SAFE AND ATTRACTIVE WATERPROOF CITIES
Nature based solutions for integrated urban water management
IHS Rotterdam Netherlands, June 2018
## Planning

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.00 – 10.00</td>
<td><strong>Presentation: principles and best practices</strong></td>
</tr>
<tr>
<td>10.00 – 10.15</td>
<td>Break</td>
</tr>
<tr>
<td>10.15 – 11.00</td>
<td><strong>Round 1:</strong></td>
</tr>
<tr>
<td></td>
<td>- Physical solutions (30 min.)</td>
</tr>
<tr>
<td></td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
</tr>
<tr>
<td>11.00 – 11.45</td>
<td><strong>Round 2:</strong></td>
</tr>
<tr>
<td></td>
<td>- Stakeholder identification, stakeholder involvement and value creation (30 min.)</td>
</tr>
<tr>
<td></td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
</tr>
<tr>
<td></td>
<td><strong>Wrap Up (15 min)</strong></td>
</tr>
</tbody>
</table>
ARCADIS at a Glance

Consultants, project managers and engineers

Focus on Water, Buildings / Urban, Infrastructure and Environment

Founded in 1888

More than 27,000 staff, +300 offices worldwide

Top 3 in Europe and top 10 worldwide

Business Lines

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>26%</td>
<td>19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment</th>
<th>Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>36%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Services

- Program & project management
- Consultancy
- Master planning & Architecture
- Design & Engineering
- Implementation
Urban flooding – a worldwide problem
BY 2050: 70% OF WORLD POPULATION WILL LIVE IN DELTA CITIES
Urban water positive:
Attractive and fun
Urban water negative: nuisance and danger
Asia/Pacific and European water challenges

- Flooding
- Water quality
- Excessive rainfall
- Levee breaks (drought)
- Inundated cellars
- Heat waves
Background and principles for flood safe and attractive cities
Climate change and water challenges

- Threats coming from 4 directions
  - Precipitation
  - Groundwater
  - River discharges
  - Sea level rise
  - Land subsidence
Think water cycle...
Think river bassin...
Think comprehensive...

- Physical solutions
- Legislative framework
- Stakeholder involvement
- Financial strategy
Integrated Water management – layer method

First think water, Then think urban

Layer approach
From bottom to top:
3. Buildings Level
2. Infrastructure
1. Water
• Flood risk assessment: develop blue green framework
Principles

Detain

Retain

Discharge
Safe and attractive cities

From principles to best practices
Use Nature: protect and restore natural protective landscapes such as mangroves and beaches.
Building with Nature

- Working with, instead of against the forces of Nature
- Strengthening the beaches & dunes with enhanced natural sedimentation
Building with nature: Sand Engine 2011-2017
Multi purpose flood protection

Function combinations: safe and attractive
DUTCH WATER GOVERNMENT

General democracy

Functional democracy

12 Provinces

National Government
(Ministry for Infrastructure & Environment)

390 Municipalities

23 Regional Water Authorities

10 Drinking Water companies

Public owned utilities

EU

Provinces

Regional Water Authorities

Municipalities
• Coastal Weak Links (Zwakke Schakels)
Comprehensive waterfront protection - case Scheveningen
The challenge: safety and quality combined

Safety
Risk management

Spatial quality
Economic vitality
Assessment 2003
Stakeholder engagement
Assessment options, preferred solution: Cross-section hybrid coastal defence “Dyke in dune”
• Scheveningen safe and attractive:

• Dyke in dune

• Reinforcement and Boulevard Development
Hybrid coastal defence Katwijk

Katwijk, The Netherlands

Design of new coastal defense in tourist area

Stakeholder involvement & Spatial planning

Project management

Assist Client in tender phase

Client Government/Waterboard

Year 2008-running

Amount 2.5 M€
Katwijk impressions after completion
Upgrade to hybrid solution: Hondsbosche en Pettemer Sea Defence

Transforming a dike into a landscape

Reinforcement plan coastal defence based on an integrated approach:

- Design
- Integration/ embedding in environment, landscaping
- Technical calculations
- Environmental impact assessment
- Permitting
Protecting lower Manhattan against hurricanes
Rebuilt by design – The Big U: landscaping, protection, infrastructure
Resilient critical infrastructure
NY temporary flood resiliency proofing

- NYC Telecom client downtown buildings temporary flood walls
Bellevue Hospital emergency department

