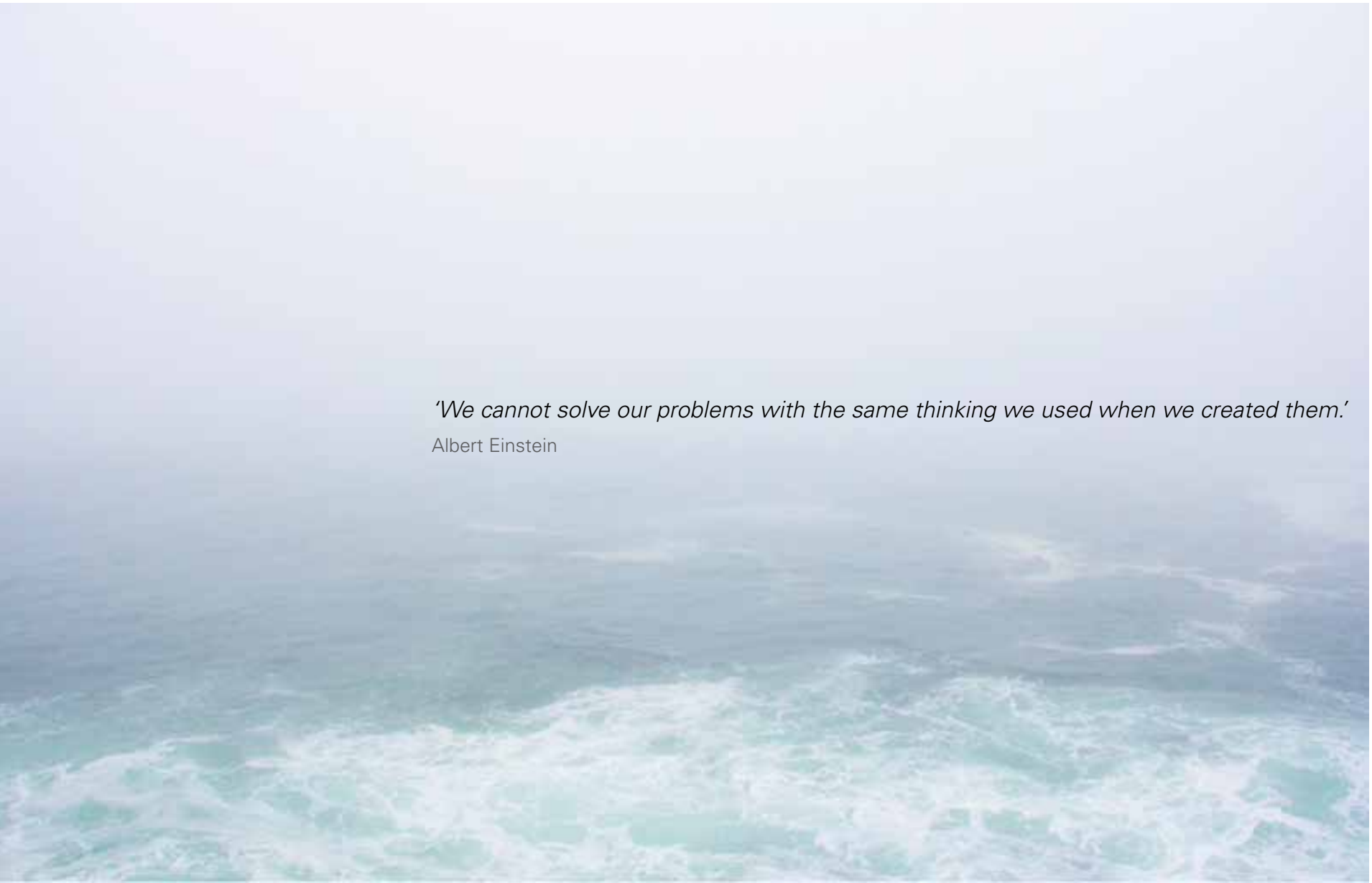
SUSTAINABLE INFRASTRUCTURE

SUMMERSCHOOL
REGIONAL PLANNING & DESIGN WITH WATER
LEARNING WITH DUTCH CITIES AND REGIONS

AEB/ U/TU DELFT, 23.07.2014



NORTH SEA
the Netherlands

'We cannot solve our problems with the same thinking we used when we created them.'

Albert Einstein

TANEHA K. BACCHIN

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Chair of Environmental Technology & Design

UNESCO-IHE Institute for Water Education, Department of Water Science and Engineering
Flood Resilience Chair Group

Chair of Environmental Technology & Design / Department of Urbanism
TU Delft / Faculty of Architecture and the Built Environment

focus

- triad people, technology and design
- urban metabolism / strategies towards sustainable development and urban resilience
- environmental technology, urban ecology and environment behavior
- smart urbanism / smart infrastructure
- urban dynamics and emerging theories of complexity
- dynamic scenarios planning / dealing with deep uncertainty

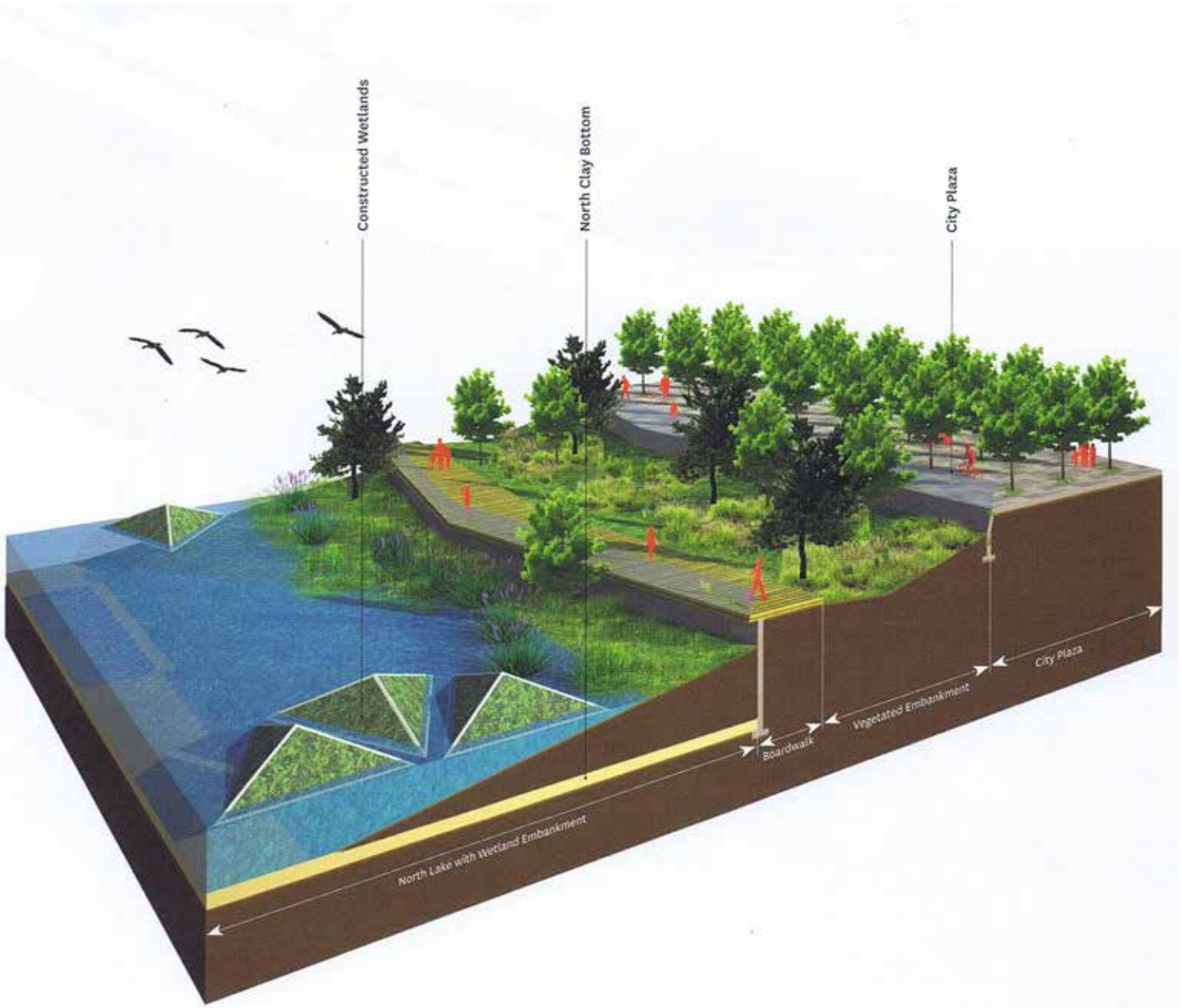
HIGHLINE NY-
James Corner
Diller Scofidio
+Renfro

NEW LONDON
LANDSCAPE

LANDSCAPE
INSTITUTE, UK

infrastructure

"Infrastructure, as we know it, no longer belongs in the exclusive realm of engineers and transportation planners. In the context of our rapidly changing cities and towns, infrastructure is experiencing a paradigm shift where multiple-use programming and the integration of latent ecologies is a primary consideration. Defining contemporary infrastructure requires a multi-disciplinary team of landscape architects, engineers, architects and planners to fully realize the benefits to our cultural and natural systems." Hung et al. (2012)



LANDSCAPE
INFRA-
STRUCTURE

SWA GROUP, CA

sustainable design

De Kay, M. (2011)

- process of planning, purposing, contemplating in ways that maintain resources and conserve the environment for future generations.

