROMISING OPTION:

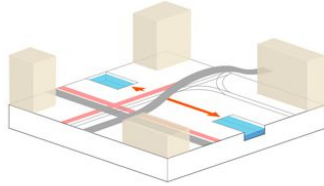
Slightly sloped traffic lanes, allowing uninterrupted movement in perpendicular direction over the water underneath.



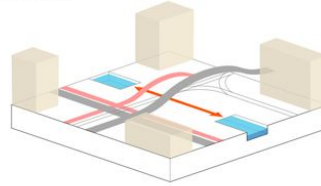
OPTION 1: BRIDGE FOR BIKE TRAFFIC



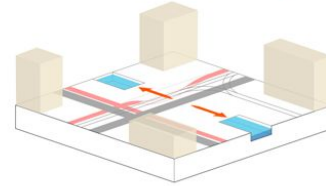
OPTION 2: BRIDGE FOR CAR TRAFFIC



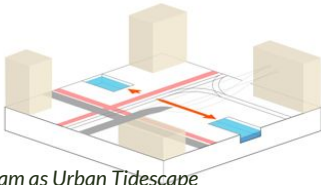
OPTION 3: BRIDGES FOR BOTH BIKE AND CAR TRAFFIC



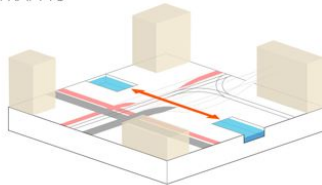
OPTION 4: TUNNEL FOR BIKE TRAFFIC



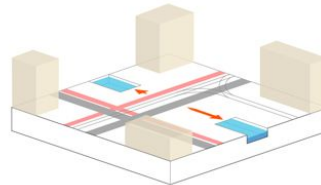
OPTION 5: TUNNEL FOR CAR TRAFFIC



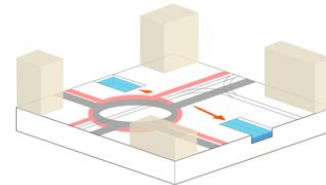
OPTION 6: TUNNELS FOR BOTH BIKE AND CAR TRAFFIC



OPTION 8: NO TRAFFIC INTERVENTIONS



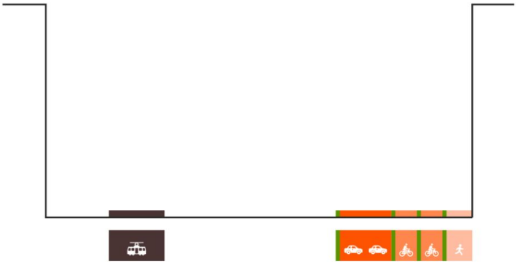
OPTION 9: ROUNDABOUT



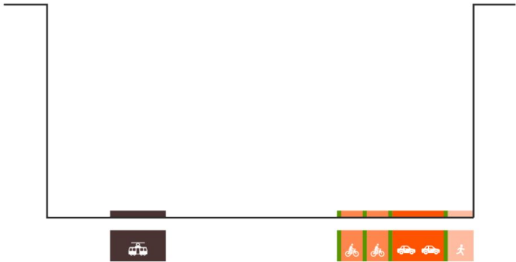
IMPROVING STREET PROFILES

By reducing mobilised traffic and focusing on walking and cycling

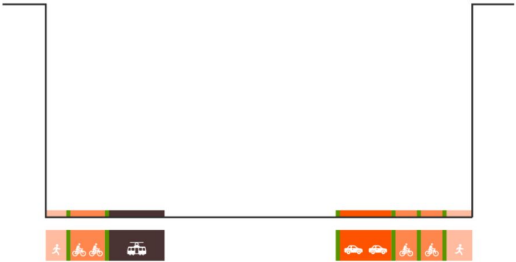
OPTION 1: 2 CAR LANES + 2 BIKE LANES; CARS CLOSER TO CENTRE



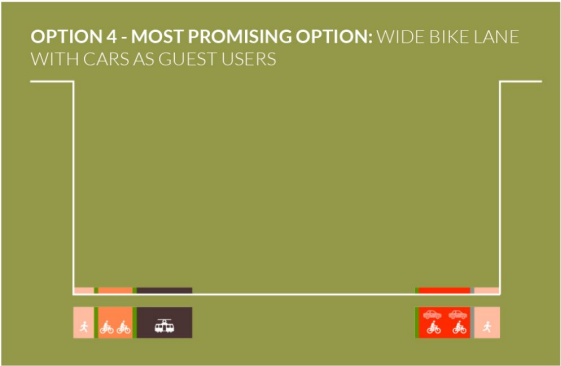
OPTION 2: 2 CAR LANES + 2 BIKE LANES; BIKES CLOSER TO CENTRE



OPTION 3: OPTION 1 WITH ADDED NECESSARY BIKE LANE IN THE NORTH



OPTION 4 - MOST PROMISING OPTION: WIDE BIKE LANE WITH CARS AS GUEST USERS

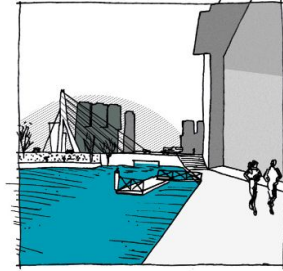
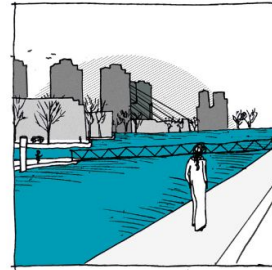
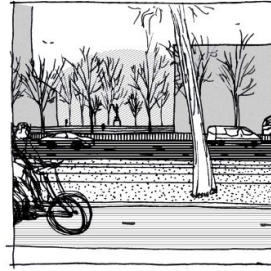
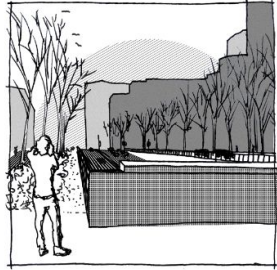


IMPROVED EXPERIENCE WHEN CROSSING WESTBLAAK-BLAAK

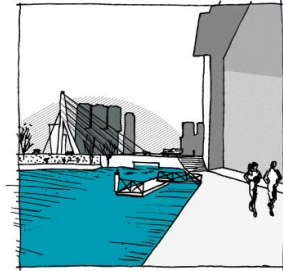
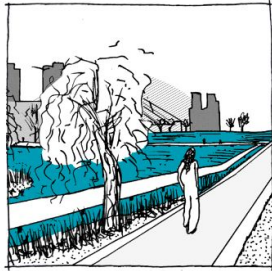
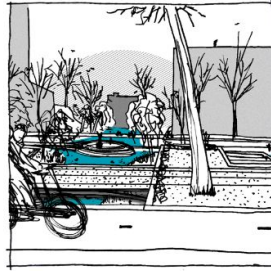
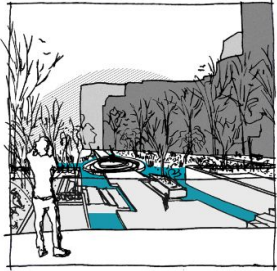
Sequence sketching the current situation and how this could be improved through implementing tidal features



CURRENT SITUATION

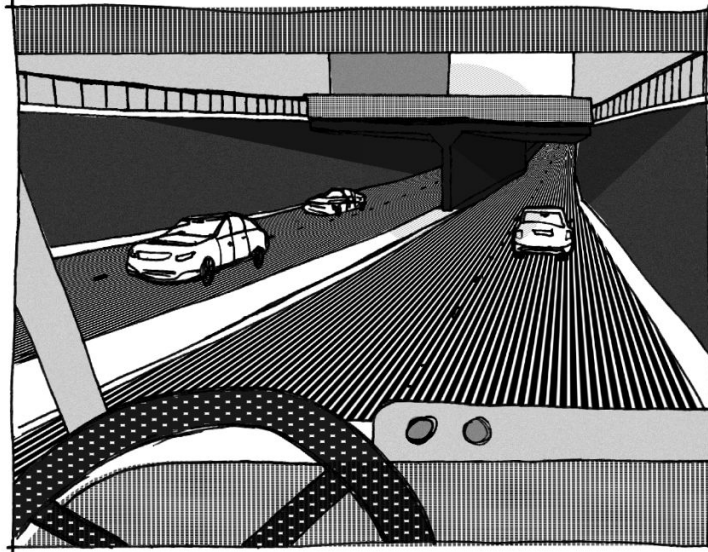


IMPROVED SITUATION

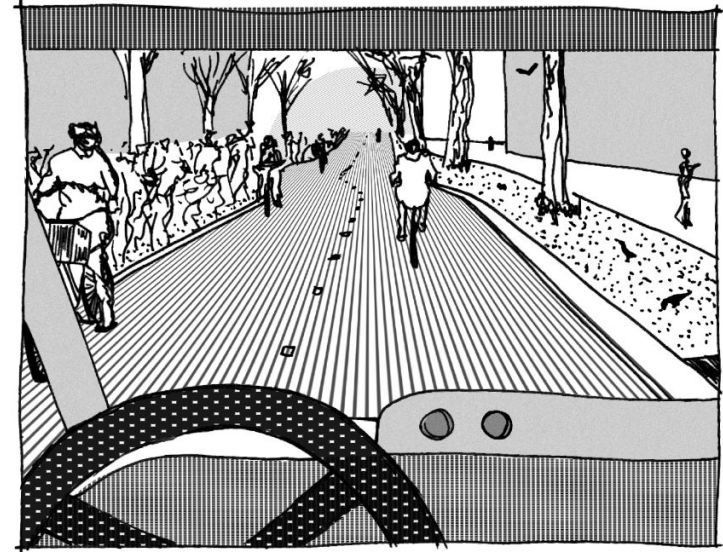


EXPERIENCE AS A CAR DRIVER

Sketches showing the removal of traffic from the tunnel, retaining just a guest role for cars on the south side



CURRENT SITUATION



IMPROVED SITUATION

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6 WESTBLAAK-BLAAK 3.0

SUB-QUESTION 3.1

Which types of habitats will contribute to recovering the biodiversity in Rotterdam, and which endangered/tidal species are expected to benefit from such habitats?