• Elevated emergency department & critical infrastructure $280 million
Adaptive building
Adaptation: Floating housing
Adaptation: amphibic housing
Adaptation: Floating green houses
Rainproof, sponge cities

Maximize retention
Rotterdam
19 century Singel system
Functional and attractive
UNDERGROUND WATER STORAGE
UNDERGROUND WATER STORAGE
Water play grounds
Rotterdam
Dry weather
Water play grounds Rotterdam
Rain starts
Water play grounds Rotterdam
Heavy rain
Retention small scale, gardens and parks
Permeable paving for ground filtration
Wuhan Sponge City
Increased retention: Rotterdam Green Roofs Program
Increased retention: green roof as identity
Increase retention on regional scale:

Room for the River
River dikes and levees:
National rivers levees emergency act

- “Almost-floods” of 1993/1995
- Evacuation of 250,000 people
- Most of the emergency levee reinforcement works
- Room for the river, Meuse River works
Netherlands Room for the River Program
Nijmegen ‘Bottleneck’
Added Value with increased flow capacity
Building resilience creates value:
- Value for the public benefit
- Economic value which can finance resilient action
Taizhou Master Plan

Central lake: water retention and urban identity
武漢海綿市 Sponge City Wuhan
National & Local Climate Adaptation Program

Protect 12 million inhabitants subject to flooding and intense rainfall
Innovations to create more green public spaces to absorb storm water
More attractive and livable, managing 60 % of the rainwater
Rio Tiete Linear Parks Sao Paulo
Xinjin Chengdu Master Plan
Tidal city maximizes waterfronts along the river: water retention and urban identity
Xinjin Chengdu Master Plan, with MVRDV
Tidal city maximizes waterfronts along the river: water retention and urban identity
Partnerships are needed

“Every city has a different set of needs—but every city needs a Chief Resilience Officer. While ‘100 Resilient Cities’ is helping to hire the first 100, other cities don't have to wait.”

ROCKEFELLER FOUNDATION
Pro-bono technical expertise on request of UN-Habitat

2010-2017 : 75 Projects worldwide
Annual Shelter Academy
Sponsorship World Urban Campaign
Program locations 2010-2016

Shelter projects and workshops

Shelter workshops and Urban Thinkers Campuses
More information:
Facebook: https://www.facebook.com/ARCADISShelterProgram
SUMMARY OF PRINCIPLES
SUMMARY OF PRINCIPLES FOR COMPREHENSIVE SOLUTIONS: SAFE AND ATTRACTIVE

- LAYER APPROACH: FIRST THINK WATER THEN THINK URBAN
- DEVELOP BLUE GREEN FRAMEWORKS & STUDIES
- BUILD WITH NATURE
- SOFT SOLUTIONS WHERE POSSIBLE, HARD WHERE NECESSARY
- ROOM FOR THE RIVER
- ADAPTIVE SOLUTIONS IN FLOOD PRONE AREAS
- STAKEHOLDER INVOLVEMENT
- CREATE VALUE: FOR PUBLIC BENEFIT AND TO FINANCE RESILIENCE
Thank you
Interactive workshop
Case model city “Arcadia”

Arcadia City

• Flood prone area
• More then 20 typhoons per year
• Extreme storm in Nov 2016
• Washed away residential areas
• Over 320 casualties
Goals

• Personal Goals:
  • Learn different concepts for a sustainable, waterproof city
  • Develop the best coastal protection strategy

• General Goals:
  • Make the City of Arcadia an attractive and safe waterproof City
Location and different areas of Arcadia

• The North river Delta supplies sediments. Sea currents are mainly north to south. Has a diverse and resilient vegetation.

• People have indicated the coastline between the city and the North river suffers from erosion; 100-200m of land has been lost in 40 years time. It is a sandy coastline with no protection.

• The Business district and airport are located on the north-west peninsula, for now protected by sea walls and groins. However they have been damaged at a number of locations and need to be repaired.

• Port area: the port is sheltered behind the peninsula, but needs regular dredging because of heavy sediment inflow.

• Arcadia Central is an important tourist hub that acts like a basis to enjoy the surrounding area. However after the disastrous typhoon, tourism is low.

• Most of the settlements are located along the coast line at terrains at levels above the high watermark, experiencing no flooding other than during the typhoon.

• In general people don’t want to relocate since alternative housing is not available for everyone or is not providing livelihood alternatives.

