

SUSTAINABLE COASTAL & DELTA ZONE DEVELOPMENT

Integrated Coast & Delta Policy via Building with Nature[®] & Aquapuncture[©]



$(\alpha + \beta + \gamma)$ knowledge
+ action $\rightarrow \Delta_{\text{sustainable}}$



Delft University of Technology
Civil Engineering & Applied GeoScience

2020



SUSTAINABLE FUTURE OF INLAND WATERWAYS



AQUAPUNCTURE©

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WCC – 2016
Inverness
2019





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SUSTAINABLE FUTURE OF INLAND WATERWAYS

**Stimulating the Blue Green Economy
for
Regional, Socio-Economic &
Spatial Development,
while safeguarding
Safety, Navigability as well as
Environmental Values & Nature**

AQUAPUNCTURE®

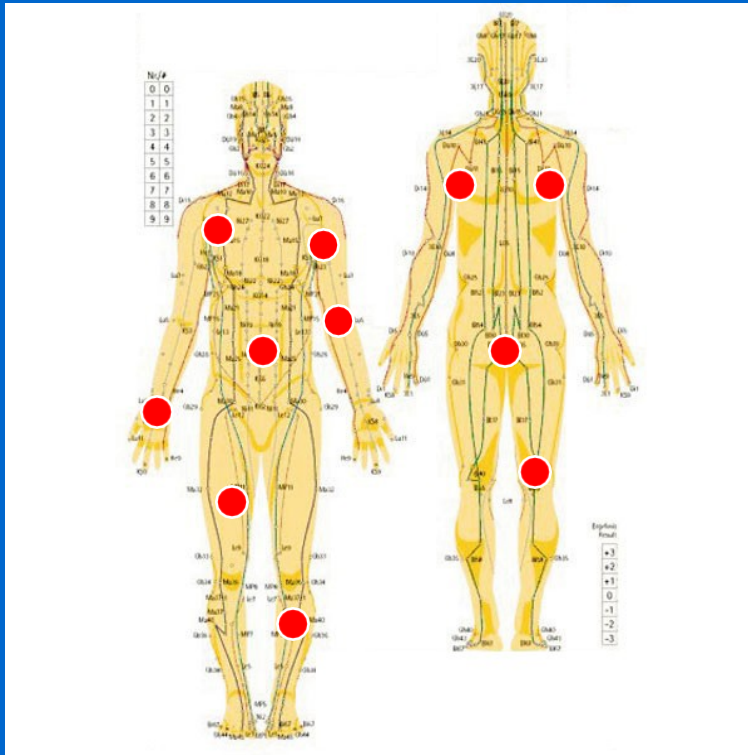
Introduction of AQUAPUNCTURE®

**Optimal use, adaptation, experience and
management of inland waterways and
their waterfronts**

**for safety against flooding, water storage,
water level regulation, water quality,
navigability, economy, employment,
environment and nature-landscape**

ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs

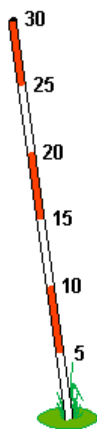


AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts

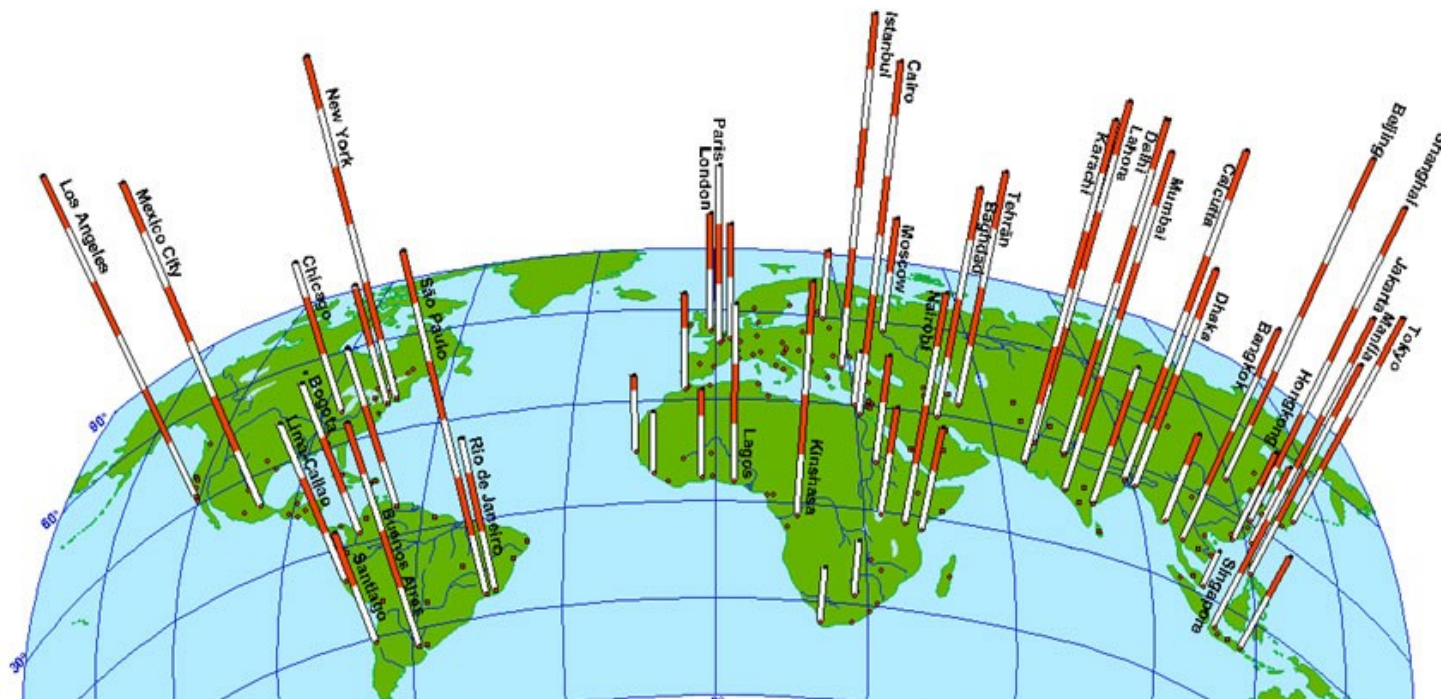
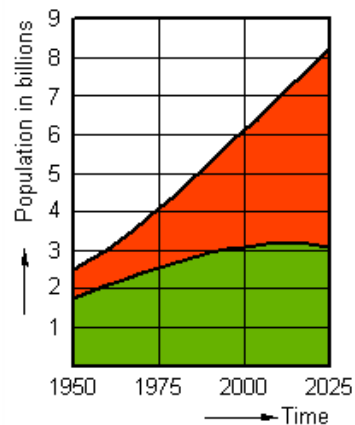


Number of inhabitants
in millions



major city (more than
1 million inhabitants)

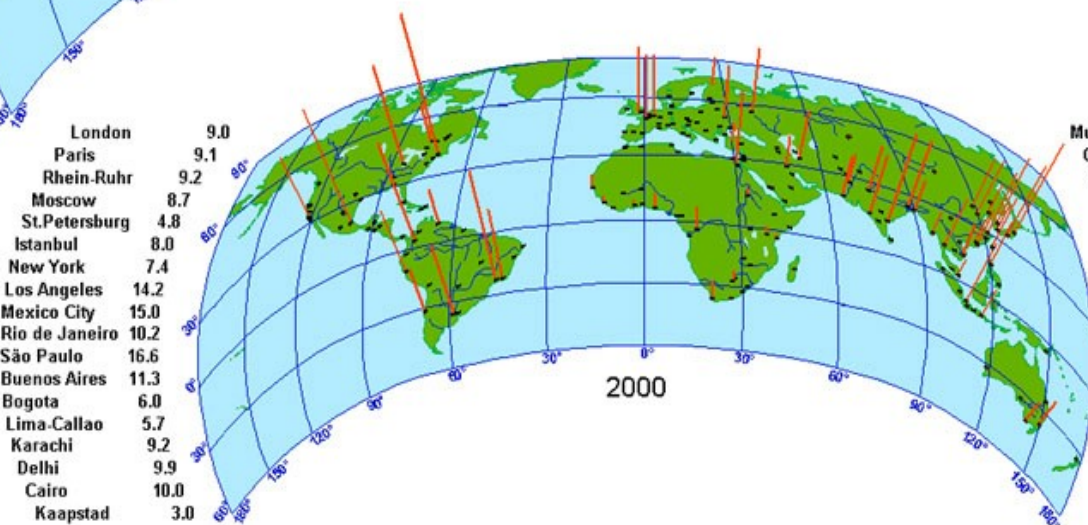
Growth of World Population
in urban (red) and rural (green)
areas in billions



About 80 % of the major cities
can be found in coastal
and deltaic areas

2025

A large part of the remaining
20% can be found upstream
along rivers, lakes & canals