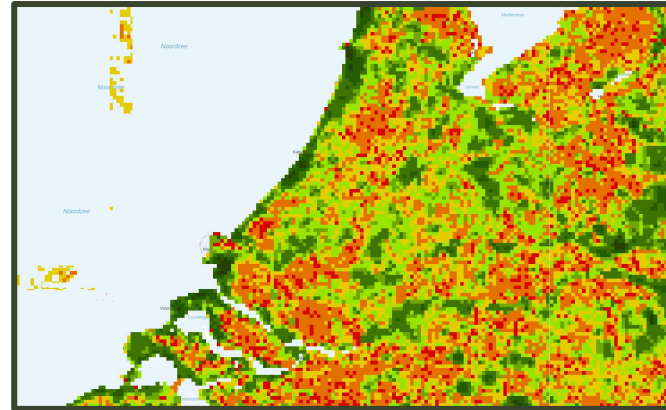
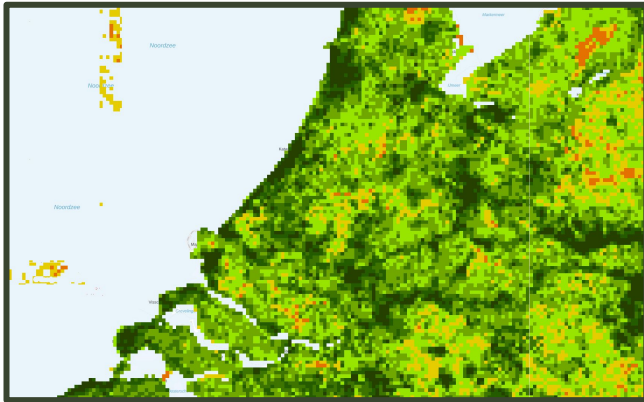
SUB-QUESTION 3.2

How could these habitats be incorporated in urban planning with an ever-changing environment as the result?

BIODIVERSITY CRISIS

A global crisis especially present in Rotterdam

- High amount of paved surfaces due to harbour and city expansion;
- Loss of natural habitat has resulted in an ongoing decrease in species;
- Rotterdam ranks a poor 353 out of 355 municipalities in ecological capital; (Het Pon & TELOS, 2020)
- More habitats needed; the solution is in the river!

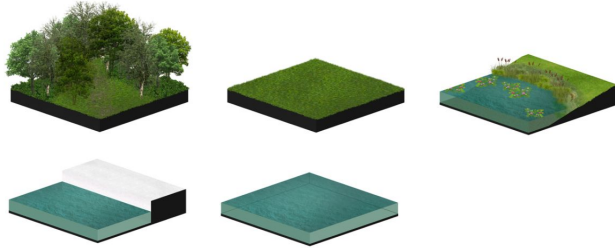


Based on: Atlas Natuurlijk Kapitaal, 2021.

CURRENT HABITATS WITHIN THE CITY CENTRE

Current availability of habitats

- Few & monotonous habitats;
- Hard quays, no gradients.



TREE SPECIES ON THE COOLSINGEL



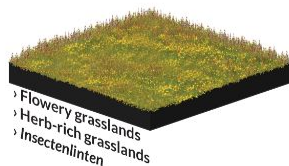
Drawn by author.



TIDAL & NON-TIDAL HABITATS

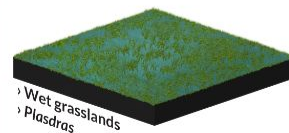
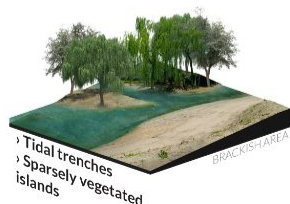
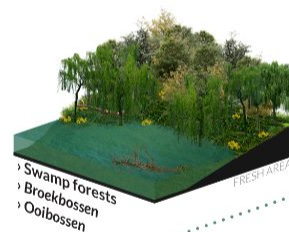
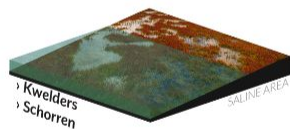
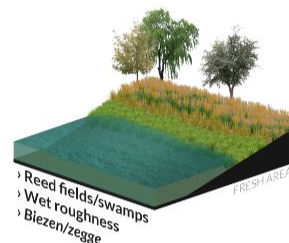
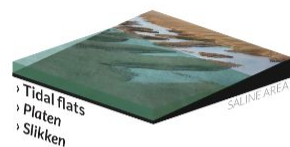
Habitats with potential for an ecologically diverse, healthy and attractive city

DRY HABITATS

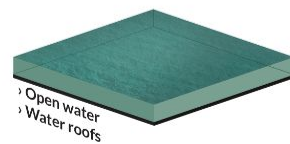
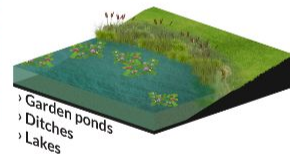
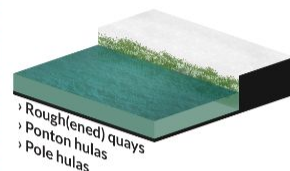


TIDAL HABITATS

from Saline to Brackish to Fresh



WET HABITATS

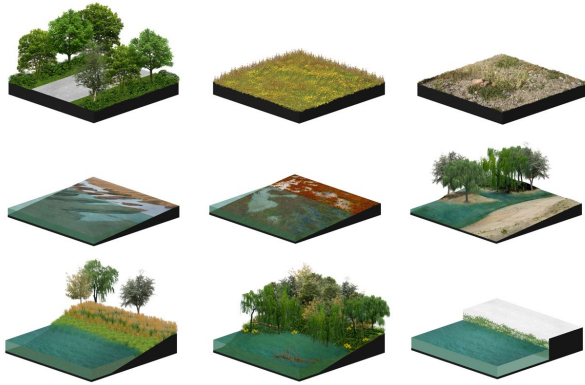


PROPOSED NEW HABITATS WITHIN THE CITY CENTRE

Suggested additional tidal and non-tidal habitats

Drawn by author.

- Ecological corridor network;
- Various roof surfaces;
- Tidal nature within the city;
- Larger variety of habitats:
great for animals *and* people!



CURRENT DISTRIBUTION OF TREES

A total of 7 tree species is found across the entirety of Blaak-Westblaak



*Platanus
x hispanica*

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
| HEAT ISLAND REDUCTION | ★★★ | NECTAR SOURCE <small>for insects</small> | ☆☆☆☆ |
| ENDURES WET PERIODS | ☆☆☆ | POLLEN SOURCE <small>for insects</small> | ☆☆☆☆ |
| ENDURES DRY PERIODS | ★★★ | CAPTURES NO ₂ /O ₃ | ★★★★ |
| FOOD SOURCE <small>for birds</small> | ☆☆☆ | SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|



*Platanus
orientalis*

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
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| FOOD SOURCE <small>for birds</small> | ★★★ | SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|



*Acer
pseudoplatanus*

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
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DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|



Tilia x europaea

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
| HEAT ISLAND REDUCTION | ★★★ | NECTAR SOURCE <small>for insects</small> | ★★★★ |
| ENDURES WET PERIODS | ☆☆☆ | POLLEN SOURCE <small>for insects</small> | ★★★★ |
| ENDURES DRY PERIODS | ☆☆☆ | CAPTURES NO ₂ /O ₃ | ★★★★ |
| FOOD SOURCE <small>for birds</small> | ☆☆☆ | SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|



Quercus robur

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
| HEAT ISLAND REDUCTION | ★★★ | NECTAR SOURCE <small>for insects</small> | ☆☆☆☆ |
| ENDURES WET PERIODS | ☆☆☆ | POLLEN SOURCE <small>for insects</small> | ★★★★ |
| ENDURES DRY PERIODS | ☆☆☆ | CAPTURES NO ₂ /O ₃ | ★★★★ |
| FOOD SOURCE <small>for birds</small> | ★★★ | SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|



*Tilia x europaea
Euclyora*

BENEFICIAL CHARACTERISTICS

| | | | |
|--------------------------------------|-----|--|------|
| HEAT ISLAND REDUCTION | ★★★ | NECTAR SOURCE <small>for insects</small> | ★★★★ |
| ENDURES WET PERIODS | ☆☆☆ | POLLEN SOURCE <small>for insects</small> | ★★★★ |
| ENDURES DRY PERIODS | ☆☆☆ | CAPTURES NO ₂ /O ₃ | ★★★★ |
| FOOD SOURCE <small>for birds</small> | ☆☆☆ | SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | | | |
|---------------|-----|--------------|-----|
| ALLERGENICITY | ▲▲▲ | VOC EMISSION | ▲▲▲ |
|---------------|-----|--------------|-----|

Data: Hiemstra, 2018.