Integral sustainable design - 4 perspectives

- behaviour perspective;
- systems perspective;
- experience perspective;
- cultural perspective.

sustainable design

De Kay, M. (2011)

It is most often discussed in systems such as LID (low impact development) and essentially defined in its operational terms as a technological problem whose solutions can be measured by their **PERFORMANCE**.

> 'Better performance equals greater (sustainable design) success.'

perfomance and beyond

De Kay, M. (2011)

Technological sustainability depends for its success on the nature of solutions in relation to ecological issues. Within this context, is essential to note:

- the nature of environmental challenges;
- the context of sustainable (infrastructure) planning & design;
- the solution space (range of propositions);
- the methods and perspectives needed for these multidimensional propositions

Wusong Riverfront Phase I Pilot Project

SWA synergizes development and environment with amenities that are supported by a water-quality improvement system.

Guided by a regional riverfront restoration vision, a water treatment pilot project is being implemented upon reclaimed post-industrial borrow pits and a degraded water network. Monitoring and in-field adjustments to the design and implementation will inform the future phases of work. The project will serve as a model for landscape infrastructure supporting wild-life habitat, public education, and economic growth along the Wusong River corridor.

The pilot project is sited upstream of future development parcels, and intakes both river water and municipal stormwater outfalls. The system mimics a wide variety of natural processes and acts as the "kidney" for the river, cleaning sludge and industrial effluents discharged into the river upstream, extending the benefits of the park downstream to a larger region. A sequence of pools and channels remove targeted pollutants through settling, filtration, aeration, and bio-processing in alternating oxic and anoxic environments.

Location
Kunshan, China
Client
Kunshan Huaqiao Economical Development and Planning Bureau
SWA Scope
Regional concept planning and Master planning services
Size
Project - 955,286 sqm
Building - Phase I: 108,900 sqm
Phase II: 78,000 sqm
Architect
Ojanen_Chiou Architects, LLP
Environmental Consultant
Herrera Environmental Consultants
Awards
ASLA Honor Award - Analysis and Planning
ASLA Northern California Chapter Honor Award - Analysis, Research, Planning and Communication

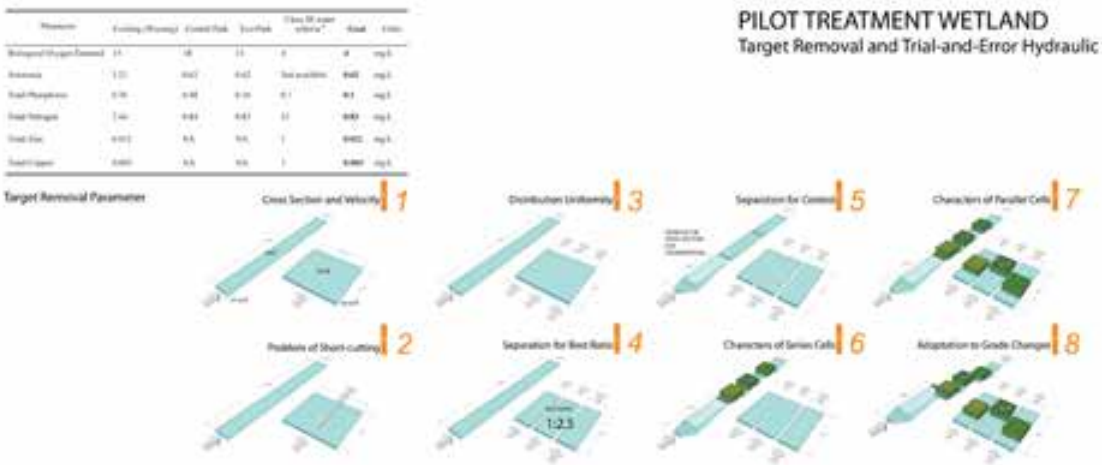
WUSONG
RIVERFRONT
KUNSHAN,
CHINA

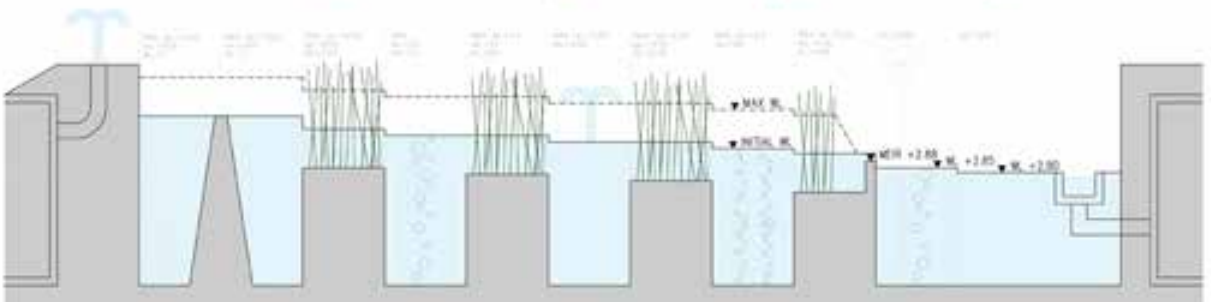
SWA GROUP, CA

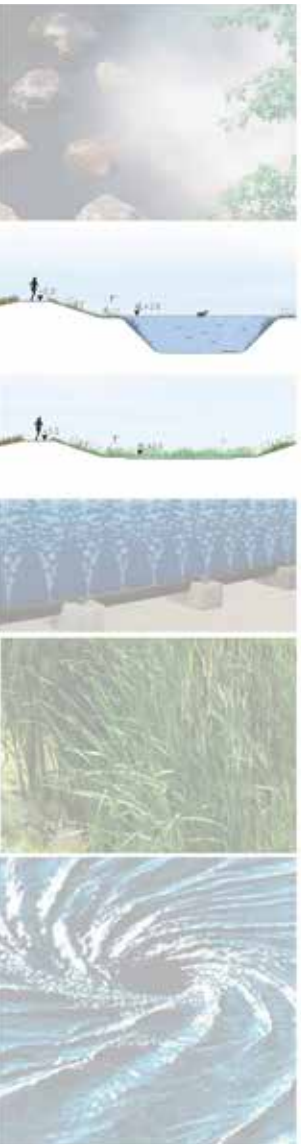
WUSONG
RIVERFRONT
KUNSHAN,
CHINA

SWA GROUP, CA

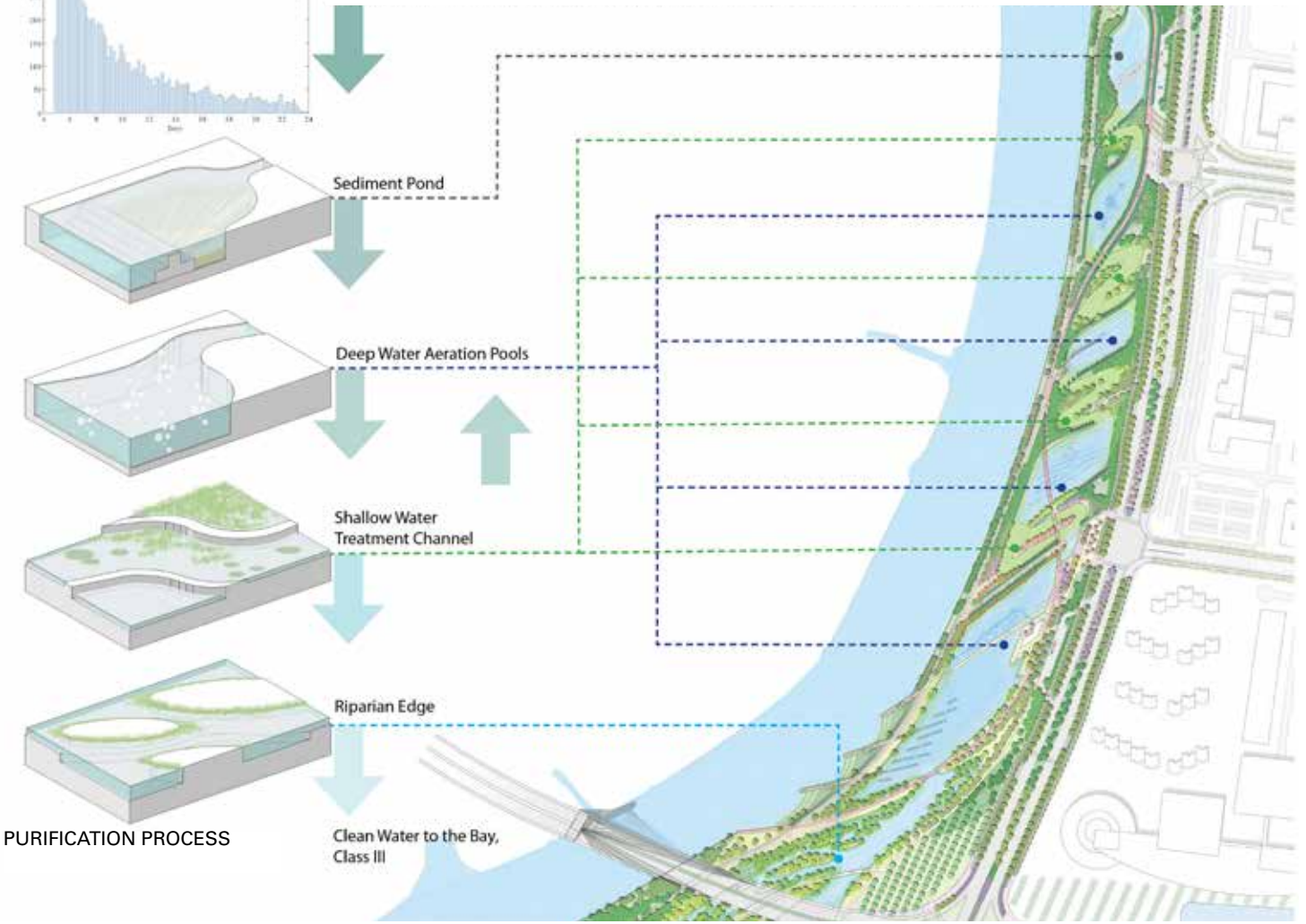
PILOT TREATMENT WETLAND
Target Removal and Trial-and-Error Hydraulic Experiments