London	9.1
Paris	9.2
Rhein-Ruhr	8.7
Moscow	8.0
St. Petersburg	7.4
Istanbul	15.0
New York	10.2
Los Angeles	16.6
Mexico City	11.3
Rio de Janeiro	6.0
São Paulo	5.7
Buenos Aires	9.2
Bogotá	9.9
Lima-Callao	10.0
Karachi	3.0
Delhi	9.1
Cairo	9.2
Kaapstad	3.0

Mumbai	10.0
Chennai	5.9
Calcutta	11.7
Dhaka	6.1
Bangkok	5.6
Singapore	3.1
Ho Chi Minh	3.5
Beijing	7.0
Tianjin	8.5
Hongkong	6.9
Shanghai	8.2
Guangzhou	3.1
Seoul	10.2
Pusan	3.2
Jakarta	9.3
Manila	8.6
Tokyo	11.9
Osaka - Kobe	8.6

SUSTAINABLE COASTAL ZONE DEVELOPMENT

About 80% of
the major cities
can be found in
coast and delta areas

Building with Nature[®]

Aquapuncture

A large part of
the remaining 20%
can be found upstream
along rivers, lakes & canals

Aquapuncture[©]

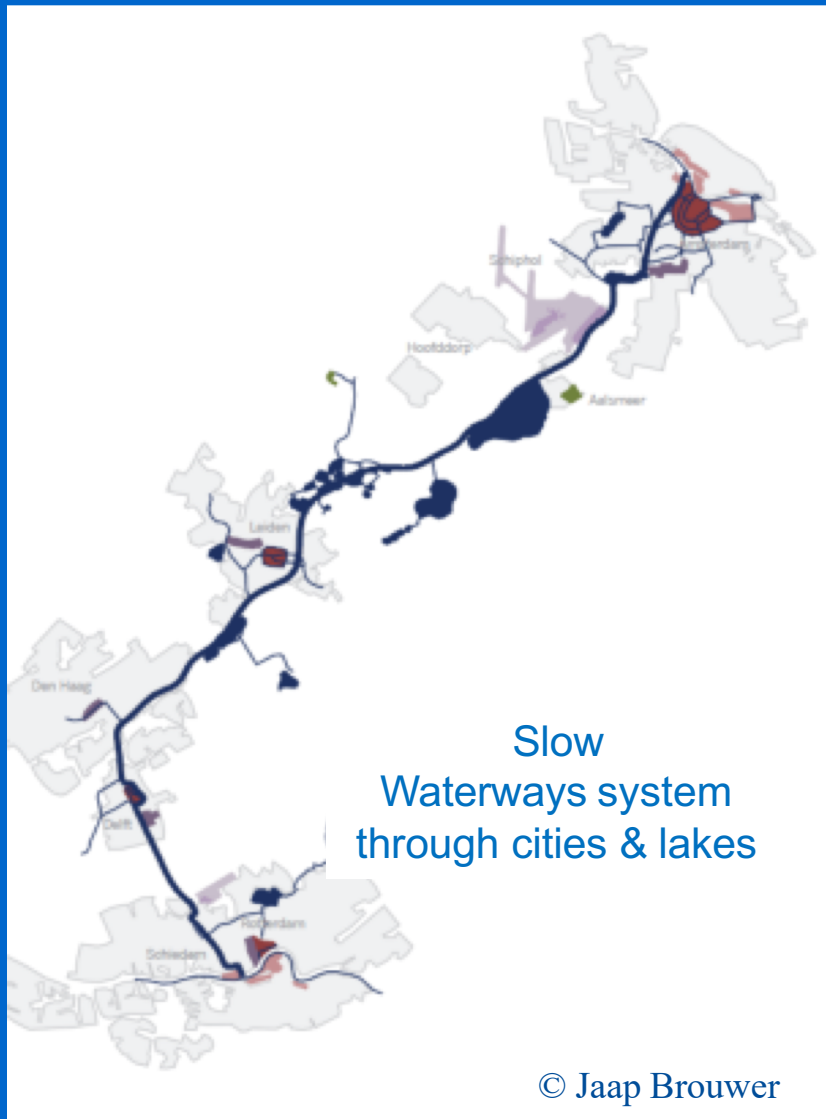
Building with Nature

In these densely populated areas there is little space available for living, working, infrastructure, recreation & tourism, and at the same time there is the need to preserve or expand valuable environment, nature and landscape.

European Inland Waterways



AQUAPUNCTURE OF INLAND WATERWAYS

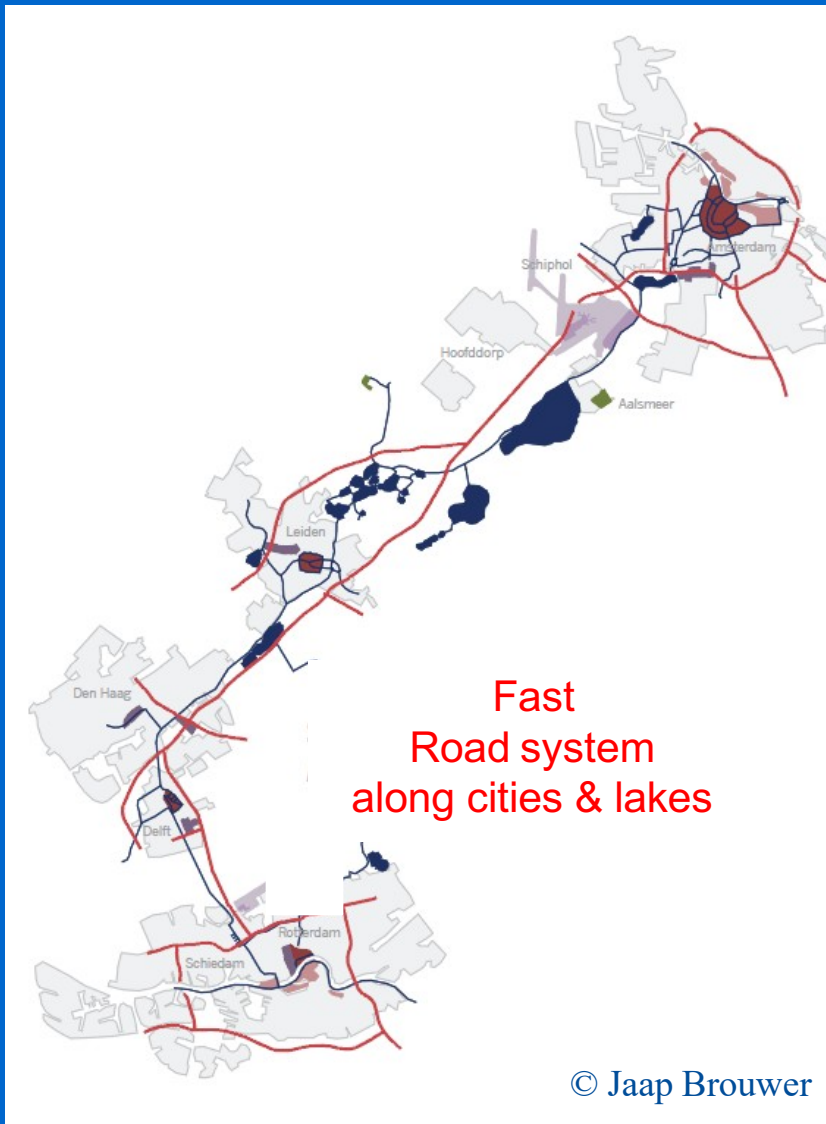


Waterways were always a focal point for settlements & economic activities.

We used to have the slow waterway system through cities & lakes.

Waterways were used for everything from drinking water supply, beer production, fishing, transport of persons & goods (a.o. coal, oil, peat, straw, sand, gravel, manure, fruit, vegetables, milk), defence, but also as open sewer.