ADVANTAGEOUS TREE PLAN

The introduction of specific trees would increase experience and offer ecological benefits



BENEFICIAL CHARACTERISTICS

| | |
|-----------------------|-----|
| HEAT ISLAND REDUCTION | ★★★ |
| ENDURES WET PERIODS | ☆☆☆ |
| ENDURES DRY PERIODS | ★★☆ |
| FOOD SOURCE for birds | ☆☆☆ |

| | |
|--|------|
| NECTAR SOURCE for insects | ☆☆☆☆ |
| POLLEN SOURCE for insects | ★★★★ |
| CAPTURES NO ₂ /O ₃ | ★★★★ |
| SECURES CO ₂ | ★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | |
|---------------|-----|
| ALLERGENICITY | ▲▲▲ |
|---------------|-----|

| | |
|--------------|-----|
| VOC EMISSION | ▲▲▲ |
|--------------|-----|



BENEFICIAL CHARACTERISTICS

| | |
|-----------------------|-----|
| HEAT ISLAND REDUCTION | ★★★ |
| ENDURES WET PERIODS | ★★☆ |
| ENDURES DRY PERIODS | ★★☆ |
| FOOD SOURCE for birds | ☆☆☆ |

| | |
|--|-------|
| NECTAR SOURCE for insects | ★★★☆☆ |
| POLLEN SOURCE for insects | ★★★★☆ |
| CAPTURES NO ₂ /O ₃ | ★★★★★ |
| SECURES CO ₂ | ★★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | |
|---------------|-----|
| ALLERGENICITY | ▲▲▲ |
|---------------|-----|

| | |
|--------------|-----|
| VOC EMISSION | ▲▲▲ |
|--------------|-----|



BENEFICIAL CHARACTERISTICS

| | |
|-----------------------|-----|
| HEAT ISLAND REDUCTION | ★★★ |
| ENDURES WET PERIODS | ☆☆☆ |
| ENDURES DRY PERIODS | ★★☆ |
| FOOD SOURCE for birds | ☆☆☆ |

| | |
|--|-------|
| NECTAR SOURCE for insects | ★★★★☆ |
| POLLEN SOURCE for insects | ★★★★☆ |
| CAPTURES NO ₂ /O ₃ | ★★★★★ |
| SECURES CO ₂ | ★★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | |
|---------------|-----|
| ALLERGENICITY | ▲▲▲ |
|---------------|-----|

| | |
|--------------|-----|
| VOC EMISSION | ▲▲▲ |
|--------------|-----|



BENEFICIAL CHARACTERISTICS

| | |
|-----------------------|------|
| HEAT ISLAND REDUCTION | ★★☆☆ |
| ENDURES WET PERIODS | ☆☆☆☆ |
| ENDURES DRY PERIODS | ☆☆☆☆ |
| FOOD SOURCE for birds | ★★★ |

| | |
|--|-------|
| NECTAR SOURCE for insects | ★★★★★ |
| POLLEN SOURCE for insects | ★★★★☆ |
| CAPTURES NO ₂ /O ₃ | ★★★★★ |
| SECURES CO ₂ | ★★★★★ |

DISADVANTAGEOUS CHARACTERISTICS

| | |
|---------------|-----|
| ALLERGENICITY | ▲▲▲ |
|---------------|-----|

| | |
|--------------|-----|
| VOC EMISSION | ▲▲▲ |
|--------------|-----|

Data: Hiemstra, 2018.

INTERESTING TREES

Trees with benefits related to wetness, appearance, food sources for birds and insects, etc.



Populus × canescens 'De Moffart'
Grey Poplar/*grauwe abeel*



Salix alba 'Belders'
White Willow/*schietwilg*



Acer saccharinum
Silver maple/*zilveresdoorn*



Robinia pseudoacacia 'Nyirségi'
Black Locust/*schijnacacia*

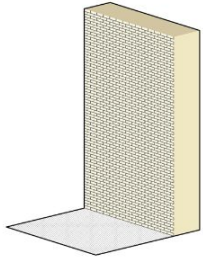
ADVANTAGEOUS TREE PLAN

The introduction of specific trees would increase experience and offer ecological benefits

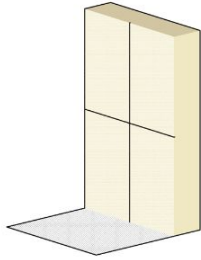


VERTICAL HABITATS

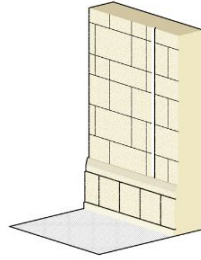
Expanding the ecological zone from surfaces to facades



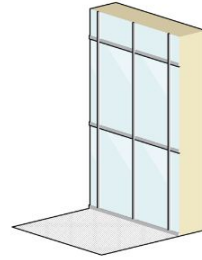
BRICK WALL



NATURAL STONE
(GLAZED) WALL



NATURAL STONE
(ROUGH) WALL



GLAZING



PLANTING ON
CONSTRUCTION FRAME



PLANTING IN
PLANTING BOXES



LIVING WALL WITH
SUBSTRATE ON PVC



BUILDING EDGE
FACADE GARDEN

VERTICAL HABITATS

Overview of combinations





Lists of expected species related to their respective habitats

Lists of expected species related to their respective habitats

The diagram illustrates the progression of coastal erosion in five stages:

- Tides, waves, dunes:** Shows a beach with waves and dunes.
- Erosion, Scharen:** Shows the beach eroding, with the label "Scharen" (likely a typo for "Scharren" or "Scharren").
- Dune retreat, sparsely vegetated dunes:** Shows the dunes retreating and becoming sparsely vegetated.
- Dune collapse, wave platform, beach ridge:** Shows the dunes collapsing, forming a wave platform and a beach ridge.
- Dune collapse, beach ridge, dune:** Shows the final stage with a collapsed dune, a beach ridge, and a new dune.

[illegible]

Lists of expected species related to their respective habitats

Lists of expected species related to their respective habitats

The diagram illustrates the progression of coastal erosion in five stages:

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- Dune collapse, beach ridge, dune:** Shows the final stage with a collapsed dune, a beach ridge, and a new dune.

A 10x10 grid of green checkmarks, where each checkmark represents a completed item. The grid is organized into 10 rows and 10 columns, with each cell containing a single green checkmark, indicating that all 100 items have been successfully completed.

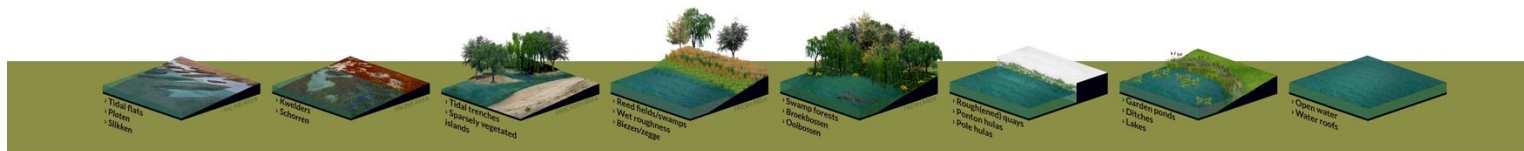
Figure 1 consists of five 3D block diagrams, each representing a different type of wetland. The diagrams are arranged horizontally from left to right. Each diagram shows a cross-section of the wetland's surface and its underlying structure. Below each diagram is a label identifying the wetland type and its characteristic vegetation or features.

- Barren wetland:** Shows a flat, low-lying area with sparse, low-growing vegetation. The label below it reads: "Barren wetland / Marshy wetland / Shrub wetland".
- Marshy wetland:** Shows a flat area with dense, low-growing vegetation. The label below it reads: "Marshy wetland / Shrub wetland / Forested wetland".
- Forested wetland:** Shows a flat area with a dense stand of trees. The label below it reads: "Forested wetland / Shrub wetland / Marshy wetland".
- Shrub wetland:** Shows a flat area with dense, low-growing shrubs. The label below it reads: "Shrub wetland / Marshy wetland / Barren wetland".
- Deep water wetland:** Shows a flat area with a large body of water and some emergent vegetation. The label below it reads: "Deep water wetland / Marshy wetland / Barren wetland".

SPECIES: FISH & THEIR HABITATS









Lists of expected species related to their respective habitats

| SPECIES | | |
|---------|-------------------------------|---|
| | AAL/PALING | European Eel <i>ANGUILLA ANGUILLA</i> ^{4,5} |
| 🚲 | ALVER | Common Bleak <i>ALBURNUS ALBURNUS</i> ^{2,6,7} |
| ⊕ | ATLANTISCHE STEUR | Atlantic Sturgeon <i>ACIPENSER STURIO</i> ^{1,4,5} |
| ⊕ | ATLANTISCHE ZALM | Atlantic Salmon <i>SALMO SALAR</i> ^{1,4,5,8} |
| ⊕ | BITTERVOORN | European Bitterling <i>RHODEUS AMARUS</i> ¹ |
| | BOT | European Flounder <i>PLATICHTHYS FLESUS</i> ^{5,8} |
| 🚲 | BRASEM | Common Bream <i>ABRAMIS BRAMA</i> ² |
| | DIKLIPHARDER | Thicklip Grey Mullet <i>CHELON LABROSUS</i> ⁸ |
| 🚲 | DRIEDOORNIGESTEKLBAARS | Three-Spined Stickleback <i>GASTEROSTEUS ACULEATUS ACULEATUS</i> ^{2,4,5} |
| | DUNLIPHARDER | Thinlip Grey Mullet <i>CHELON RAMADA</i> ⁵ |
| | ELFT | Allis Shad <i>ALOSA ALOSA</i> ^{4,5} |
| 🚲 | FINT | Twait Shad <i>ALOSA FALLAX</i> ^{4,5,6,7} |
| | MEERVAL | Wels Catfish <i>SILURUS GLANIS</i> ⁸ |
| 🚲 | NOORDZEEHOUTING | Houting <i>COREGONUS OXYRINCHUS</i> ^{4,5,6,7} |
| 🚲 | RIVIERPRIK | River Lamprey <i>LAMPETRA FLUVIATILIS</i> ^{4,5,6,7} |
| 🚲 | ROOFBLEI | Asp <i>ASPIUS ASPIUS</i> ² |
| 🚲 | SPIERING | European Smelt <i>OSMERUS EPERLANUS</i> ^{4,5,6,7} |
| 🚲 | TIENDOORNIGESTEKLBAARS | Ten-Spined Stickleback <i>PUNGITIUS PUNGITIUS</i> ² |
| | ZEEFOREL | Sea Trout <i>SALMO TRUTTA TRUTTA</i> ^{4,5} |
| 🚲 | ZEEPRIK | Sea Lamprey <i>PETROMYZON MARINUS</i> ^{4,5,6,7,8} |
| 🚲 | ZWARTBEKGRONDEL | Round Goby <i>NEOGOBIOUS MELANOSTOMUS</i> ² |