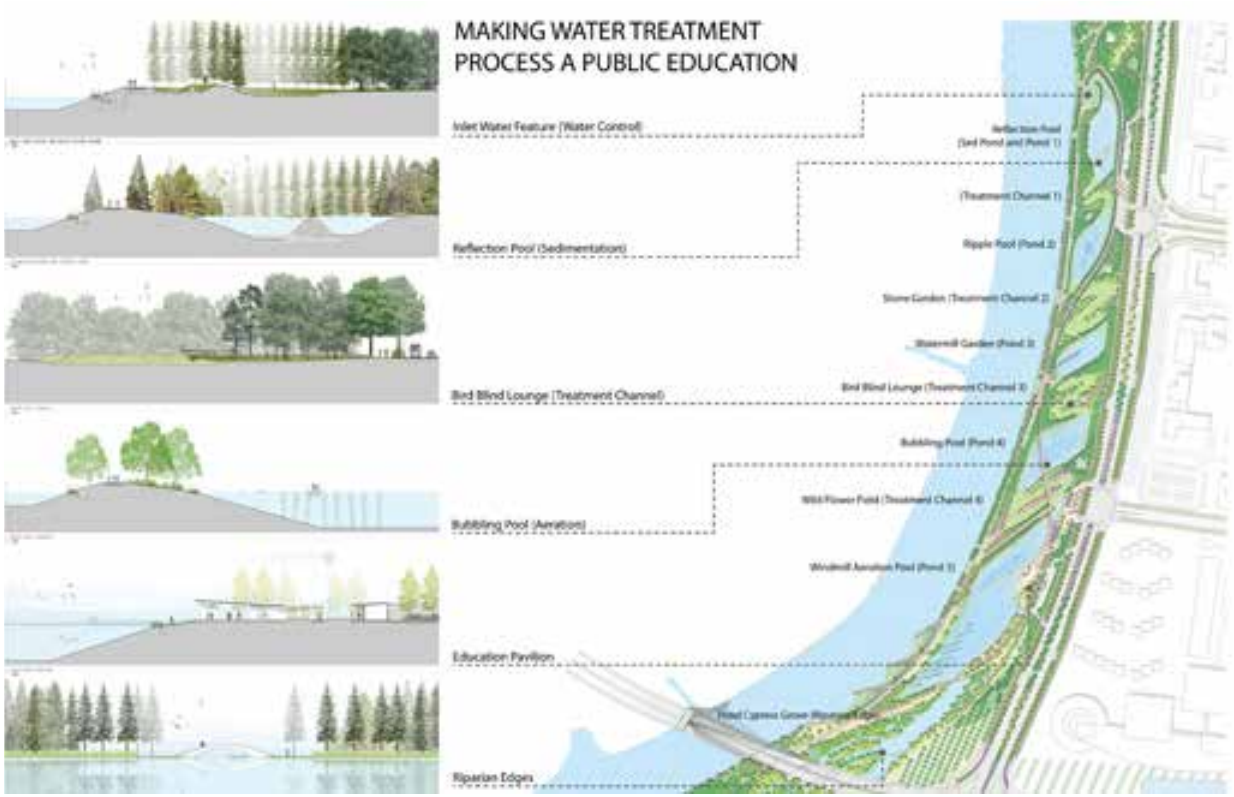
RETROFITTING PURIFICATION SEQUENCE TO SITE

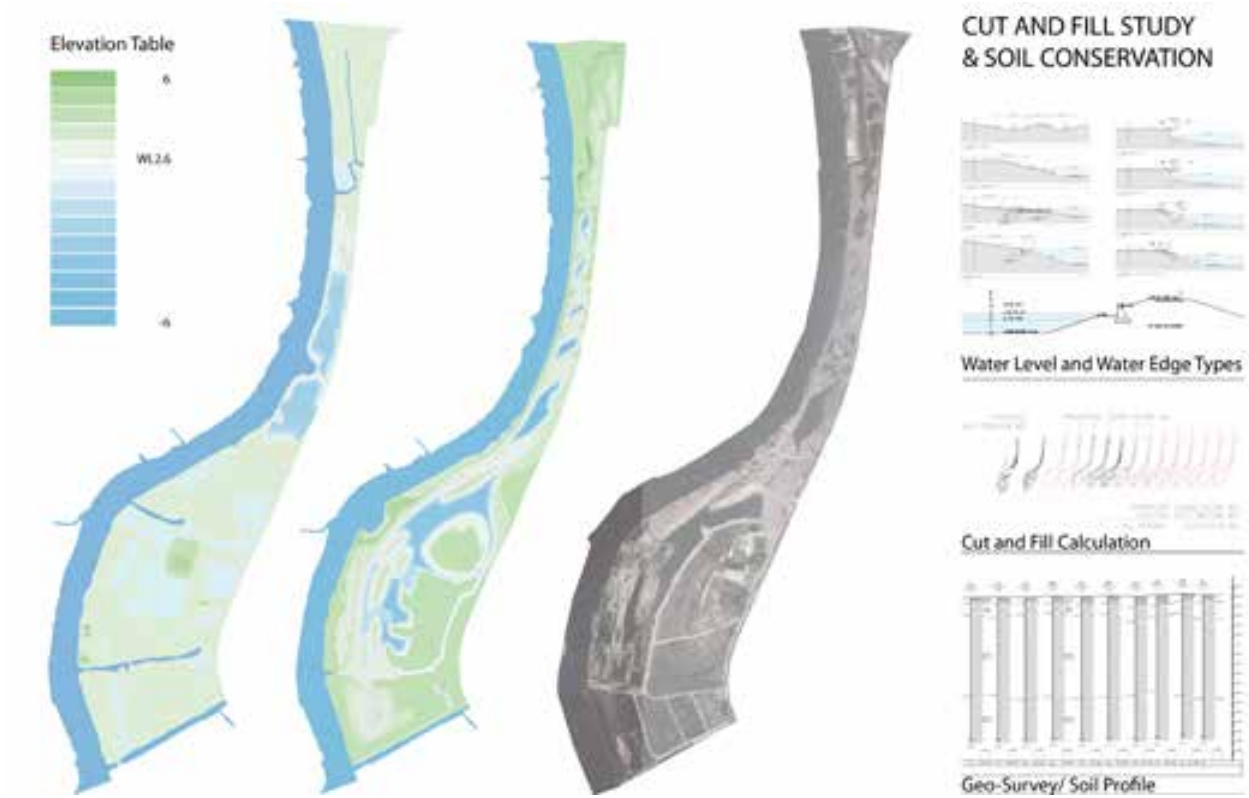


PURIFICATION PROCESS

WUSONG
RIVERFRONT
KUNSHAN,
CHINA

SWA GROUP, CA





WUSONG
RIVERFRONT
KUNSHAN,
CHINA

SWA GROUP, CA

perfomance and beyond

De Kay, M. (2011)

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- the solution space (range of propositions);
- the methods and perspectives needed for these propositions.

perfomance and beyond

De Kay, M. (2011)

_expanding our perspectives on sustainable design:

- TECHNOLOGICAL SUSTAINABILITY

design arises from applied principles of empirically based knowledge to reduce resource use and pollution. This is design committed to ‘less is more’.

perfomance and beyond

De Kay, M. (2011)

_expanding our perspectives on sustainable design:

- EXPANDING TO INCLUDE ECOLOGICAL PATTERN
  design committed to ecological community / delivering value to ecosystem services.

perfomance and beyond

De Kay, M. (2011)

_expanding our perspectives on sustainable design:

- RICH HUMAN EXPERIENCES
  to experience the cycles and forces of nature with which design interacts - building relationships between occupants and nature.