AQUAPUNCTURE OF INLAND WATERWAYS

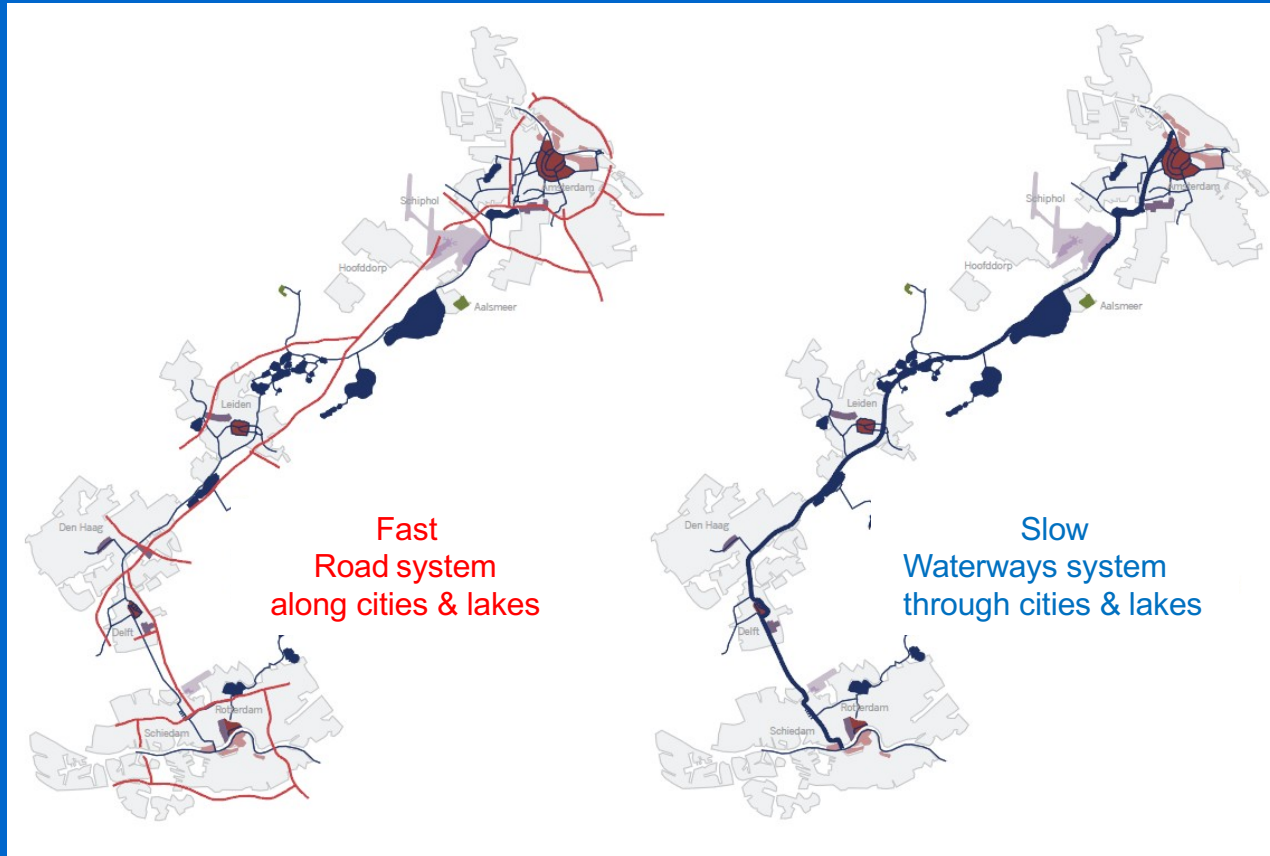


After the fast railway system came the fast road transport system along cities & lakes.

The waterway system became to a certain extent obsolete and its main function was taken over by the faster road system.

The spatial relation between the waterway and urban development became neglected.

AQUAPUNCTURE OF INLAND WATERWAYS



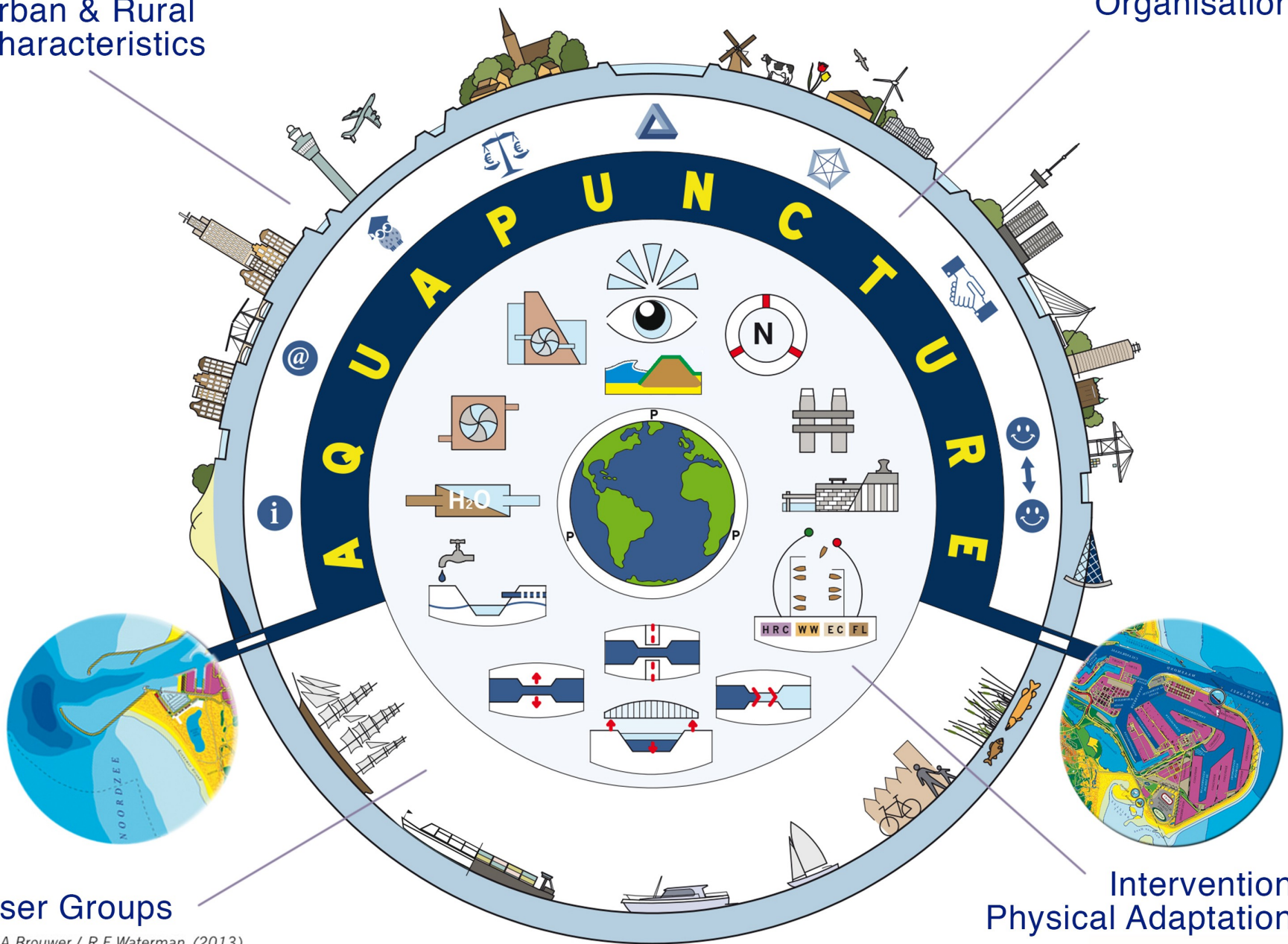
Now we are once again fully aware of the significance of this unique relation between the waterways and the adjacent urban & rural habitats.

Therefore we want to rediscover and revitalise the waterway network through

AQUAPUNCTURE[©]