SPECIES: MAMMALS & AMPHIBIANS & THEIR HABITATS

Lists of expected species related to their respective habitats

| SPECIES | |
|---|---|
|  BEVER | Eurasian Beaver CASTOR FIBER 1,2,8,10,12 |
|  DWERGMUIS | Eurasian Harvest Mouse MICROMYS MINUTUS 2,10 |
| EEKHOORN | Eurasian Red Squirrel SCIURUS VULGARIS 10,11 |
|  EGEL | European Hedgehog ERINACEUS EUROPAEUS 1,10,11 |
|  GEWONEDWERGVLERMUIS | Common Pipistrelle PIPISTRELLUS PIPISTRELLUS 2,10 |
|  HAAS | European Hare LEPUS EUROPAEUS 2,9,10 |
|  KONIJN | European Rabbit ORYCTOLAGUS CUNICULUS 2,9,10 |
|  MEERVLEERMUIS | Pond Bat MYOTIS DASYNEME 1,10 |
|   NOORDSE WOELMUIS | Tundra Vole ALEXANDROMYS OECONOMUS ARENICOLA 1,2,9,10 |
|  OTTER | Eurasian Otter LUTRA LUTRA 1,10 |
|  ROSSE WOELMUIS | Bank Vole MYODES GLAREOLUS 2,10 |
|  RUIGE DWERGVLERMUIS | Nathusius's Pipistrelle PIPISTRELLUS NATHUSII 2,10 |
|  VELDMUIS | Common Vole MICROTUS ARVALIS 2,10 |

| SPECIES NAME | |
|--|---|
|  ALPENWATERSALAMANDER | Alpine Newt ICHTHYOSAURA ALPESTRIS 13 |
| BASTAARDKIKKER | Edible Frog PELOPHYLLAX KLEPTON ESCULENTUS 13 |
|  BRUINE KIKKER | Common Frog RANA TEMPORARIA 13 |
|  GEWONE PAD | Common Toad BUFO BUFO 2,13 |
|  KAMSALAMANDER | Great Crested Newt TRITURUS CRISTATUS 13 |
|  KLEINEWATERSALAMANDER | Smooth Newt LISSOTRITON VULGARIS 2,13 |
| MEERKIKKER | Marsh Frog PELOPHYLLAX RIDIBUNDUS 13 |
| POELKIKKER | Pool Frog PELOPHYLLAX LESSONAE 13 |



SPECIES: INSECTS & THEIR HABITATS

Lists of expected species related to their respective habitats

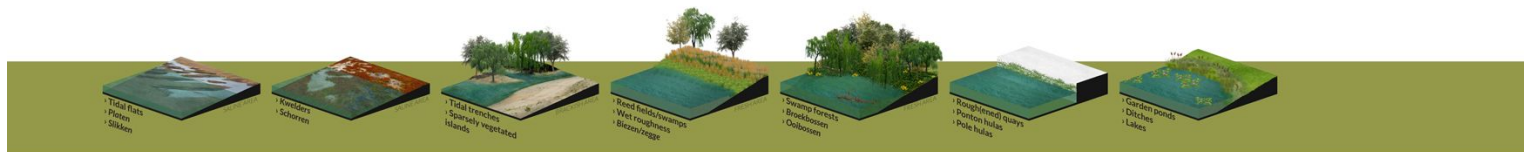
| SPECIES | |
|---------------------------|--|
| ⊕ ARGUSVLINDER | Wall Brown <i>LASIOMATA MEGERA</i> 1,16 |
| ! BOSHOMMEL | Shrill Carder Bee <i>BOMBUS SYLVARUM</i> 14,15,19 |
| 🐛 BRAMENSPRINKHAAN | Dark Bush-Cricket <i>PHOLIDOPTERA GRISEOPTERA</i> 2,20 |
| 🐛 ! BRUIN BLAUWTJE | Brown Argus <i>ARICIA AGESTIS</i> 2,16,17 |
| ! BRUINE VUURVLINDER | Sooty Copper <i>LYCAENA TITYRUS</i> 16,17 |
| DONKERE BIJ | European Dark Bee <i>APIS MELLIFERA MELLIFERA</i> 15 |
| ! GEELSTAARTKLAVERZANDBIJ | European Legume Miner Bee <i>ANDRENA WILKELLA</i> 14,15,19 |
| ! GEVLEKTE GLANSLIBEL | Yellow-Spotted Emerald <i>SOMATOCHLORA FLAVOMACULATA</i> 16,18 |
| ⊕ GLASSNIJDER | Hairy Dragonfly <i>BRACHYTROM PRATENSE</i> 1,16 |
| ! GOUDEN SLAKKENHUISBIJ | Gold-Fringed Mason Bee <i>OSMIA AURULENTA</i> 14,15 |
| ! ⊕ GROENE GLAZENMAKER | Green Hawker <i>AESHNA VIRIDIS</i> 1,16,18 |
| ! GROTE KEGELBIJ | Large Sharp-Tail Bee <i>COELIOXYSS CONOIDEA</i> 14,15 |
| 🐛 KLEINE ROODOOGJUFFER | Small Red-Eyed Damselfly <i>ERYTHROMMA VIRIDULUM</i> 2,16 |
| 🐛 LANTAARTJE | Blue-Tailed Damselfly <i>ISCHNURA ELEGANS</i> 2,16 |
| ! ORANJE ZANDOOGJE | Gatekeeper <i>PYRONIA TITHONUS</i> 16,17 |
| RIVIERROMBOUT | River Clubtail <i>STYLURUS FLAVIPES</i> 8,16 |
| 🐛 SINT-JACOBSVLINDER | Cinnabar Moth <i>TYRIA JACOBABAE</i> 2,16 |
| 🐛 VROEGE GLAZENMAKER | Green-Eyed Hawker <i>AESHNA ISOCELES</i> 2,16 |
| ⊕ WEIDEHOMMEL | Early Bumblebee <i>BOMBUS PRATORUM</i> 1,15 |
| ! ⊕ ZANDHOMMEL | Veteran Bumblebee <i>BOMBUS VETERANUS</i> 1,14,15 |
| ZWARTE HEIDELIBEL | Black Darter <i>SYMPETRUM DANAE</i> 8,16 |



SPECIES: RIVER BANK/AQUATIC PLANTS & THEIR HABITATS

Lists of expected species related to their respective habitats

| SPECIES | |
|---|--|
|  DRIEKANTIGE BIES | Triangular Club-Rush <i>SCHOENOPLECTUS TRIQUETER</i> 2,20,21 |
|  DRIJVEND FONTEINKRUID | Floating Pondweed <i>POTAMOGETON NATANS</i> 2,20 |
|  GEVLEUGELDSTERRENKROOS | Pond Water-Starwort <i>CALLITRICHE STAGNALIS</i> 2,20 |
|  GEWIMPERDLANGBAARDGRAS | Long-Bearded Grass <i>VULPIA CILIATA</i> SUBSP. <i>CILIATA</i> 2,20,21 |
|  GLANZIGE HOORNBLOEM | Common Mouse-Ear Chickweed <i>CERASTIUM FONTANUM</i> SUBSP. <i>HOLOSTEIOIDES</i> 2,20,21 |
|  GOUDKNOPJE | Buttonweed <i>COTULA CORONOPHOLIA</i> 2,20 |
|  GROTE KAARDEBOL | Wild Teasel <i>DIPSACUS FULLONUM</i> 2,20 |
|  HEELBLAADJES | Common Fleabane <i>PULICARIA DYSENTERICA</i> 2,20 |
|  MOERASKRUISKRUID | Fen Ragwort <i>JACOBAEA PALUDOSA</i> 2,20,21 |
|  MOERASSTREEPZAAD | Marsh Hawk's-Beard <i>CREPIS PALUDOSA</i> 2,20 |
|  PITRUS | Soft Rush <i>JUNCUS EFFUSUS</i> 2,20 |
|  RIETORCHIS | Southern Marsh-Orchid <i>DACTYLORHIZA MAJALIS</i> SUBSP. <i>PRATERMISSA</i> 1,20 |
|  RODE OGENTROOST | Red Bartsia <i>ODONTITES VERNUS</i> SUBSP. <i>SEROTINUS</i> 2,20,21 |
|  RODE WATEREREPRUIS | Pink Water-Speedwell <i>VERONICA CATENATA</i> 2,20 |
|  SCHEDEFONTEINKRUID | Sago Pondweed <i>POTAMOGETON PECTINATUS</i> 2,20 |
|  SPINDOTTERBLOEM | Marsh-Marigold <i>CALTHA PALUSTRIS</i> SUBSP. <i>ARANEOSA</i> 1,2,20 |
|  WATERGENTIAAN | Fringed Water-Lily <i>NYMPHOIDES PELTATA</i> 2,20 |
|  WATERPEPER | Water Pepper <i>PERSICARIA HYDROPICER</i> 2,20 |
|  ZEEGROENE RUS | Hard Rush <i>JUNCUS INFLEXUS</i> 2,20 |
|  ZOMERKLOKJE | Summer Snowflake <i>LEUCOJUM AESTIVUM</i> 2,20,21 |