- MEANING / MAKING STORIES
  how society and nature are related - place making/ liveability objectives

LANDSCAPE INFRASTRUCTURE

The term “landscape infrastructure” used today by governments, professionals and academics worldwide to designate how the field of landscape in redefining the morphology of urban infrastructure in research, pedagogy and practice vis-à-vis the complexities of sub-urbanization and super-urbanization. Bélanger, P. (2013)

Foregrounding and augmenting the biophysical landscape of living systems that has been marginalized by the historical divide between economy and ecology of industrial economies, the double-entendre of the landscape infrastructure project aims to reposition the agency of ecology as a sophisticated, instrumental system of essential services, resources, processes and agents that underpin contemporary urban economies towards the 22nd century. Bélanger, P. (2013)

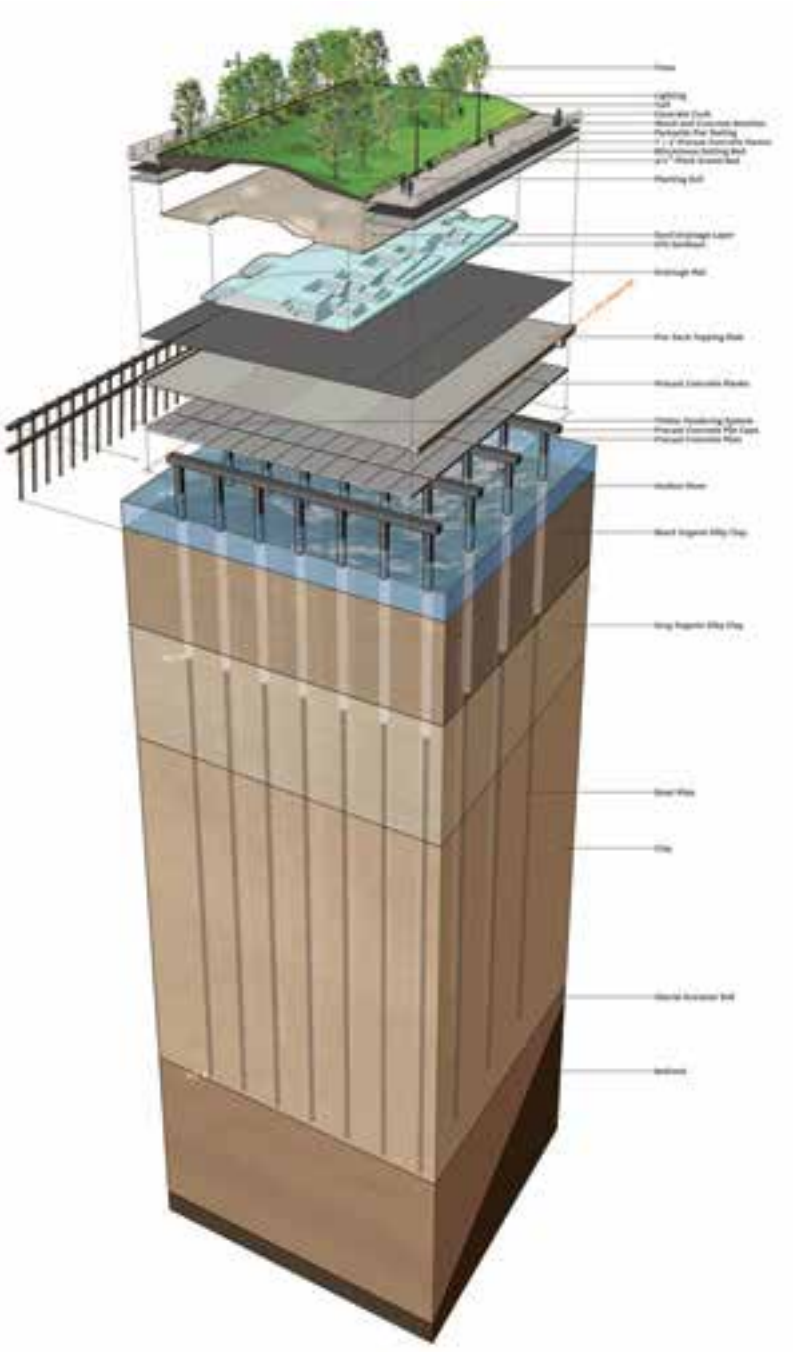
JPI - URBAN EUROPE PROJECT

GREEN/BLUE INFRASTRUCTURE FOR SUSTAINABLE, ATTRACTIVE CITIES

TUD/ETD

objective: green/blue innovation by design

- to develop knowledge and tools required to seize the opportunities arising from future challenges, to manage urban stormwater in a way that facilitates robust, synergistic and multi-functional green infrastructure that will address today's and tomorrow's climate and other changes in dynamic urban areas.



DESIGN THE WATERFRONT PARK INFRA-STRUCTURE OF THE FUTURE

MICHAEL VAN VALKENBURGH ASSOCIATES

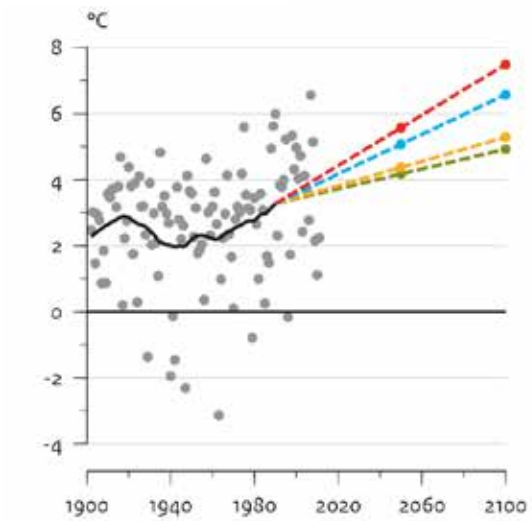
NARRATIVE

In three steps, the common ground for discussion is develop, dynamic scenarios on the environmental, social, and economic changes are written, and the potential spatial consequences in relation to sustainable urban development outlined.
Multi-scale green/ blue/ grey networks and integrated infrastructural responses can then be designed using urban engineering/ open systems ecologies.

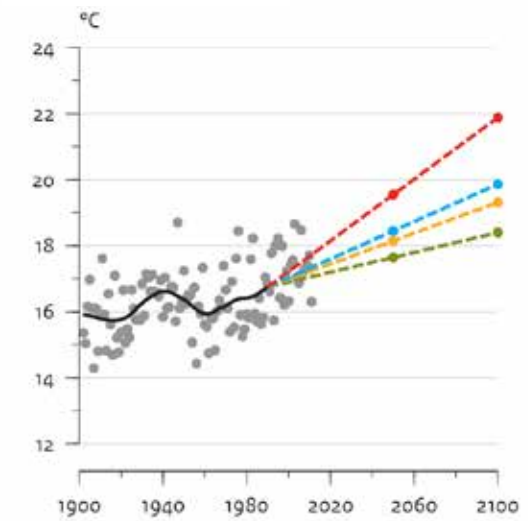
POSSIBLE CLIMATE CHANGES, 1990-2050

KNMI, 2006

winter



summer



observations
moving average (30 years)

g/ scenario
g+ scenario
w/ scenario
w+ scenario

g and w scenarios: temperatures increases more in winter
g+ and w+ scenarios: temperatures increases more in summer

ATMOSPHERIC CIRCULATION PATTERNS

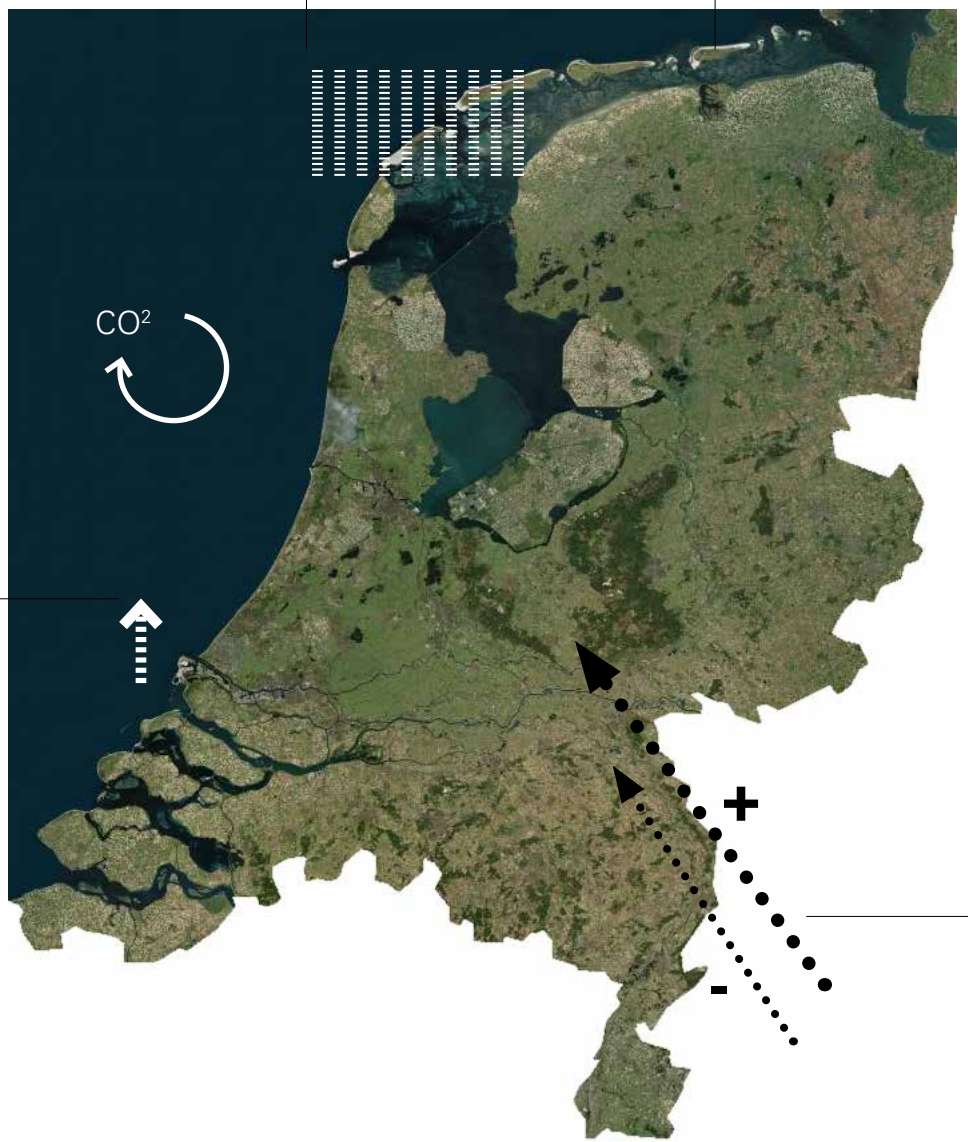
+1 °C → +2 °C → GLOBAL TEMPERATURE IN 2050 COMPARED TO 1990