Urban & Rural
Characteristics

Organisation

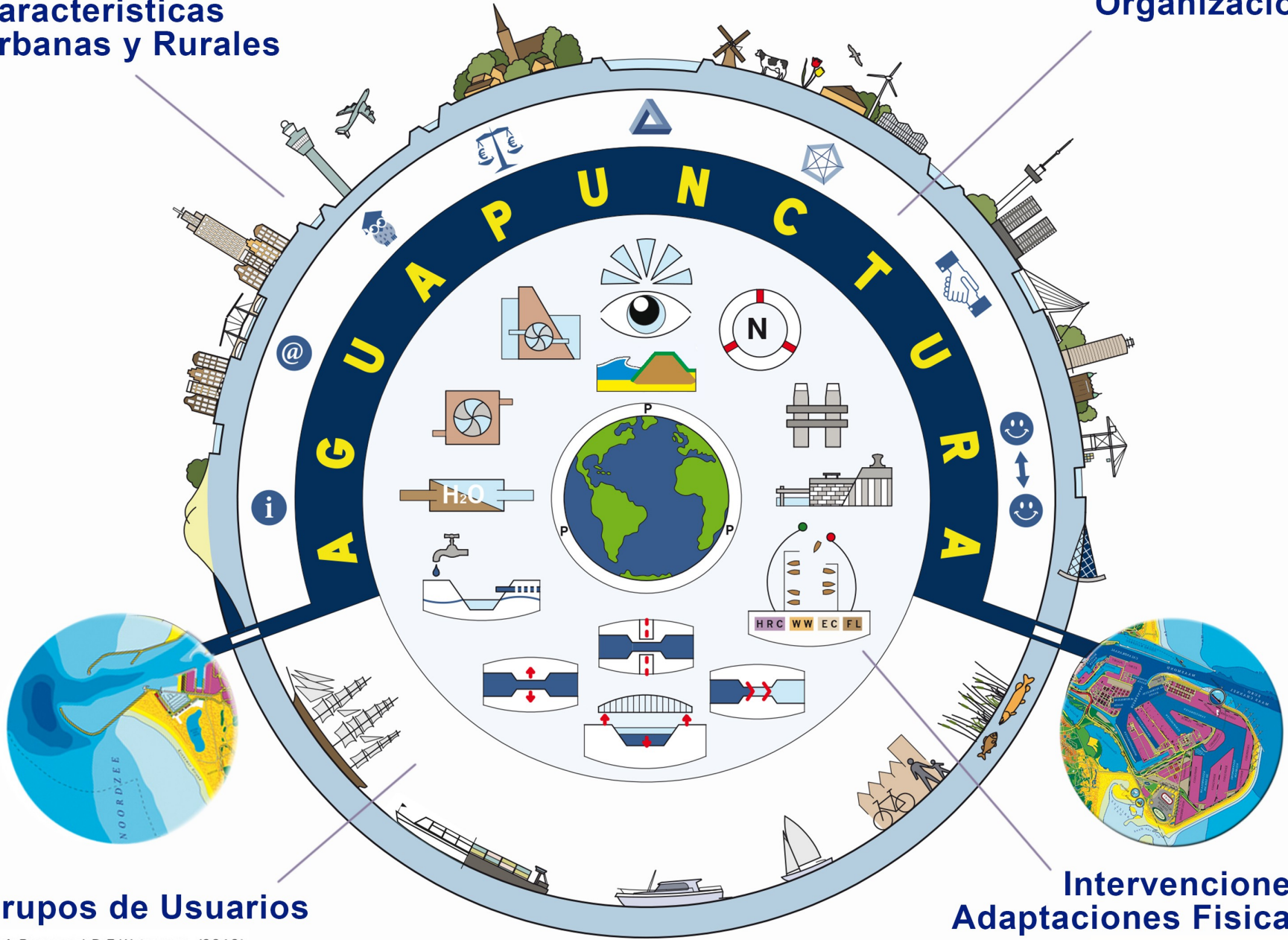


User Groups

Interventions
Physical Adaptations

**Características
Urbanas y Rurales**

Organización

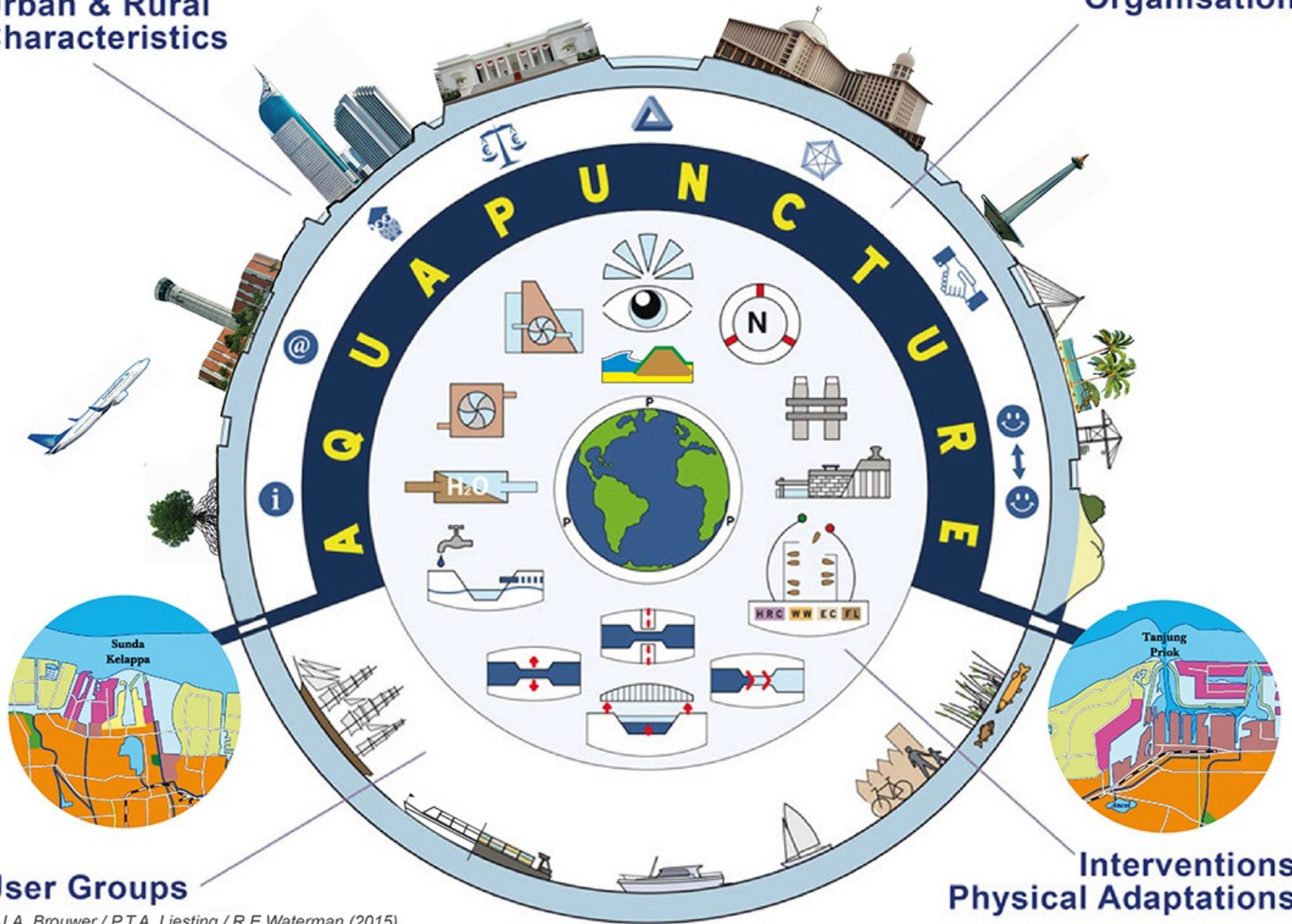


Grupos de Usuarios

**Intervenciones
Adaptaciones Físicas**

Urban & Rural
Characteristics

Organisation



Urban & Rural Characteristics along the Waterways

Connection Inland Waterway with Seaport Marina & Nature Reserve Areas via Building with Nature[©]

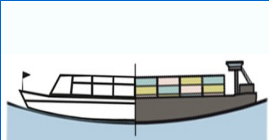
- 1 Soft Coastal Defense
- 2 City
- 3 Village
- 4 Culture & History
- 5 Farms, Agriculture, Horticulture, Nature
- 6 Modern City & Port
- 7 Strong Coastal Defence

Connection Inland Waterway with Mainport Development & Nature Reserve Area via Building with Nature[©]





User Groups in and along the Waterways



Commercial Shipping



Tourism & Recreation



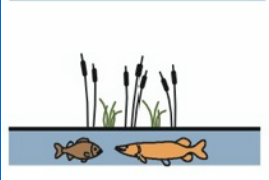
Special Nautical Events



Water Related Sports



Waterfront Users & Developers

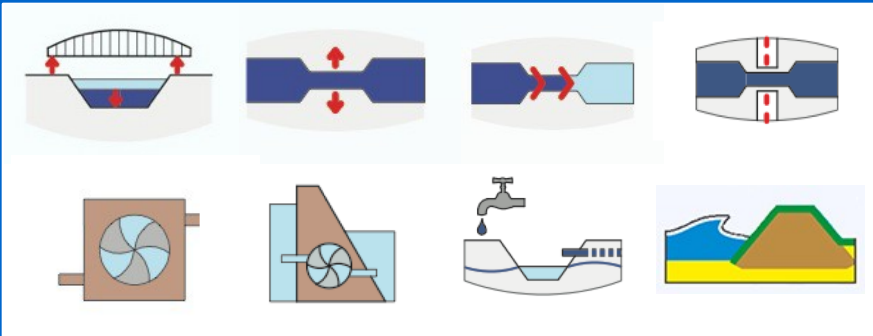


Aquatic / Terrestrial Flora & Fauna

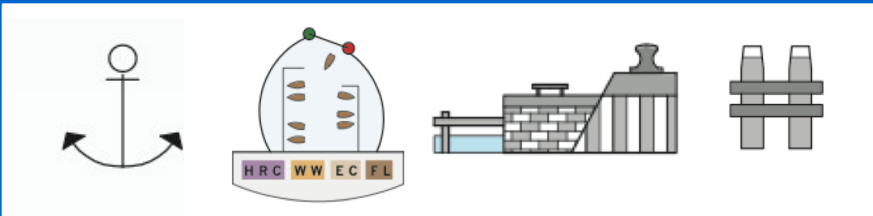


Physical Adaptations - Interventions

Physical Adaptations



Realisation of Facilities



Safety including Nautical Safety

Enhancing Spatial Qualities



Measures for improving Safety & Environment Mitigating measures with regard to Climate Change



Water use for
Agriculture
Aquaculture
Drinking Water
Cooling & Process Water
Energy
Transport
Water Level Control