- 1 INTRODUCTION
- 2 DEVELOPMENTS IN SOUTH HOLLAND
- 3 WATER SYSTEM, TIDES & POTENTIAL OF TIDAL NATURE
- 4 MOBILITY TRANSITION & TRANSFORMATION POTENTIAL
- 5 RECOVERING BIODIVERSITY THROUGH EXPANDING HABITATS

WESTBLAAK-BLAAK 3.0

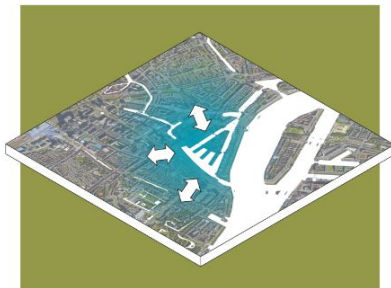
*Translating gained knowledge into a resilient urban transformation with
space for people and animals*

DESIGN GOALS

As concluded from the conducted research



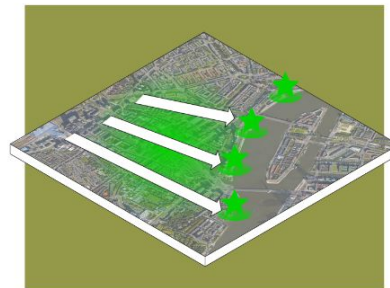
DYNAMIC PUBLIC SPACE



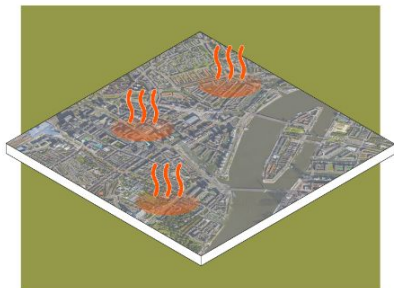
CONNECTED DISTRICT



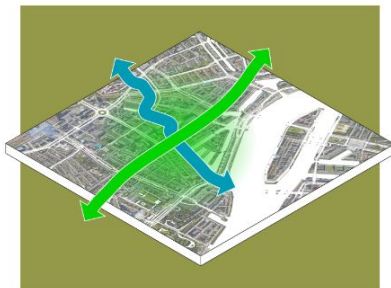
SAFER INTERSECTIONS



REACHING THE RIVER



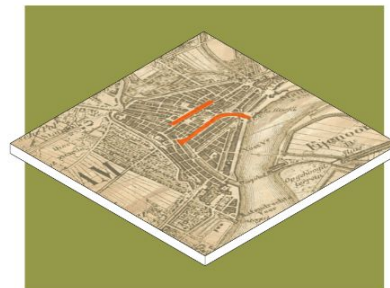
CLIMATE-ADAPTIVE CITY



HABITATS & CORRIDORS



MOBILITY TRANSITION



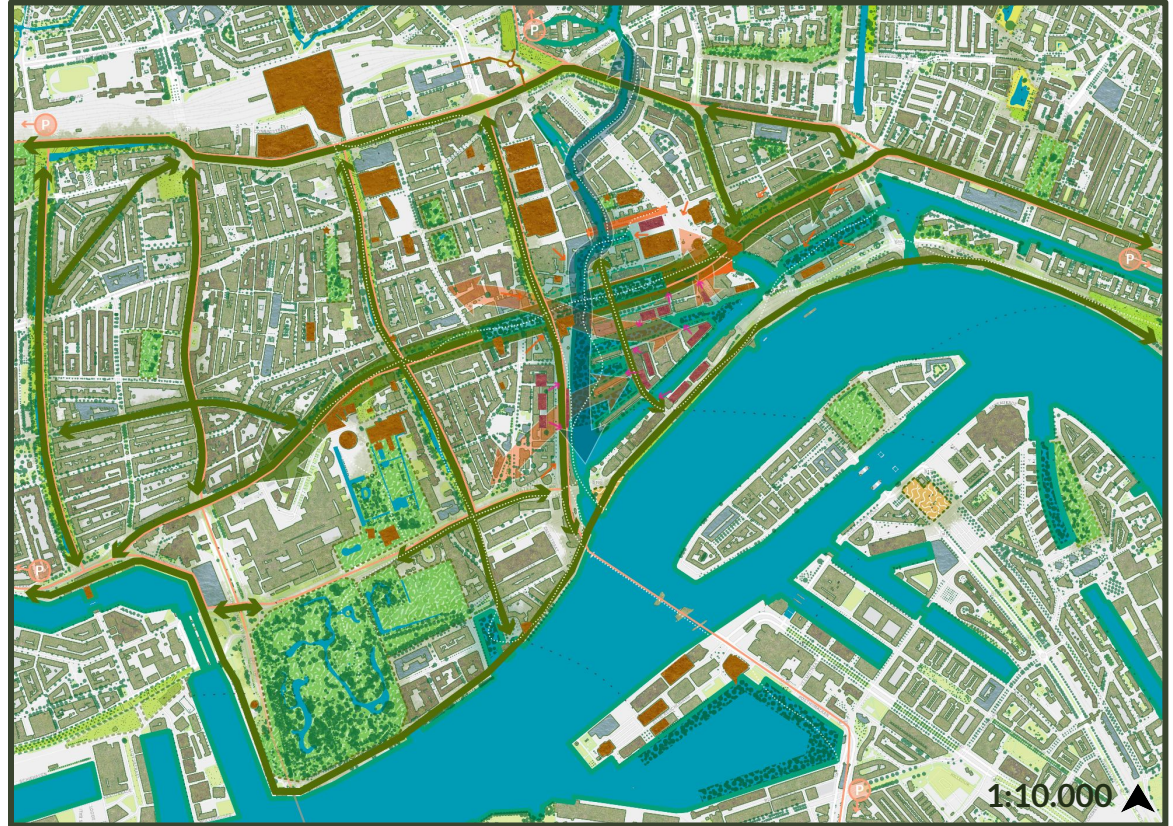
HISTORIC IDENTITY

VISION MAP

Towards a resilient city centre through the ecological strength of corridors and rivers

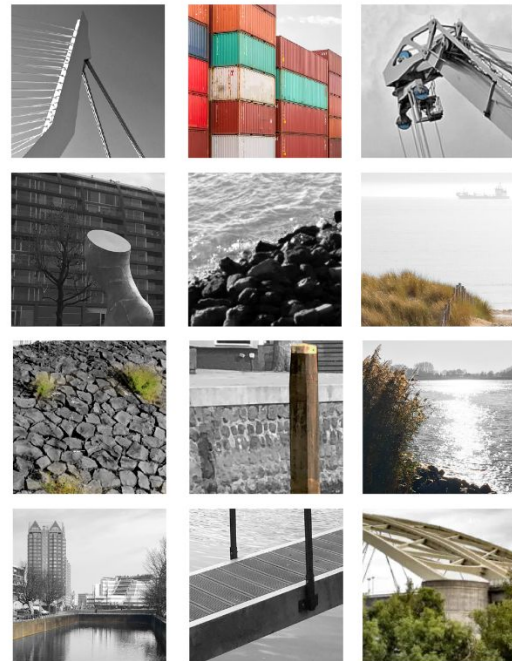
Drawn by author.

- Green public space for current & future inhabitants;
- Rotterdam as one large biodiverse stepping stone;
- Connecting with adjacent city districts;
- Car parking hubs at borders, focus on slow traffic;
- Ecological corridors, (tidal) nature into the city.