ANNUAL PRECIPITATION
From -5% to +6%

WET PERIODS
Ten-day precipitation total
that wil be exceeded
once every 10 years.
Winter: +8% to 24%

DRY PERIODS
+7%to +30%
potential evaporation

AVERAGE ANNUAL TEMPERATURE
+1.8 to +5.1 °C

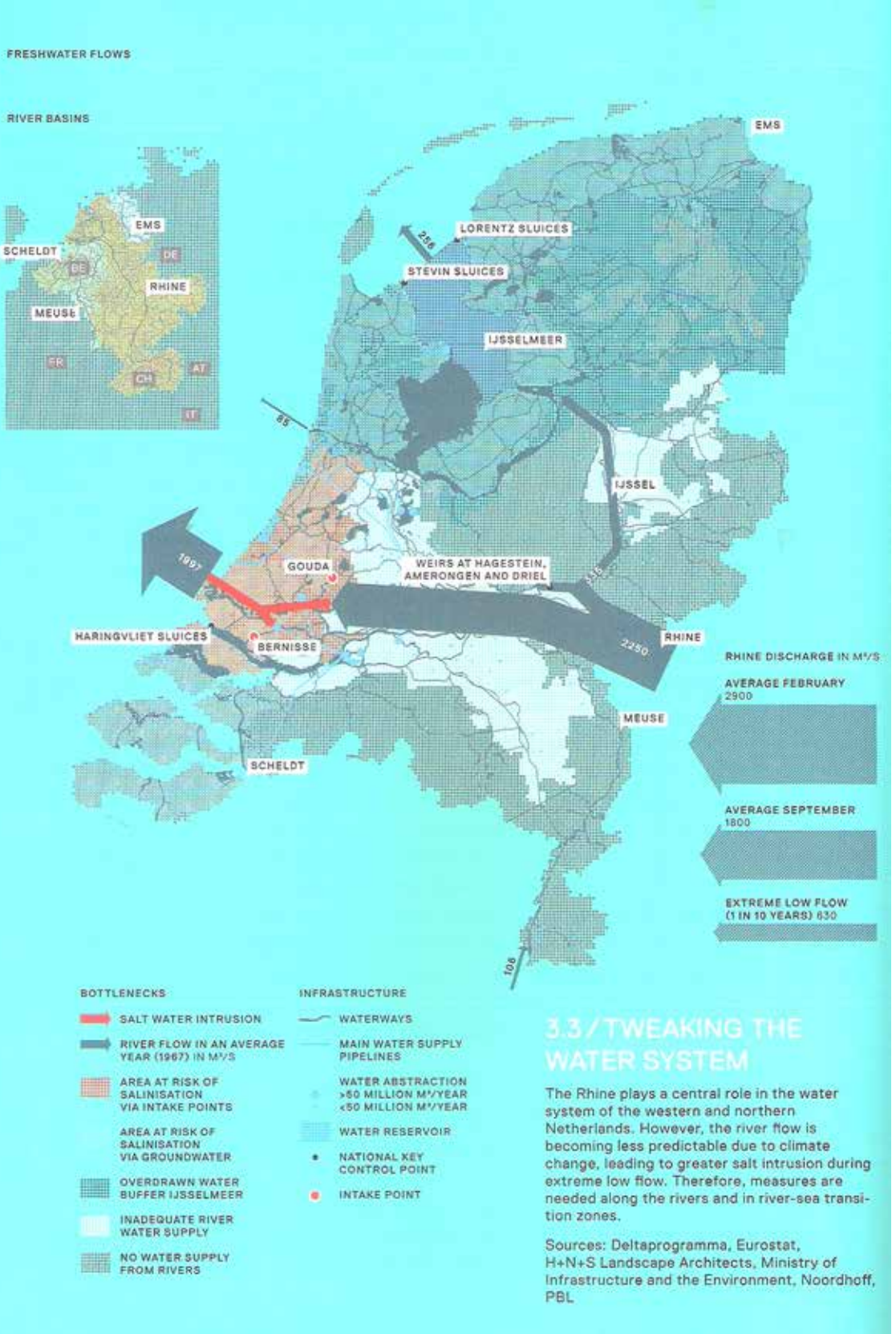


SEA LEVEL AT
DUTCH COAST
+35 TO +85 cm

RIVER DISCHARGES
River Rhine average in winter: +12% to +27%
River Rhiine average in summer: -41% to +1%
River Rhine extremely high discharges:
4 to 40 times more often

POSSIBLE CLIMATE CHANGES, 1990-2100

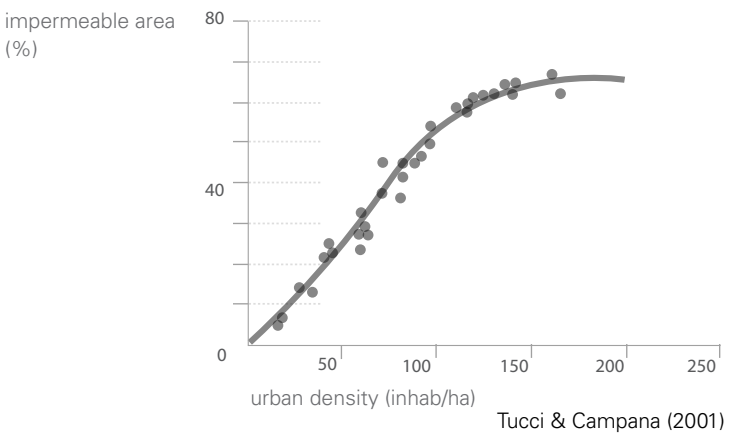
KNMI, 2006 / 2009a;
Kwadijk et al., 2008



SMART ABOUT CITIES
Hajer, M & Dassen, T; 2014

spatial patterns of land use

beyond climate, land use patterns, and their manifestation on land cover change and pollution loads, are the major factors altering the structure, function and natural processes on the physical environment. Grimm, N. et al. (2008)



Tucci & Campana (2001)

URBAN GRADIENT

FROM CLOSED SYSTEM DYNAMICS TO OPEN SYSTEMS ECOLOGIES

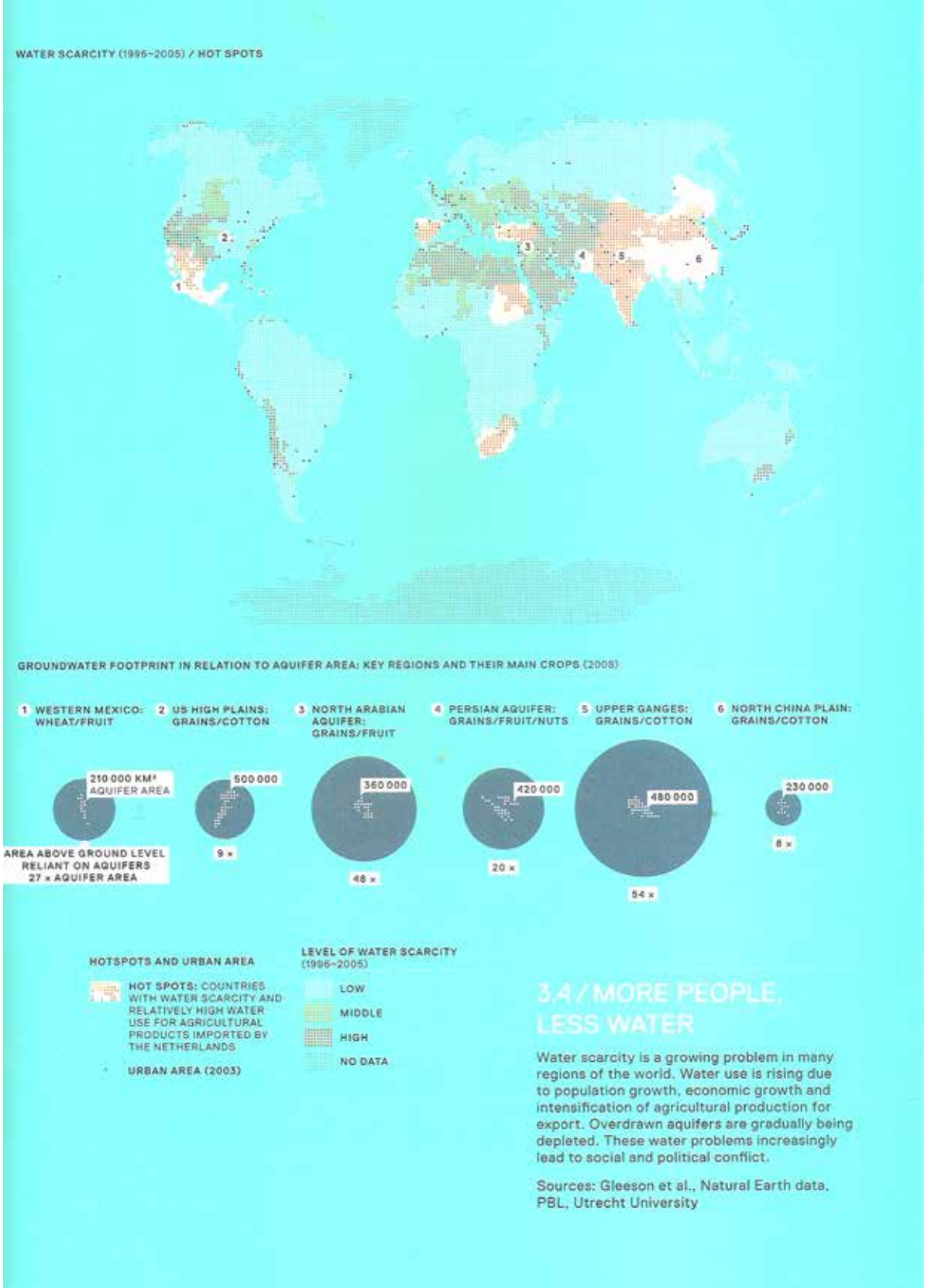
Bélanger, P. (2014)

SPRAWL IS INEVITABLE

/ we must look beyond the parameters of our current debate to find the future of the city

URBAN POPULATION DENSITY IS IN DECLINE

/ even as the word's population increases



SMART ABOUT CITIES
Hajer, M & Dassen, T; 2014

SUPPLY OF GOODS AND SERVICES BY DUTCH ECOSYSTEMS RELATIVE TO DOMESTIC DEMAND, IN %

DEMAND AND SUPPLY

CURRENT SUPPLY

5.1 / THE SERVICES OF NATURE

Nature is of vital importance to man. We may view nature as a service providing system that delivers services such as water purification, food production and coastal protection. For example, one fifth of the Dutch coastline and riverbanks is protected from flooding by natural barriers, such as coastal dunes. The remainder has to be protected by dikes and engineering works.