Organisation for Waterway & Waterfront Development



Stakeholder Participation



Public & Private Partnership



Societal Costs & Benefits



Cooperation with 5 levels of Government



Trias Politica: Legislative / Judicial / Executive Power



Knowledge & Education

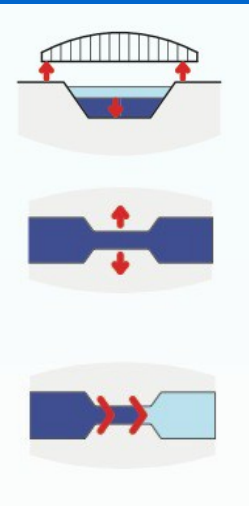
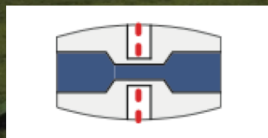
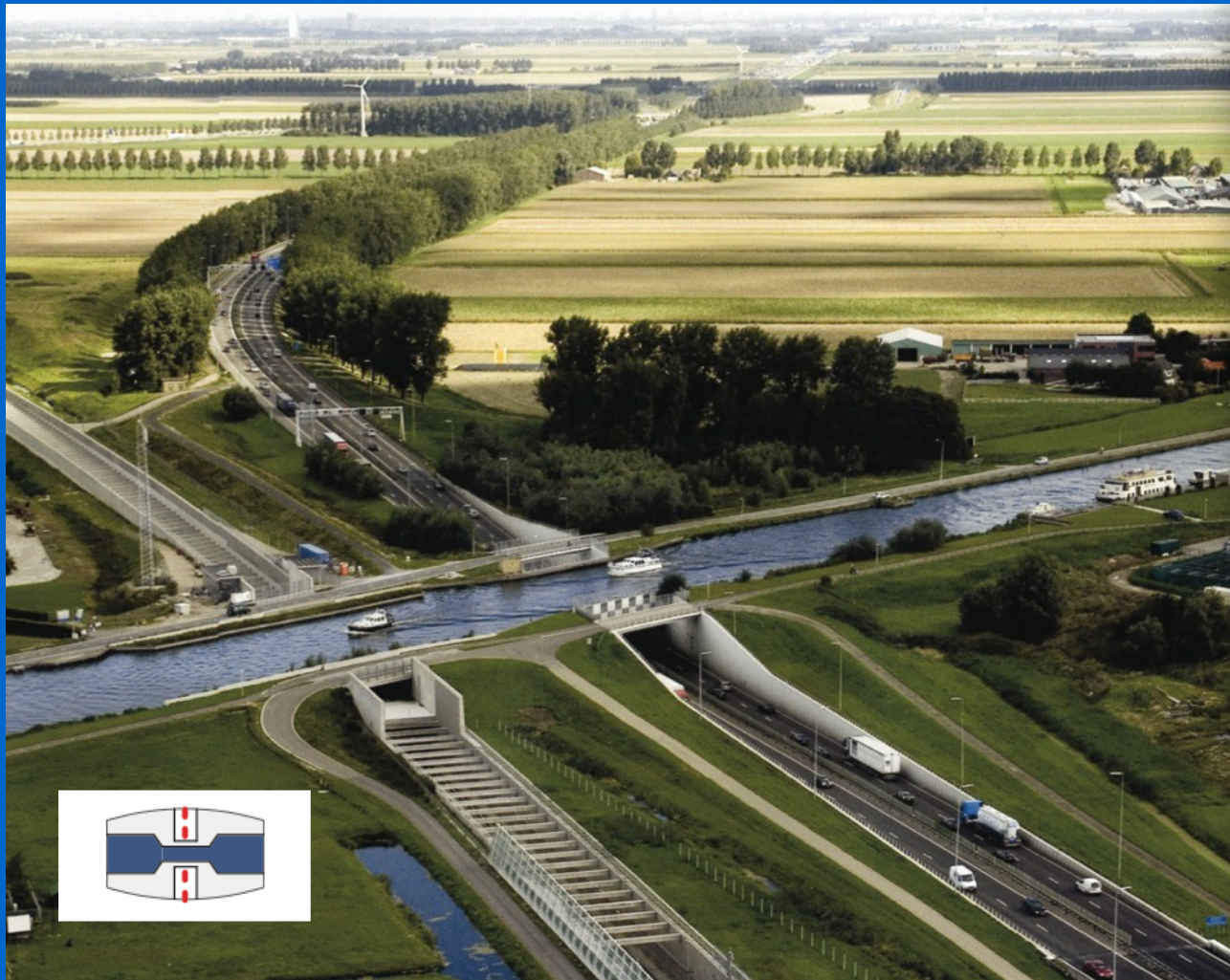


Information, Awareness, Promotion



Communication Tools (e.g. Internet & Apps)

Physical Adaptations - Interventions

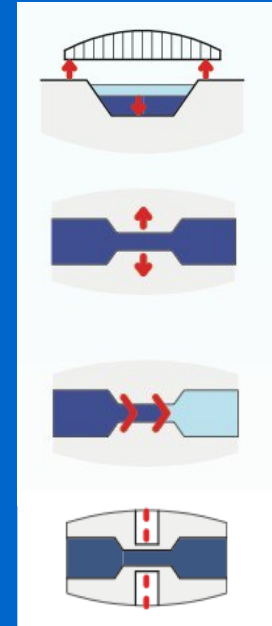


Height bridges
above water
surface

Depth waterway
through
environment-
friendly dredging

Enlarging sluice
/shiplock capacity

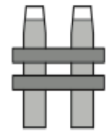
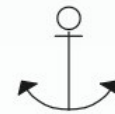
Physical Adaptations - Interventions



Urban
development
with connecting
waterways

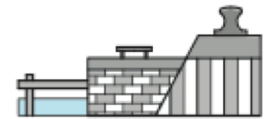
Boat conveyor

Realisation of Facilities

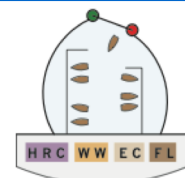


Moorings

Berths with facilities



**Jetties, Quay walls,
Loading/Unloading
Platforms
Container Terminals**



Yachting harbour

Safety including Nautical Safety



**Safety against
Flooding**



Nautical Safety

Enhancing Spatial Qualities



Enhancing
blue-green
spatial qualities of
rural & urban areas

Enhancing Spatial Qualities



▲ Amsterdam

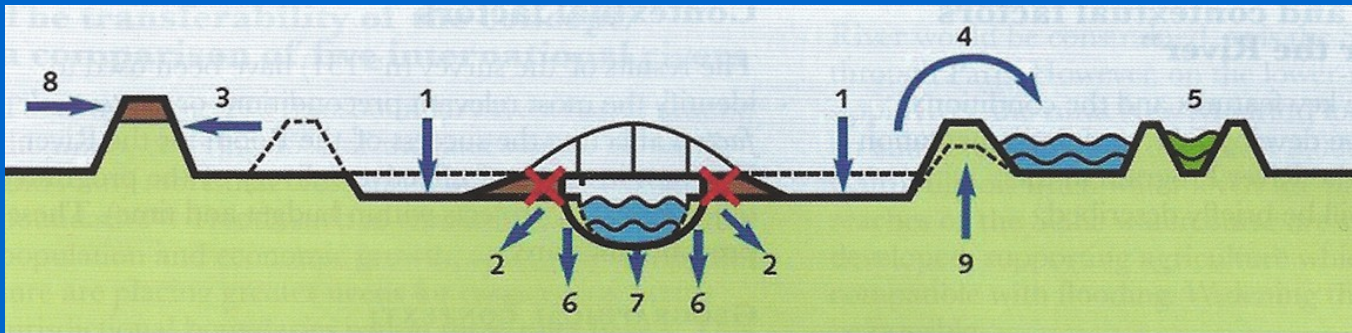
▼ Rotterdam



City meets
blue-green
landscape



Mitigating measures with regard to Climate Change



- 1 Lowering of floodplains
- 2 Removal of obstacles
- 3 Dyke relocation

- 4 Water retention and storage
- 5 By-pass
- 6 Height reduction of groynes

- 7 Deepening of summer bed
- 8 Heightening of dykes
- 9 Dyke improvement



Room for
the River

Calamity Storage

Retention Basins

Flood Prevention

Measures for Improving the Environment



**Waste Water
Emission
Prevention**

**Waste Water
Purification**

**Water Framework
Directive**

-
-
-

Societal Costs & Benefits Analysis

For the physical adaptations / interventions in and along the waterways initial investments are necessary. These are followed in a later stage by revenues of various types and from various sources.