DESIGN CONCEPT

Experiencing the Nieuwe Maas within the centre of Rotterdam



PATTERNS & MATERIALS from the Rotterdam Area

MASTERPLAN

Current situation, mean low water



MASTERPLAN

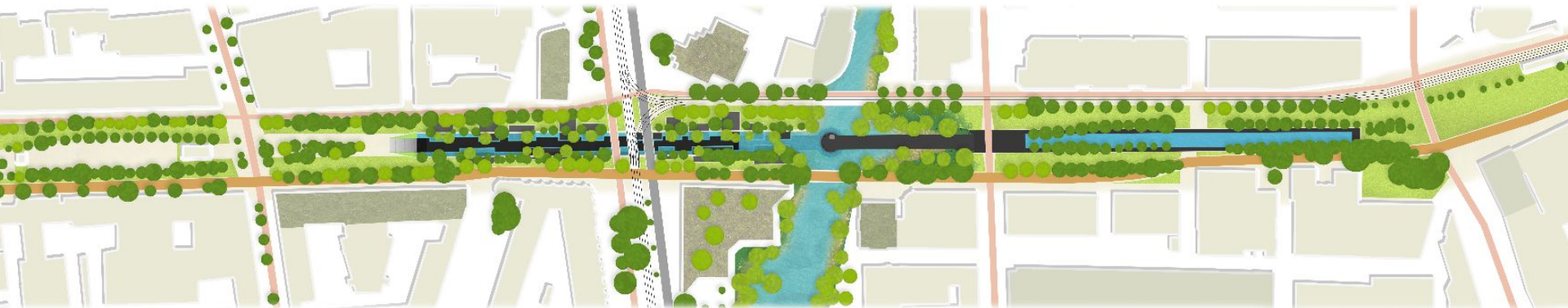
Current situation, mean high water



MASTERPLAN

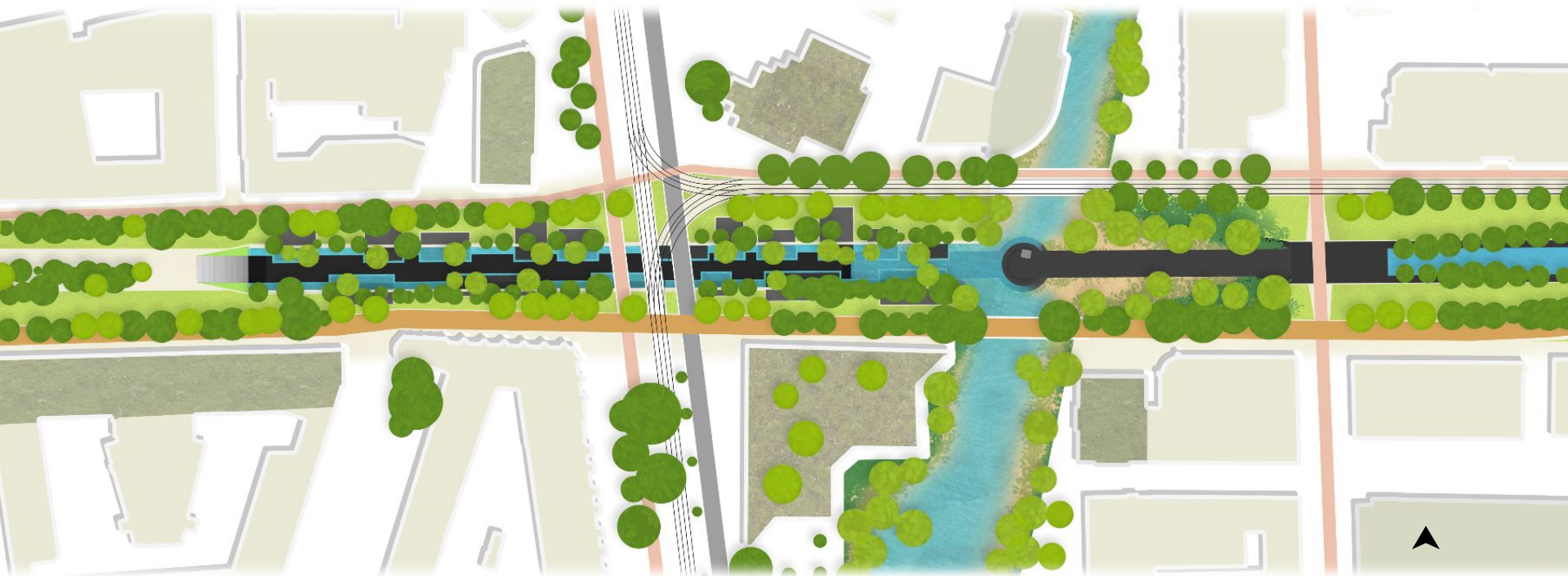
2100 situation, mean high water

Sea level rise: 1.1 m (IPCC, 2020)



MASTERPLAN

Current situation, mean high water



THROUGH THE DAY & YEAR

Situation in spring



THROUGH THE DAY & YEAR

Situation in spring



THROUGH THE DAY & YEAR

Situation in autumn



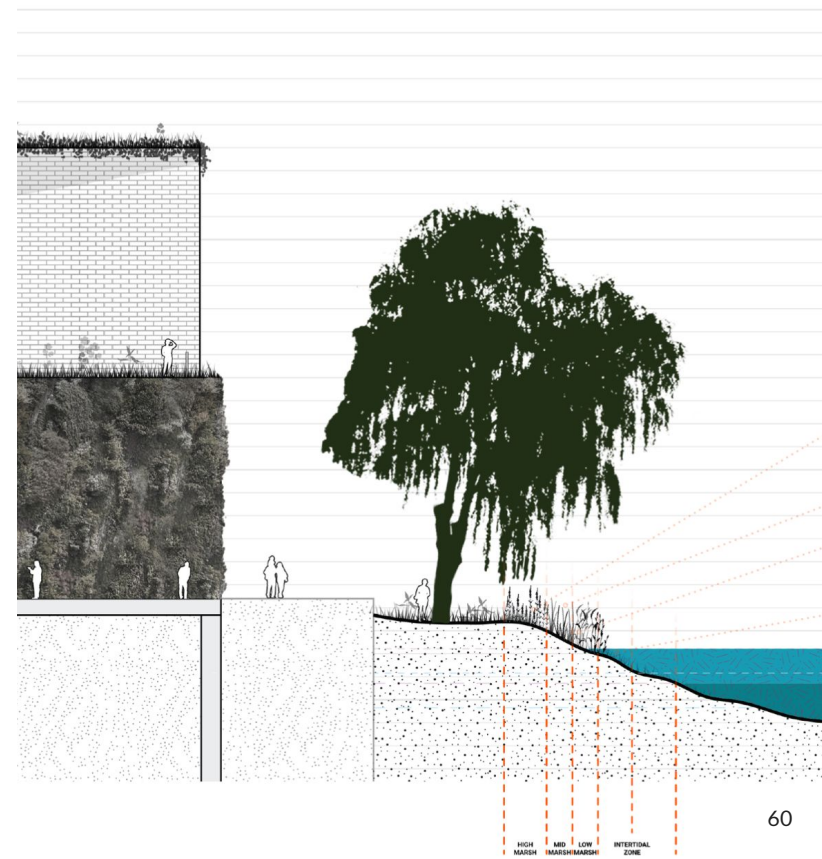
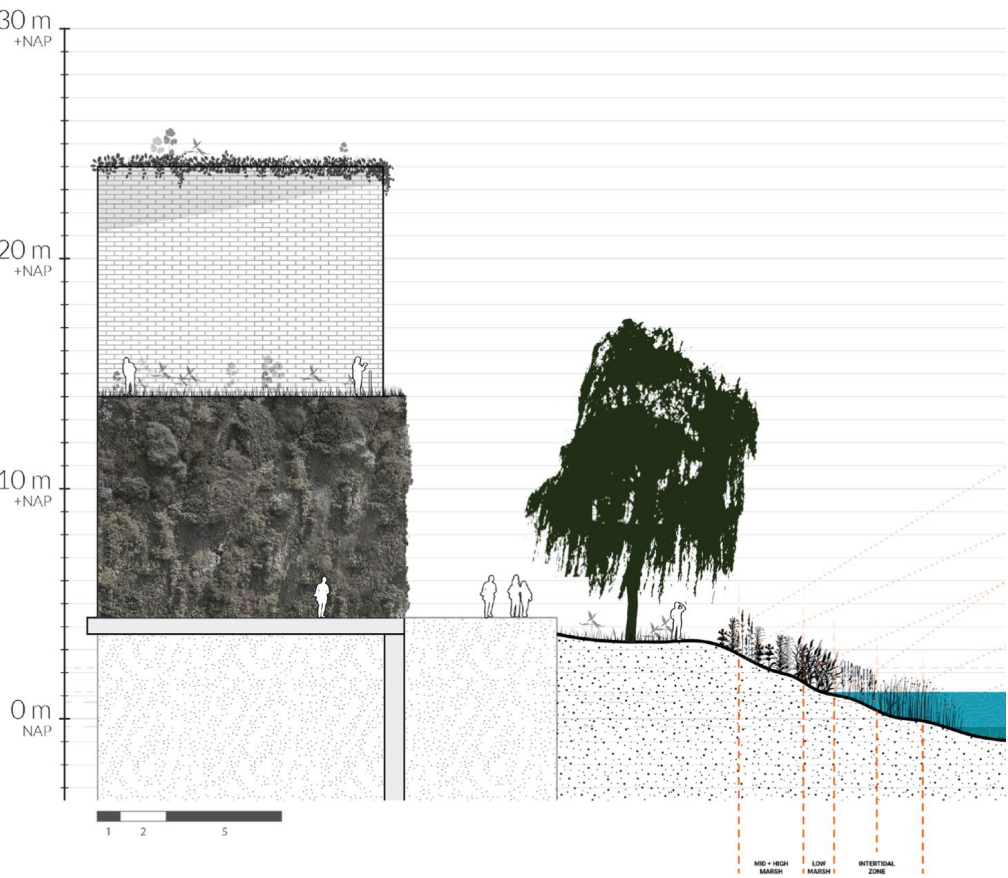
THROUGH THE DAY & YEAR

Situation in autumn



THROUGH THE DECADES

Due to the Maas river becoming more saline, experience and environments change over time

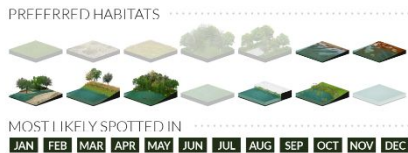


HIGHLIGHTED SPECIES

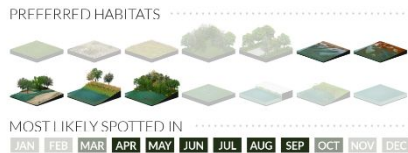
Space for common, red-listed and icon species throughout various habitats