Source : PBL/WUR

SMART ABOUT CITIES
Hajer, M & Dassen, T; 2014

FROM CLOSED SYSTEM DYNAMICS TO OPEN SYSTEMS ECOLOGIES

Bélanger, P. (2014)

cities of circuits?

from problematique to process

flow as form: systems ecologies

decentralization as decompaction

flexibility, contingency, risk

INFRASTRUCTURAL ECOLOGIES

NORTH SEA
aircraft condensation trails
ESA/NASA

SMART CITIES OR SMART URBANISM

Hajer, M. & Dassen, T. (2014)

<u>200 years of transitions:</u>

- 19th century, Western cities adjusted from having medieval city structures to becoming industrial cities.

- 20th century, the arrival of the car called for large-scale readjustments.

- Now, we are on the verge of a new transition -

we must find a way yo make cities eco-efficient, with renewable energy, and fewer CO_2 emissions. Cities that do not respond rung great risks, both financially and in terms of operational liability (UNEP 2013a).


I'M
NOWHERE

SMART CITIES OR SMART URBANISM

Hajer, M. & Dassen, T. (2014)

cities in the antropocene / 21st century:

- nature and society, today, are so much out of sync that we can no longer address singular problems in a meaningful way
- the word bank suggests a USD 30 to 50 trillion investment in urban infrastructure
- moments of discursive shift are moments of opportunity
- the problem with an overly fast move from problem to solution is the rather short amount of time in which to hold the debate

...when it comes to cities, there are no 'set' of solutions.

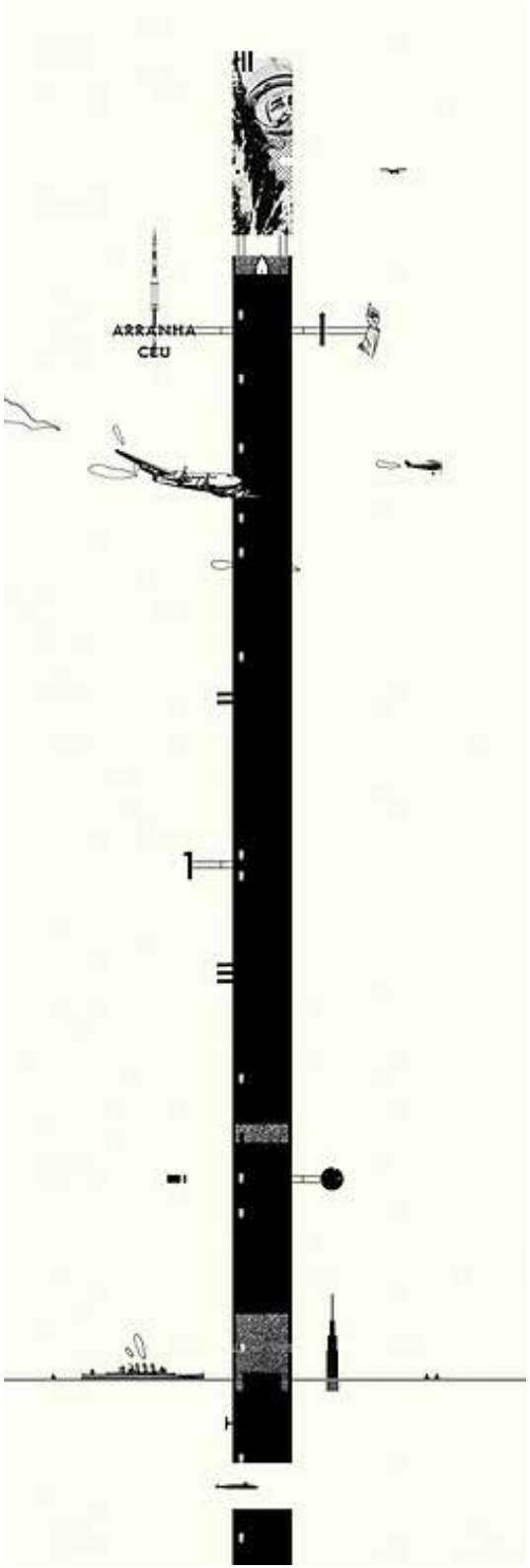
in what type of city would you like to live?

Hajer, M. & Dassen, T. (2014)

1. ‘decoupling’ as the strategic orientation

2. a persuasive story line about the future

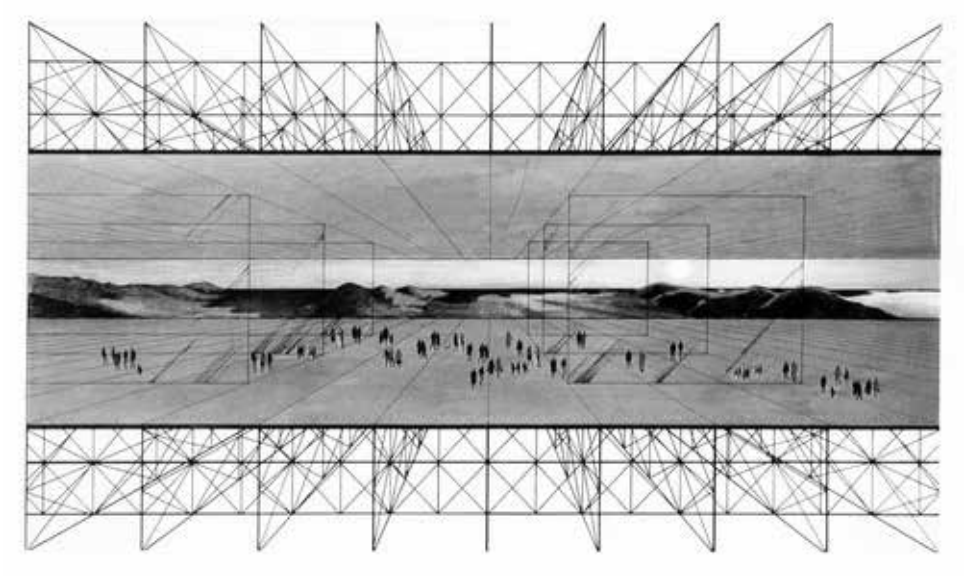
   ‘planning as a persuasive story about the future’ - James Throgmorton (1996) argued that the essence of planning was not about ends or means, ordering, organisation and reorganisation; instead he found that underlaying effective planning was a vision, a persuasive story: this has a generative capacity.

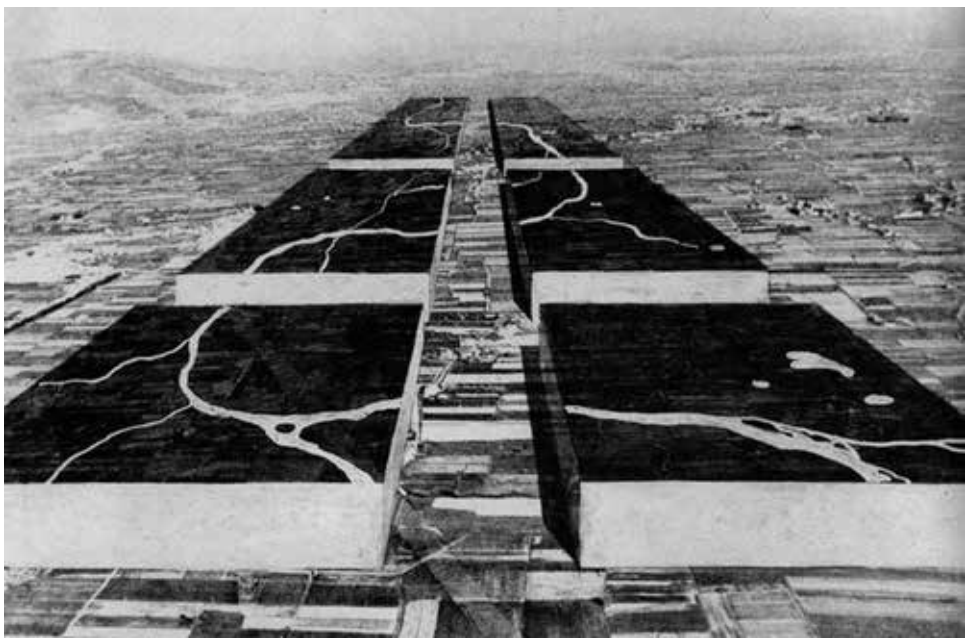


UTOPIAN
FUTURES

CITY
MODELS

miniatura77:
Arranha-céu
Outdoor, 2014





UTOPIAN
FUTURES

CITY
MODELS

ArchiZoom |
No-Stop City |
1970-72

iin what type of city would you like to live?