- **WATER QUANTITY REVENUES**

flood prevention, surface- & ground water regulation, drainage, irrigation for agriculture, drinking water supply, cooling water, process water, water flow, thermal & osmotic energy

- **WATER QUALITY REVENUES**

water quality: beneficial to environment, nature & health

- **NAVIGABILITY REVENUES**

transport of persons and goods, water related sports, tourism & recreation

- **WATERFRONT ATTRACTION REVENUES**

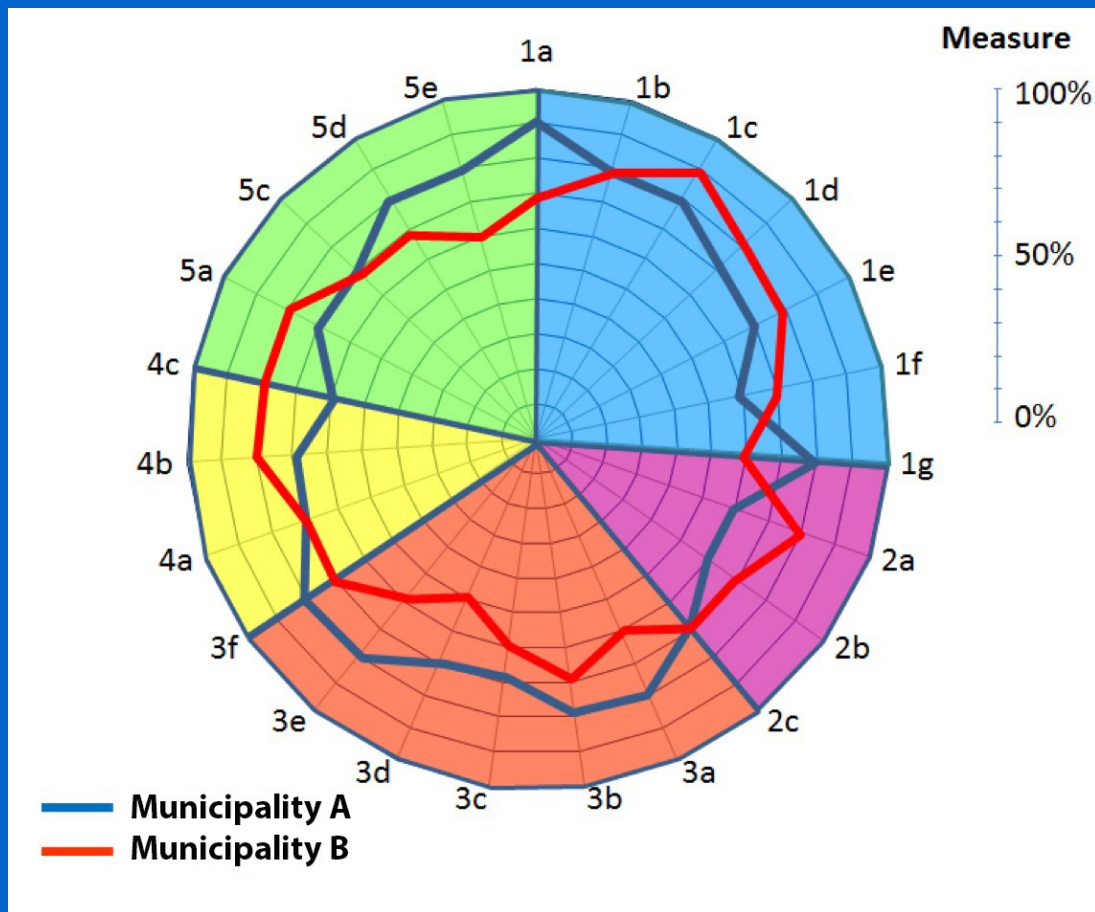
increased liveability, economic activities and increased value of property

- **SPATIAL QUALITY REVENUES**

improved urban & rural environment, preservation & restoration of cultural heritage, attractive residential areas, leisure parks, sustainable industrial parks; overall sustainability also with regard to climate & climate change

Values	Objectives
1. Water quantity	a) Ensure flood protection b) Surface water & ground water regulation c) Drainage, irrigation for agriculture & aquaculture d) Drinking water supply e) Cooling water f) Process water g) Water flow, thermal, osmotic energy
2. Water quality	a) Improvement of water quality for environment b) Improvement of water quality for nature c) Improvement of water quality for health
3. Navigability	a) Commercial transport of persons b) Commercial transport of goods c) Tourism and recreation d) Special events on/at water e) Water related sports f) Waterway classification & connectivity
4. Water front revenues	a) Increased liveability b) Economic activities c) Increased value of property
5. Spatial quality revenues	a) Improved urban & rural environment b) Preservation & restoration of cultural heritage c) Attractive residential & business areas d) Leisure parks, sustainable industrial parks e) Overall sustainability, also with regard to climate & climate change

Aquapuncture - Shared Value: Societal Costs & Benefits Measurement Model





Regional Waterway System



Objective: Sustainable Environment for Living & Working

Utilization & Improvement
Inland Waterways

Socio-Economic & Spatial
Development

Preservation & Development
Environment & Nature

Climate Change
Adaptation

Aspects

Navigational
Routes
(bottleneck analysis)