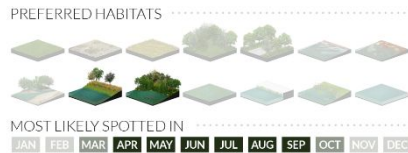
Grey Heron



Spoonbill



Purple Heron



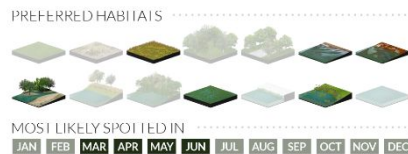
Savi's Warbler



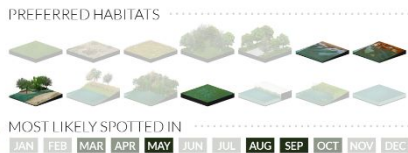
Eurasian Oystercatcher



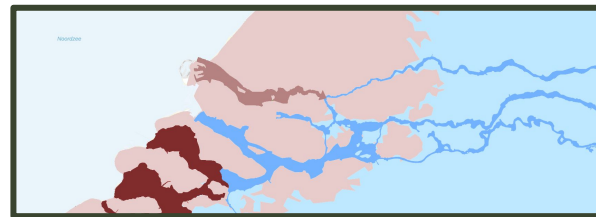
Common Redshank



Common Ringed Plover



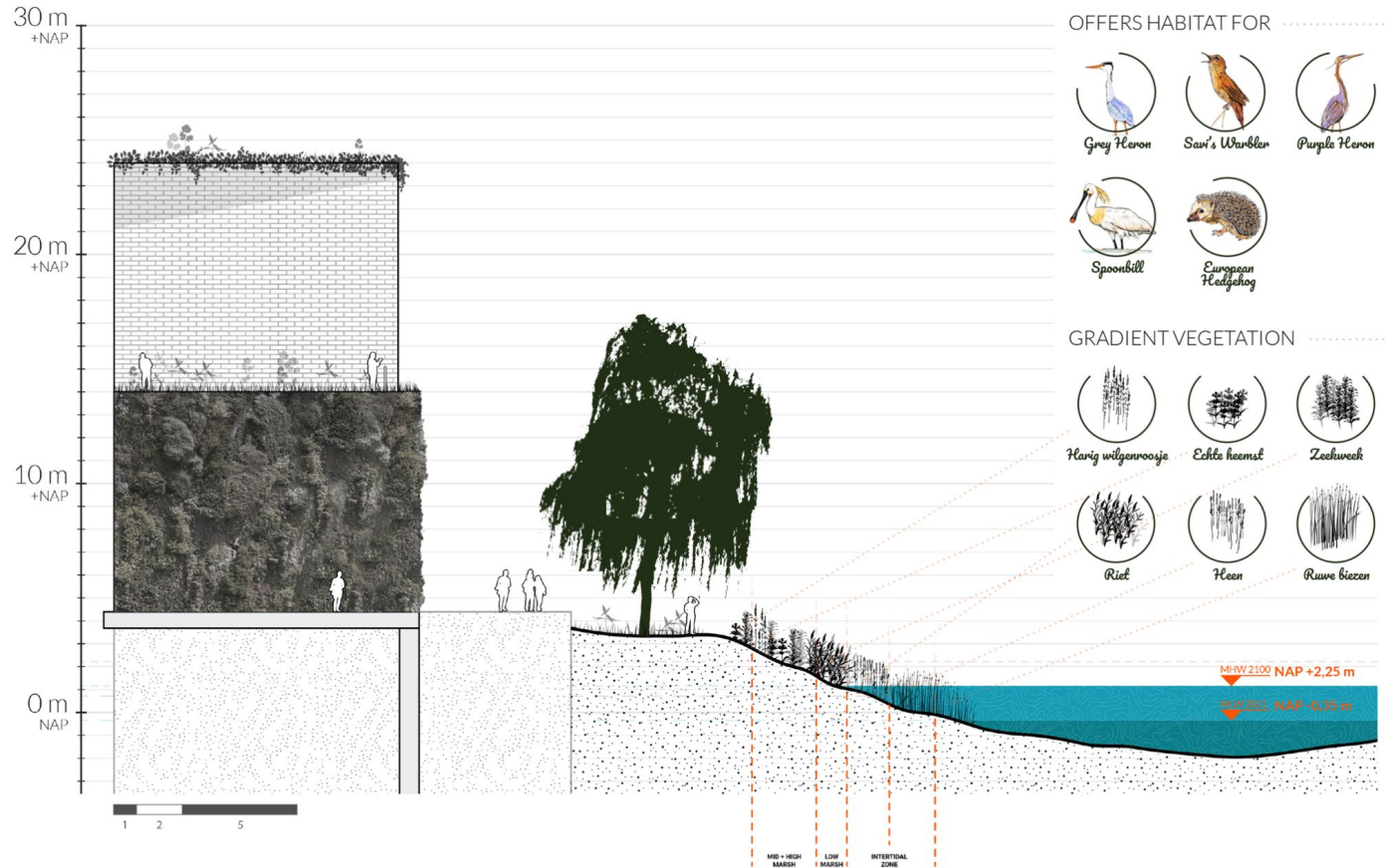
European Hedgehog



Based on: Atlas Natuurlijk Kapitaal, 2021.

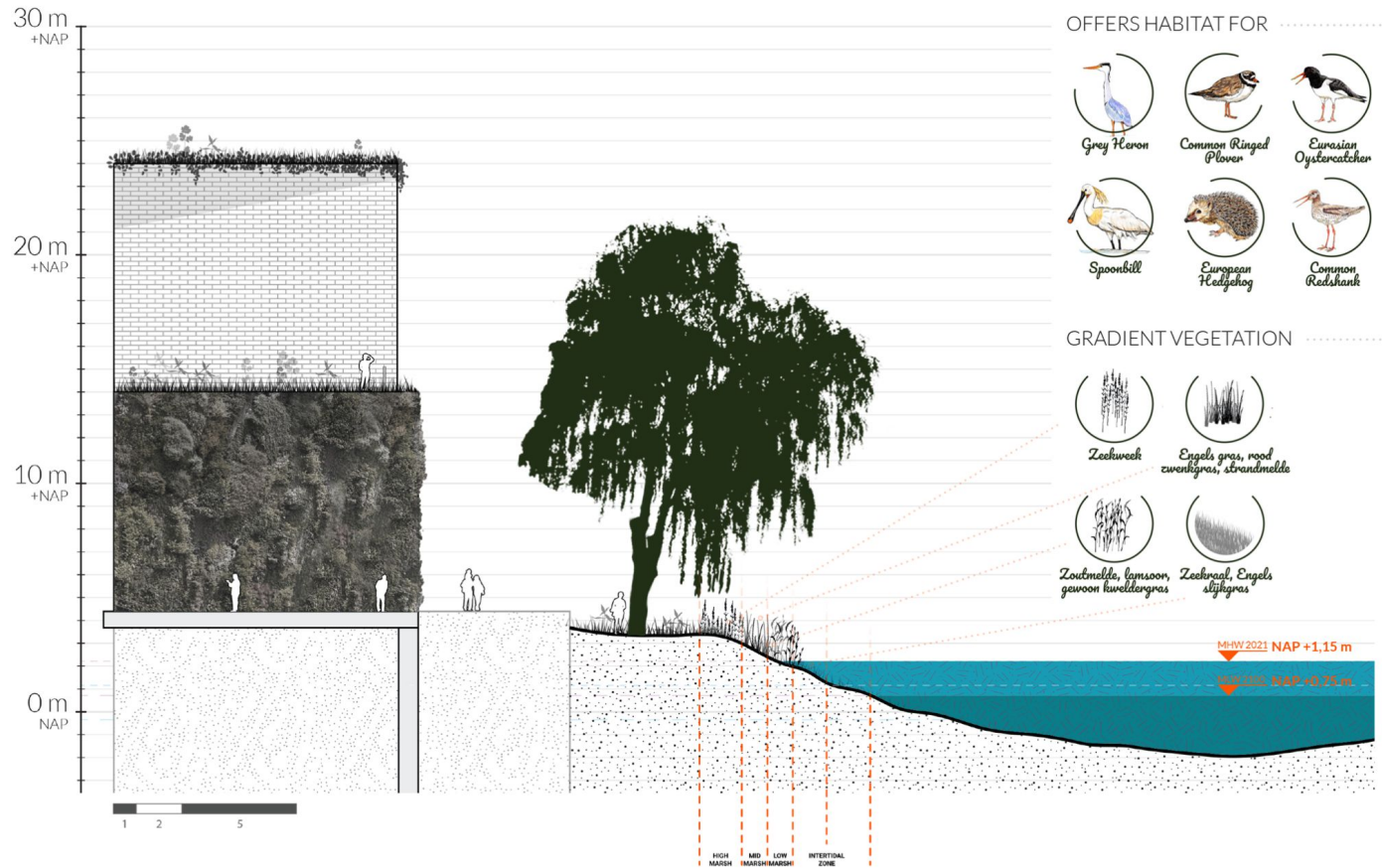
TIDAL ZONE SPACE FOR LEISURE AND SPOTTING SPECIES

A range of vegetation types across the fresh-brackish gradient



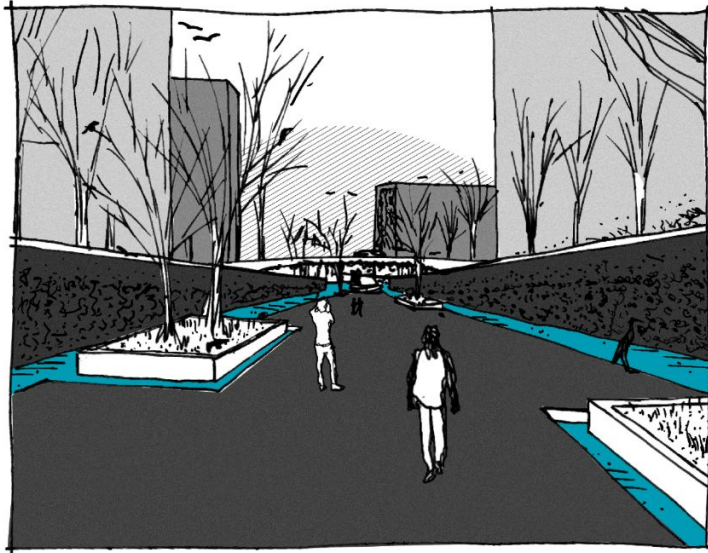
TIDAL ZONE SPACE FOR LEISURE AND SPOTTING SPECIES

A range of vegetation types across the brackish-saline gradient, ca. 2100



STROLLING ON THE FLOATING BOULEVARD

Sketches showing the experience on the tide-influenced boulevard, with floating and (dis)appearing fixed elements