Hajer, M. & Dassen, T. (2014)

2. a persuasive story line about the future

'...smart economy

smart people

smart governance

smart mobility

smart environment

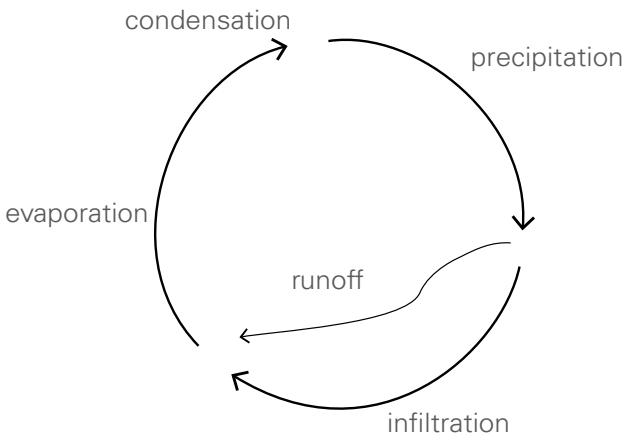
smart living...'

in what type of city would you like to live?

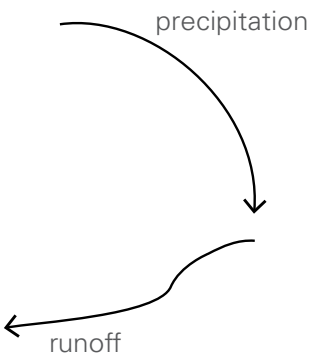
Hajer, M. & Dassen, T. (2014)

3. urban metabolism as framework for strategic decision-making

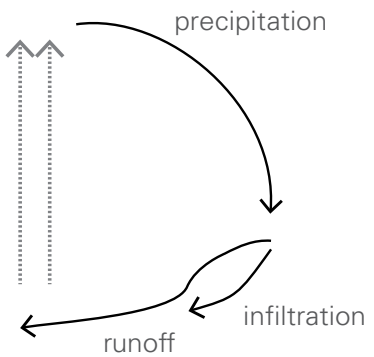
water (flow) cycle:
managing stormwater synergistically with green areas –
cities are simultaneously made greener as well as being drained effectively, with water being used directly at source and recycled where possible.



water cycle in natural systems



water cycle in an urban area without SSWM



water cycle in an urban area with SSWM

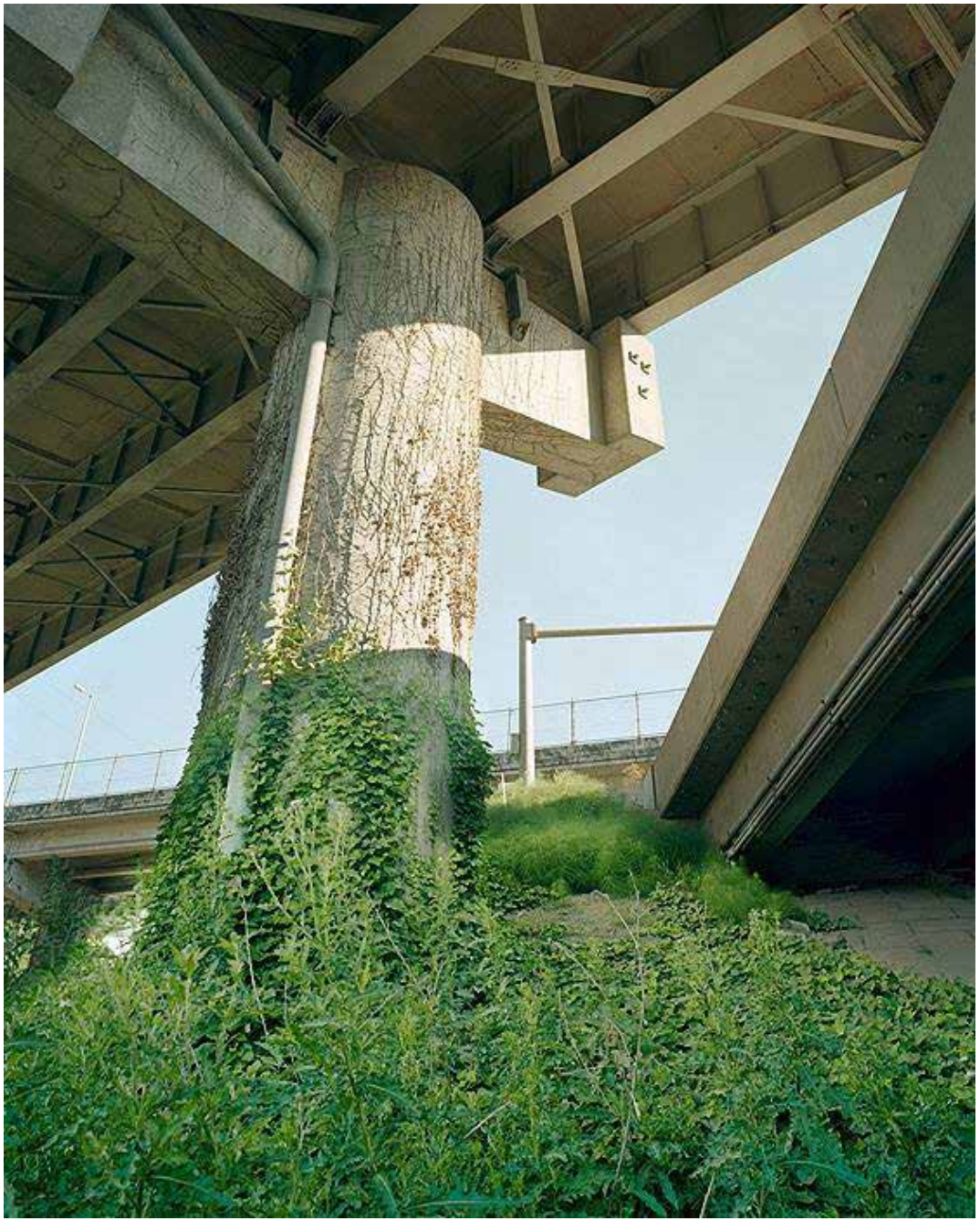
alternative pathways to the future: environment

NOTION OF ECOSYSTEM SERVICES

where benefits from and to the natural ecosystem have been formally recognised and explicitly monetised.

PERFORMANCE OF GREEN-BLUE / GREY SYSTEMS

reliant on urban landscape patterns resulting from land-use planning and design practices.



(c) urbanautica

(c) urbanautica

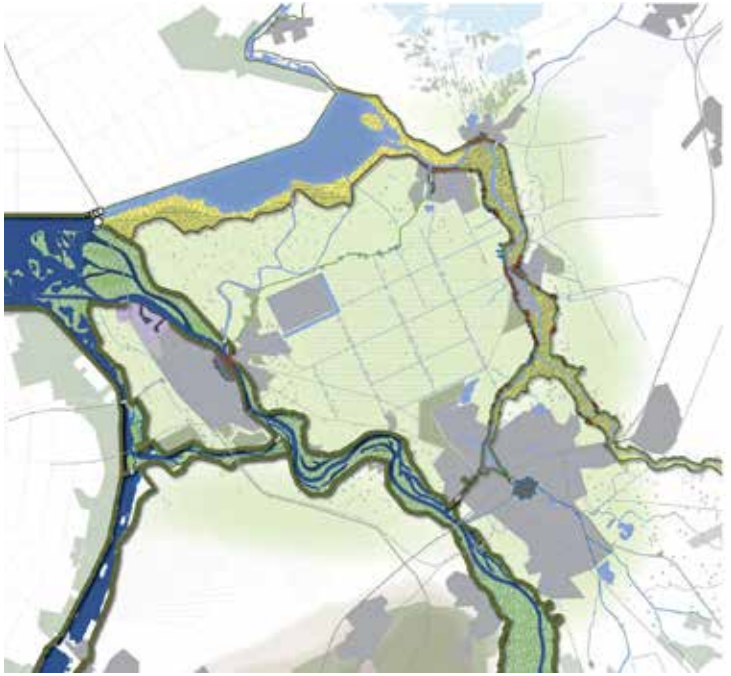
alternative pathways to the future: environment

ADAPTATION
changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.