Waterway
Facilities

Spatial
Quality

Cultural
Heritage

Environment
&
Nature

Climate

Users

Commercial
Shipping

Touristic &
Recreational
Boating

Watersports

Waterfront
Developers & Users

Special
Nautical
Events

Flora & Fauna
Micro-organisms

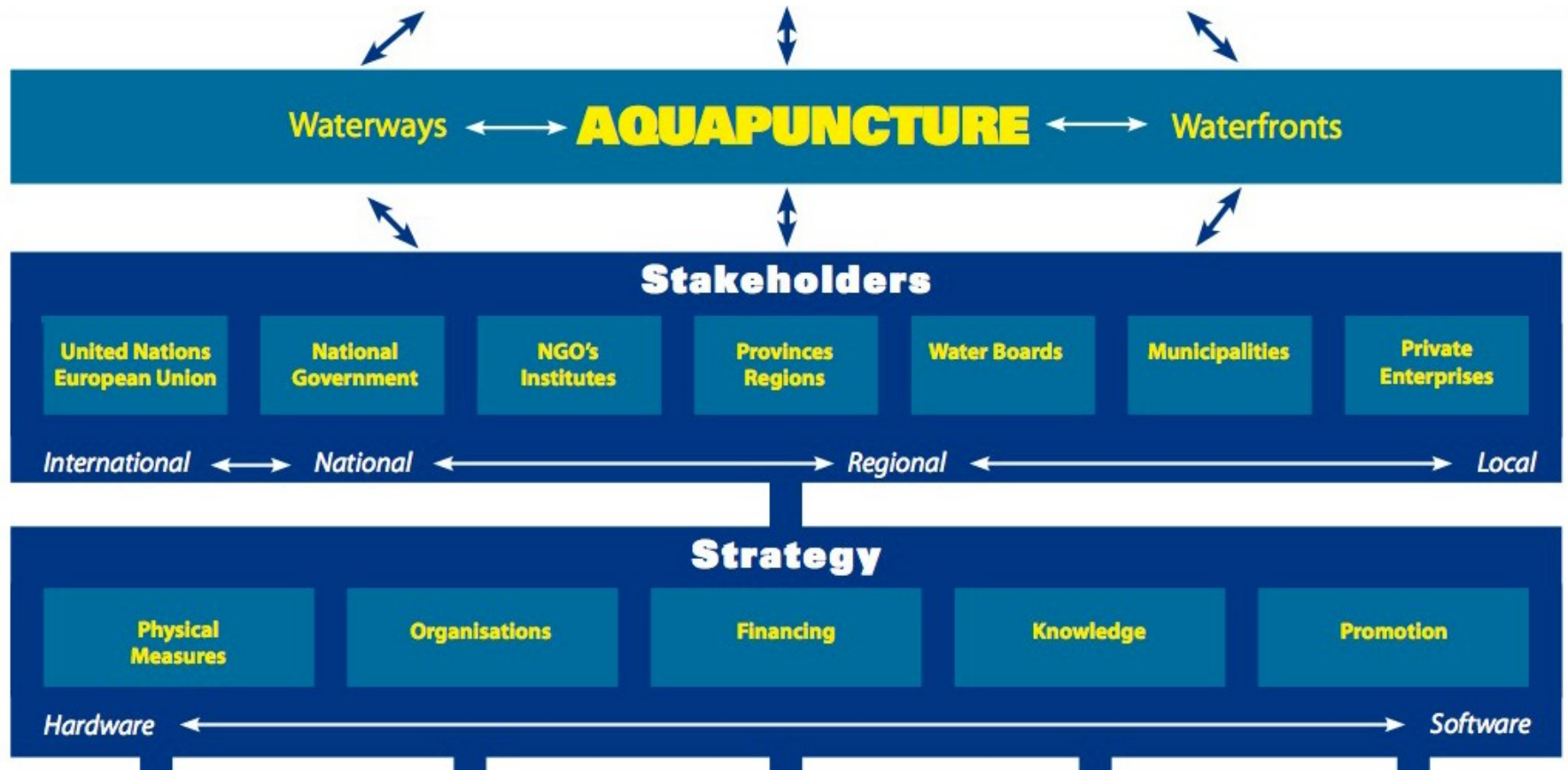
On water

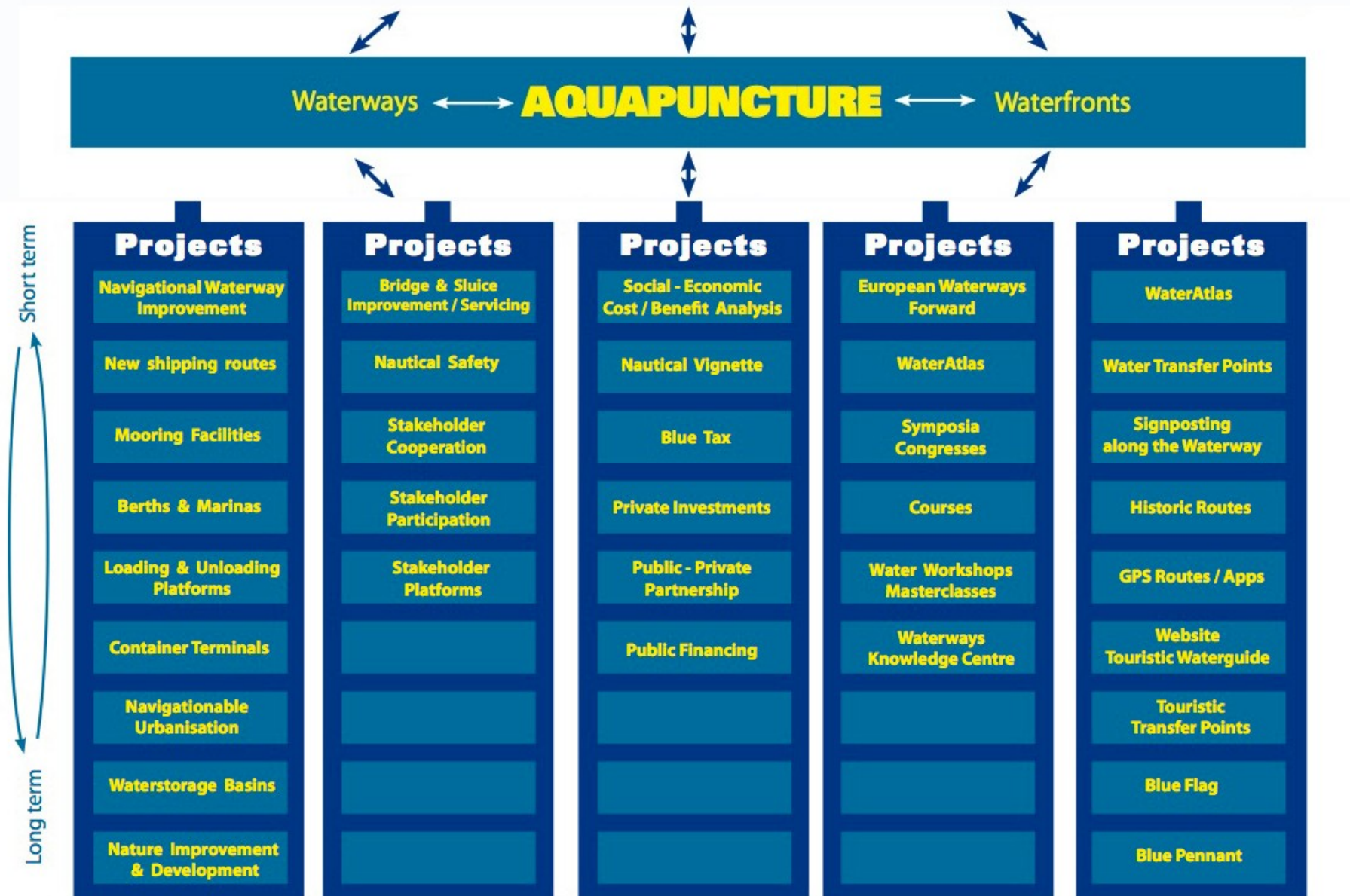
Along / in the water

Waterways

AQUAPUNCTURE

Waterfronts

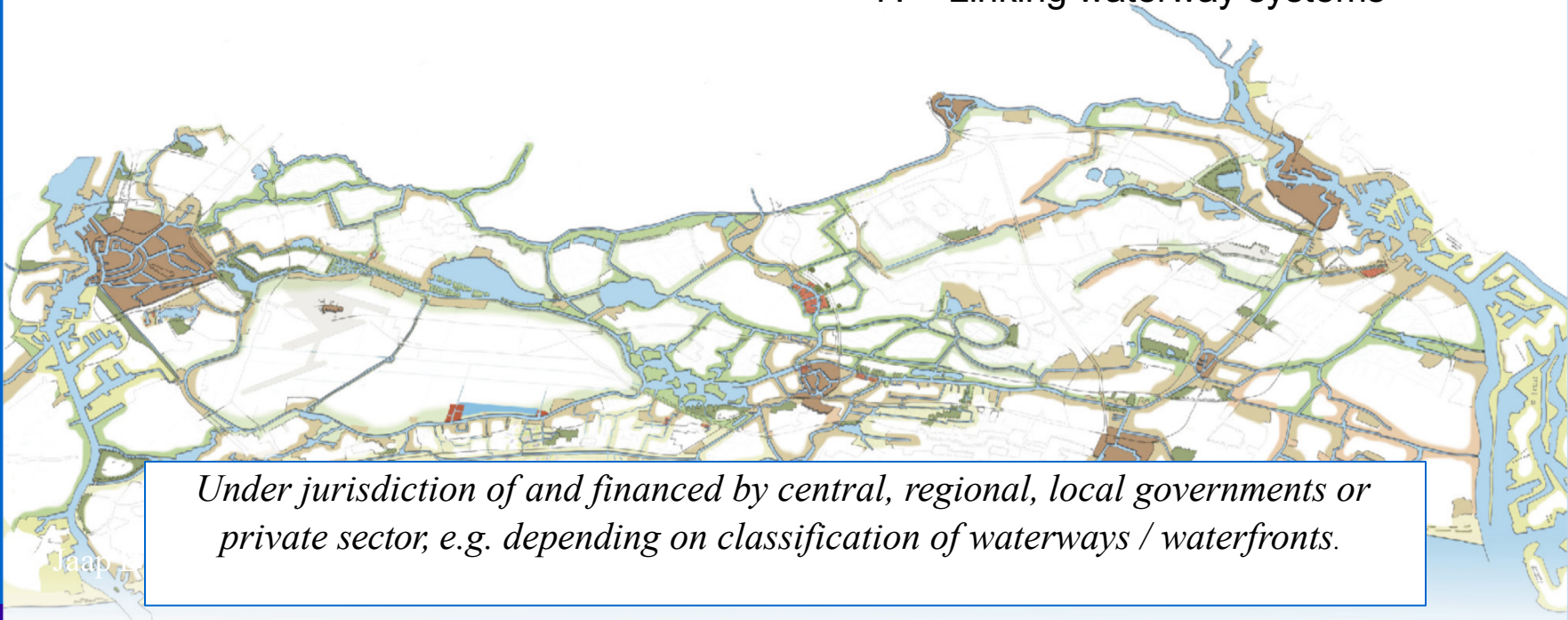




UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Adaptation of the waterways

1. Adaptation of height under bridges
2. Expanding sluice/shiplock capacity
3. Increasing depth through environment-friendly dredging methods
4. Waterway widening
5. River & canal bank adaptation
6. Waterlevel regulation
7. Linking waterway systems

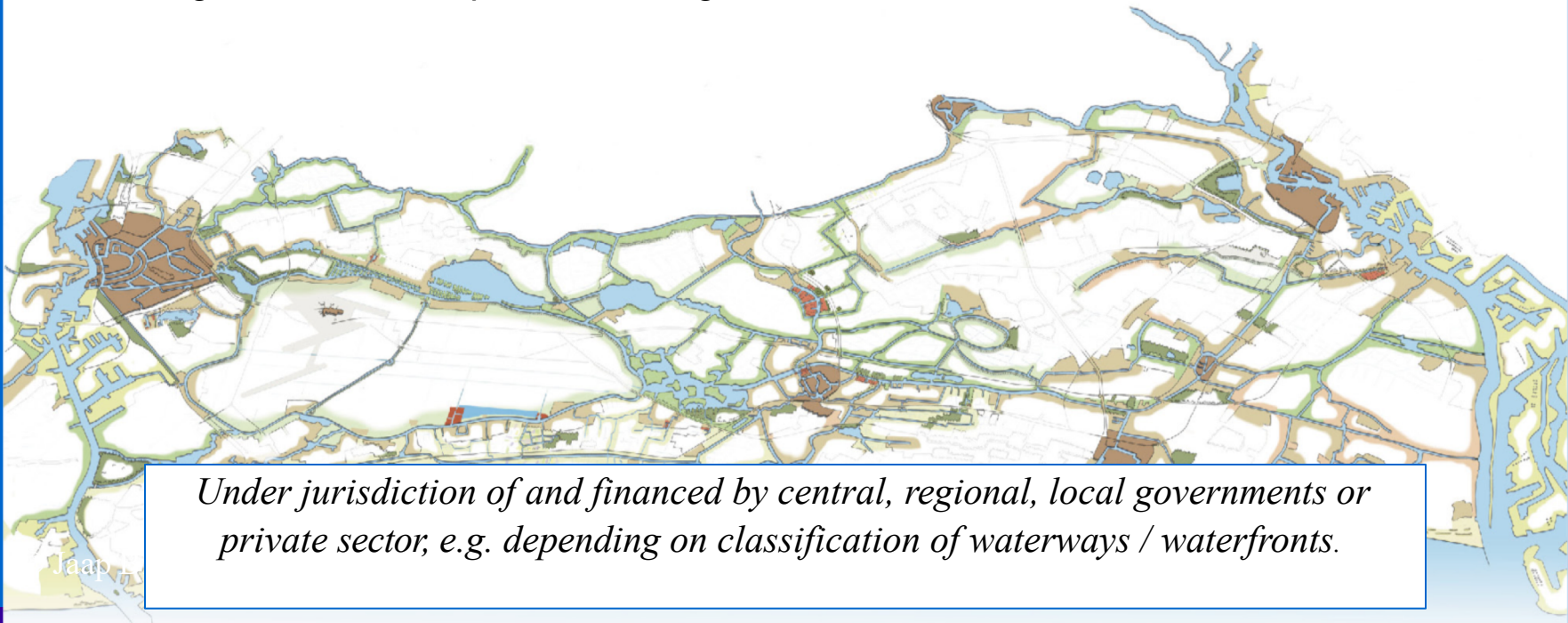


Under jurisdiction of and financed by central, regional, local governments or private sector, e.g. depending on classification of waterways / waterfronts.