• Mangroves and seagrass areas and beach forest provides valuable environmental, but ecologically sensitive areas, that are important production and nursery areas for valuable fish species and non-vertebrate species (crustaceans, bi-valves etc) and thereby contributing to the livelihood of the local fishing communities. Most of the mangroves are insufficiently managed and in a less than optimal condition. A condition that calls for improved protection.
## Workshop Planning

<table>
<thead>
<tr>
<th>Time</th>
<th>Round 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.15 – 11.00</td>
<td>- Physical solutions (30 min.)</td>
</tr>
<tr>
<td></td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Round 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.00 – 11.45</td>
<td>- Stakeholder identification, stakeholder involvement, capacity building and value creation (30 min.)</td>
</tr>
<tr>
<td></td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Wrap – up</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.45 – 12.00</td>
<td></td>
</tr>
</tbody>
</table>
Round 1: Physical solutions

*Drawing the map: 30 min.*  
*Presentation of the main conclusions (by using the map): 5 min.*

- Draw a map with physical solutions for the city of Arcadia  
- Please use the concepts for a sustainable and waterproof city  
- Indicate where and how you would use those concepts  
- Use the map of Arcadia
Round 2: Stakeholder identification, stakeholder involvement and value creation and capacity building

*Rounds each 10 min.*

**Round 2A**
- Identify the main stakeholders at a national, regional and local level
- Discuss what and how their involvement should

**Round 2B**
- Identify opportunities to increase value and attract financial resources
- Look at the identified stakeholders

**Round 2C**
Develop a capacity building program for the short, medium and long term. Please think of which capacities are needed for whom and how these can be developed.
Arcadia City
- Flood prone area
- More than 20 typhoons per year
- Extreme storm in Nov 2016
- Washed away residential areas
- Over 320 casualties
Goals

- Personal Goals:
  - Learn different concepts for a sustainable, waterproof city
  - Develop the best coastal protection strategy

- General Goals:
  - Make the City of Arcadia an attractive and safe waterproof City
Location and different areas of Arcadia

The North river Delta supplies sediments. Sea currents are mainly north to south. Has a diverse and resilient vegetation.

People have indicated the coastline between the city and the North river suffers from erosion; 100-200m of land has been lost in 40 years time. It is a sandy coastline with no protection.

The Business district and airport are located on the north-west peninsula, for now protected by sea walls and groins. However they have been damaged at a number of locations and need to be repaired.

Port area: the port is sheltered behind the peninsula, but needs regular dredging because of heavy sediment inflow.

Arcadia Central is an important tourist hub that acts like a basis to enjoy the surrounding area. However after the disastrous typhoon, tourism is low.

Most of the settlements are located along the coast line at terrains at levels above the high watermark, experiencing no flooding other than during the typhoon.

In general people don’t want to relocate since alternative housing is not available for everyone or is not providing livelihood alternatives.

Mangroves and seagrass areas and beach forest provides valuable environmental, but ecologically sensitive areas, that are important production and nursery areas for valuable fish species and non-vertebrate species (crustaceans, bi-valves etc) and thereby contributing to the livelihood of the local fishing communities. Most of the mangroves are insufficiently managed and in a less than optimal condition. A condition that calls for improved protection.
# Workshop Planning

<table>
<thead>
<tr>
<th>Time</th>
<th>Round 1:</th>
<th>Round 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.45 – 11.30</td>
<td>- Physical solutions (30 min.)</td>
<td>- Stakeholder identification, stakeholder involvement and value creation (30 min.)</td>
</tr>
<tr>
<td></td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
<td>- Plenary presentations of main conclusions (15 min.)</td>
</tr>
<tr>
<td>11.30 – 12.15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Round 1: Physical solutions

Drawing the map: 30 min.
Presentation of the main conclusions (by using the map): 5 min.

- Draw a map with physical solutions for the city of Arcadia
- Please use the concepts for a sustainable and waterproof city: search for integrated solutions which add to a creative city, building with nature, soft and flexible solutions, adaptive solutions
- Indicate where and how you would use those concepts
- Use the map of Arcadia
Round 2A: Stakeholder identification, stakeholder involvement
Round 2B: finance and value creation

The second round is divided into two parts: Round 2A and Round 2B.

Rounds 2A and 2B each 15 min.
Presentation of the main conclusions: 5 min.

Round 2A
- Identify the main stakeholders at a national, regional and local level
- Discuss what and how their involvement should

Round 2B
- Identify opportunities to increase value and attract financial resources
- Look at the identified stakeholders