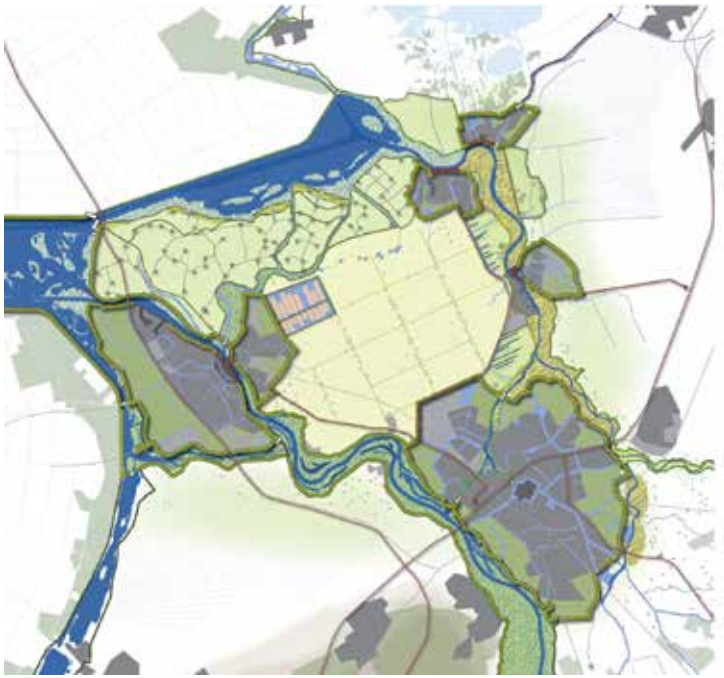
DYNAMIC RESILIENCE
climate change resilience is the capacity of an individual, community, or institution to dynamically and effectively respond to shifting climate impact circumstances while continuing to function at an acceptable level.

MULTI LAYER SAFETY
strategy for a sustainable water security by focusing on 'multi-layer safety'. 3 layers of protection:

1. prevention of a flood (main pillar of water safety);
2. sustainable spatial development;
3. improving organizational preparation for a possible flood (disaster).

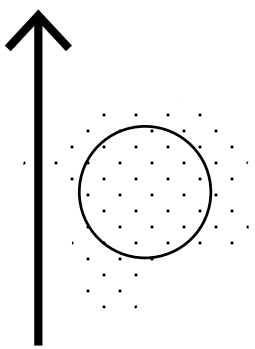


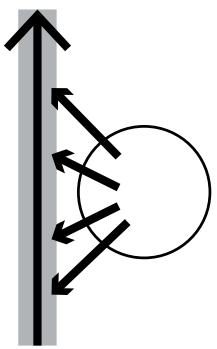
Long-term perspective
‘Prevention First ‘

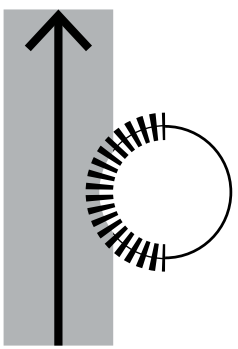


Long-term perspective
‘Mix at size ‘
source: H+N+S et al.

alternative pathways to the future
environment / SCALING INFRASTRUCTURE AND SPACE FOR PROTECTION

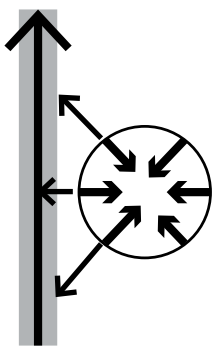


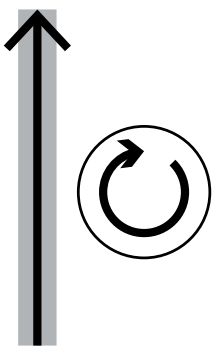




STAGIONAL CHANGE:
more intense wet and dry periods over the year.

How to adapt water infrastructure for higher seasonal variation of flow volume?





alternative pathways to the future: social

OPEN SPACE PERFORMANCE

green/blue spaces performance: air/water/ground regulation

green/blue spaces connectivity and contiguity (intelligibility/ place making): spatial quality

MULTIPURPOSE USE OF SPACES

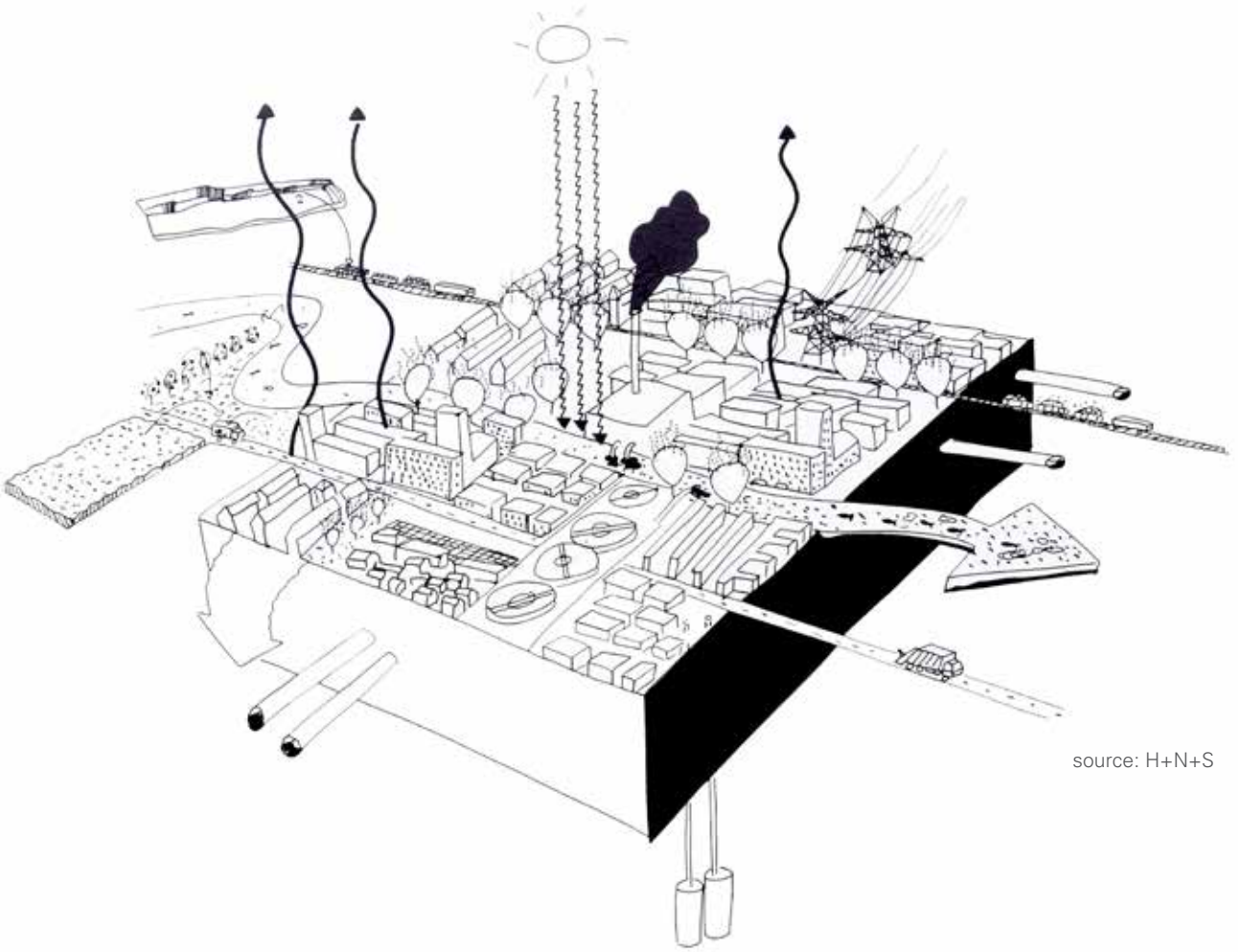
strategies for contemporary urbanization that is flexible, contingent, and multidimensional

NEW
LANDSCAPE
INFRA-
STRUCTURE

surface water
management
performance
along with
natural
characteristics
for iconic identity
of urban space

Copenhagen
TREDJE NATUR

alternative pathways to the future
economy / SUSTAINABLE URBAN METABOLISM



source: H+N+S

REDEFINING FUTURE INFRASTRUCTURE

Landscape infrastructure can transform urban blight into urban destination. It can help create an iconic identity for a city by utilizing latent natural and cultural characteristics.

landscape infrastructure

source: SWA Group Design Briefing: Landscape Infrastructure

	Traditional Infrastructure		Landscape Infrastructure
Streets	Engineering and maintaining city streets based solely on the needs of automobiles.	❶ 	Re-designing streets, streetscapes and pedestrian connections in ways that beautify and revitalize. Incorporating paving materials that offset heat island effect and help with storm water management.
Highways	Engineering and maintaining highways for peak-traffic efficiency	❷ 	Using highway corridors as opportunities for restoration of native habitat, re-vegetation, civic art, and storm water management
Waterways	Channelizing or altering waterways for storm water management or roadway development.	❸ 	Naturalizing disturbed, neglected creeks, rivers, bayous and other waterways for storm water management, public spaces, and urban wildlife habitat.
Alleyways	Identifying and using land on a utilitarian basis.	❹ 	Creating usable parks and open space as part of a larger urban plan from opportunities presented by alleyways, power line corridors, waterways and other traditional infrastructure venues.
Railways	Maintaining or converting established rail lines.	❺ 	Repurposing railway corridors for hiking and biking trails. Creating additional opportunities for parks, open space and habitat.
Parks and open spaces	Generally not considered as part of infrastructure.	❻ 	Utilizing parks and open space to nurture a respect for nature, provide recreational venues and link communities.
Urban design	Focusing on location of structures and connections.	❼ 	Synthesizing buildings, streets, corridors and natural systems. Integrating public spaces and nature into the city.

streets and walkways

stormwater management project_Copenhagen

Bishan park_Singapore

railway and
waterway

Buffalo Bayou Promenade_Houston

Green tram way_Rotterdam

parks and
open space

Westergasfabriek park _ Amsterdam

Olympic Sculpture Park _ Seattle, USA

urban design

Watersquare Benthemplein _ Rotterdam

HIGHLINE NY
James Corner
Diller Scofidio
+Renfro

thank you/
dank u wel!

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