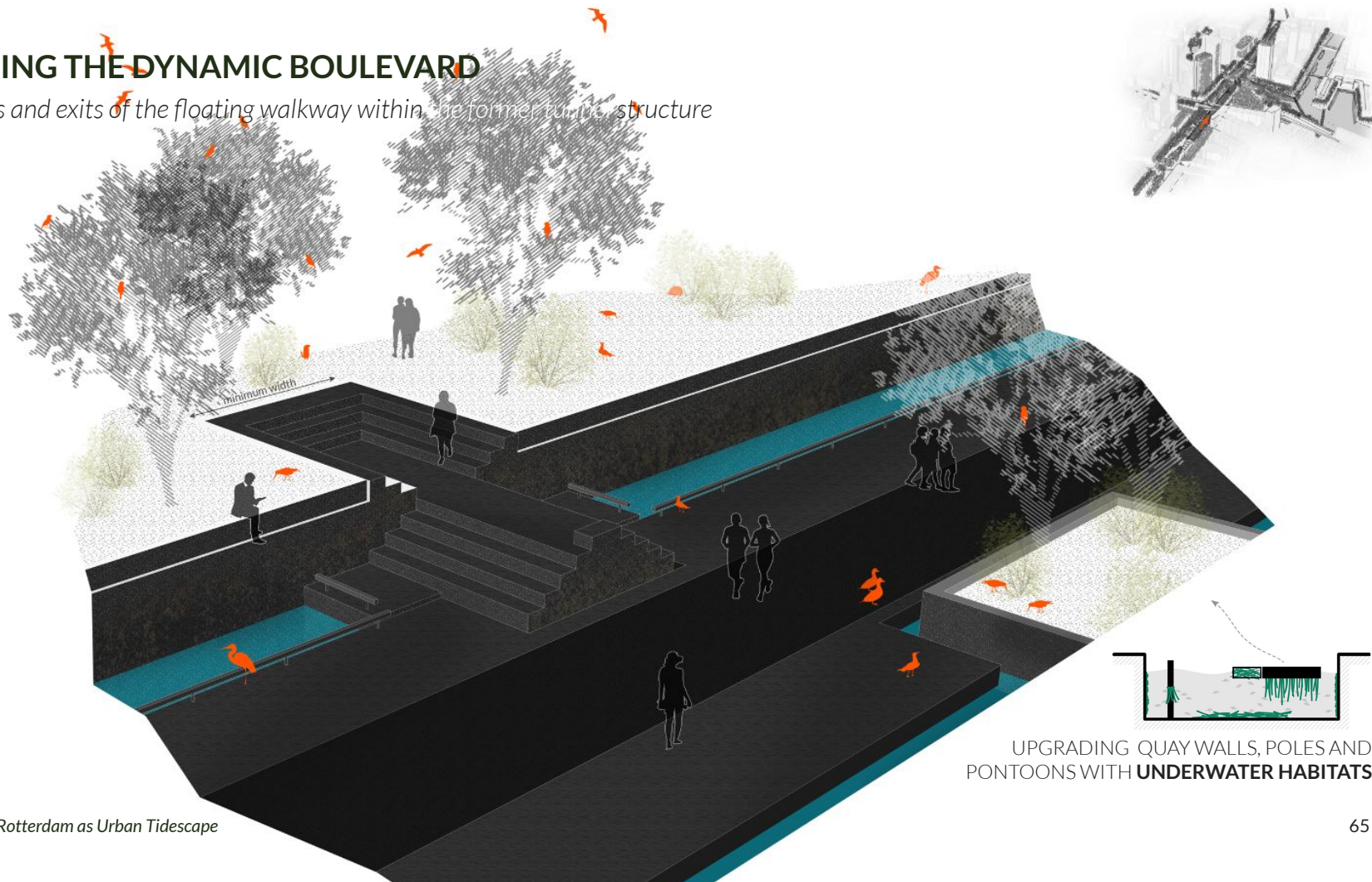
MEAN LOW WATER SITUATION



MEAN HIGH WATER SITUATION

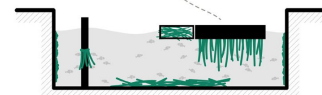
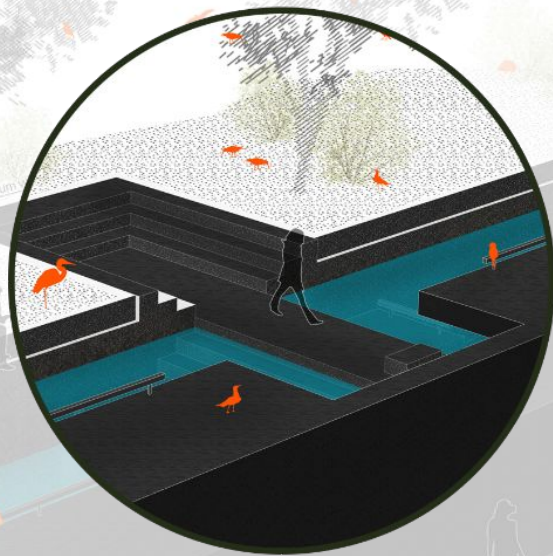
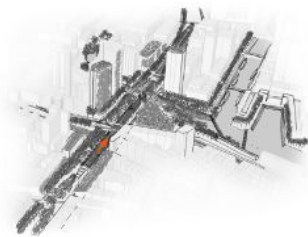
ENTERING THE DYNAMIC BOULEVARD

Entrances and exits of the floating walkway within the former tunnel structure



ENTERING THE DYNAMIC BOULEVARD

Entrances and exits of the floating walkway within the former tunnel structure



UPGRADING QUAY WALLS, POLES AND PONTONS WITH **UNDERWATER HABITATS**

DYNAMIC TIDAL STEPS

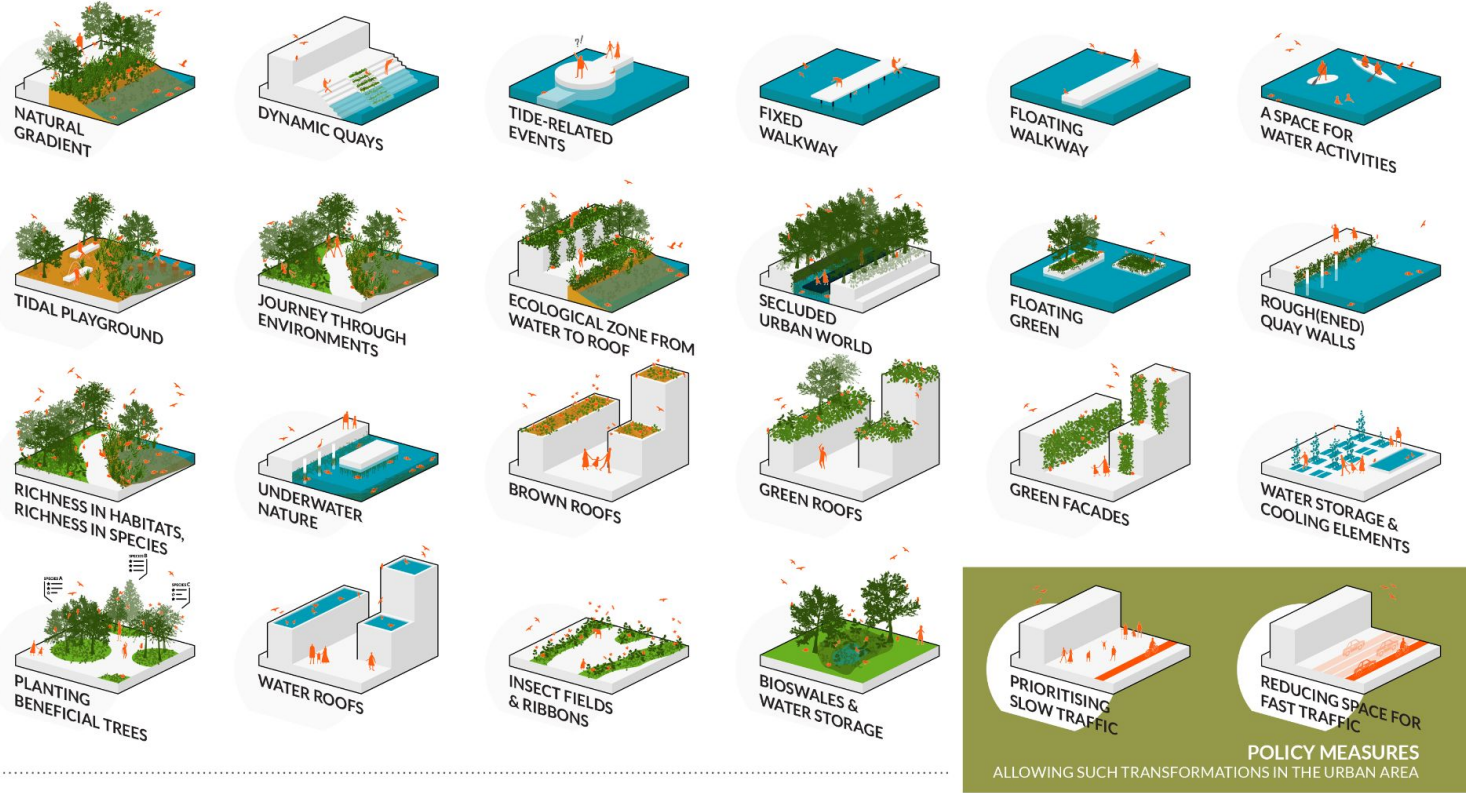
Thresholds retain the river water within the centre area of the design



URBAN TIDESCape TOOLKIT

Concluding from the design project

ORDERED GRADUALLY FROM EXPERIENCING THE TIDES TO BIODIVERSITY RECOVERY & CLIMATE



Rotterdam is just at the beginning of urban tidescapes... with the rest of the world to follow!

THANK YOU FOR YOUR ATTENTION