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Waterway facilities

1. Introduction of berths, marinas with facilities & bollards for mooring
2. Introduction of quay walls, loading/unloading platforms & inland container terminals
3. Bridge and sluice/shiplock servicing

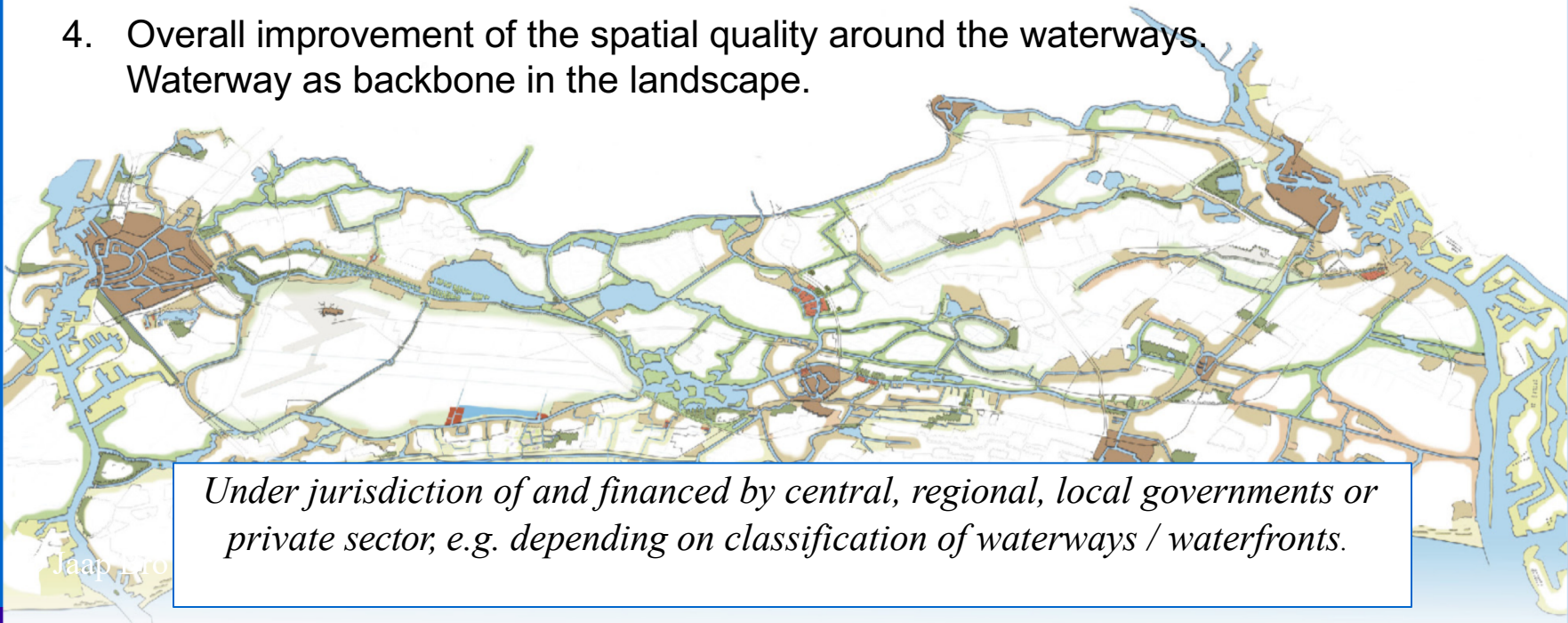


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UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

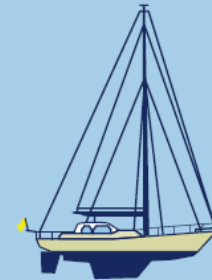
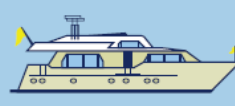
Waterfront facilities

1. Cycle- & footpaths, parking space along the waterway
2. Maintaining & restoring & purposeful using cultural heritage values in and along the waterway
3. Introduction of hotel, restaurant, café/pub facilities, museums, water related shops, leisure parks along the waterway
4. Overall improvement of the spatial quality around the waterways.
Waterway as backbone in the landscape.



Under jurisdiction of and financed by central, regional, local governments or private sector, e.g. depending on classification of waterways / waterfronts.

Recreational Navigation Classification



DESIGNATION	OPEN BOAT	CABIN CRUISER	MOTOR YACHT	SAILING BOAT	MOTOR BARGE
CLASS	RA	RB	RC	RD	I
MAX . LENGTH (M)	5.5	9.5	15.0	15.0	38.5
MAX. BEAM (M)	2.0	3.0	4.0	4.0	5.05
DRAUGHT (M)	0.5	1.0	1.5	2.0	1.8 – 2.2
MIN. HEIGHT UNDER BRIDGES (M)	2.0	3.25	4.0	30.0	4.0

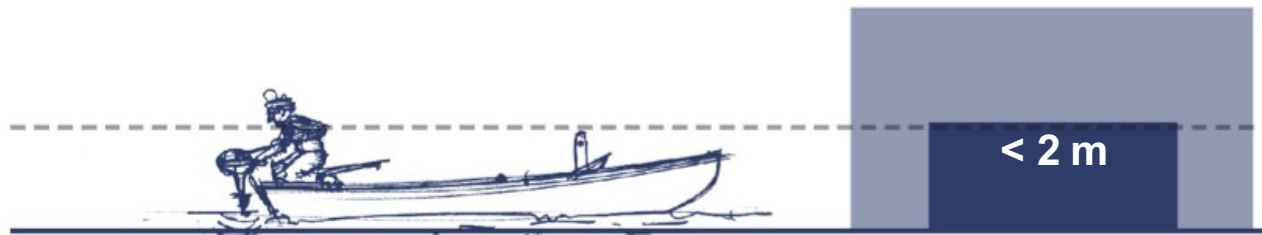
AQUAPUNCTURE OF INLAND WATERWAYS



Cruiser



Barge / Boat / Dinghy



BM / Rowing boat / canoe

Waterway classification is a.o. depending on the height of the bridges above the water surface and waterway dredging depth

AQUAPUNCTURE OF INLAND WATERWAYS

Staande Mast



3,5 tot 5 m



2,4 tot 3,5 m



2 tot 2,4 m



1 tot 2 m



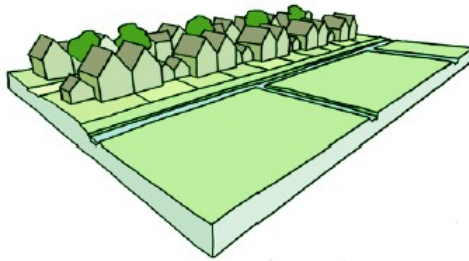
0 tot 1 m



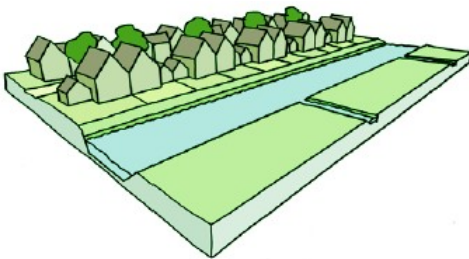
**Not only to
improve but
also to extend
the waterway
system**

© Jaap Brouwer

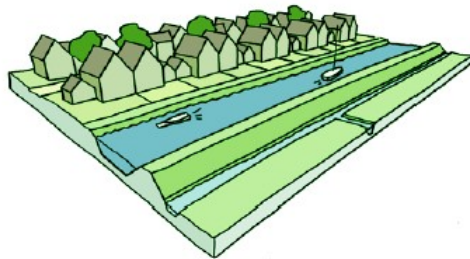
AQUAPUNCTURE OF INLAND WATERWAYS



Revenue = € X



Revenue = € X + 15,000

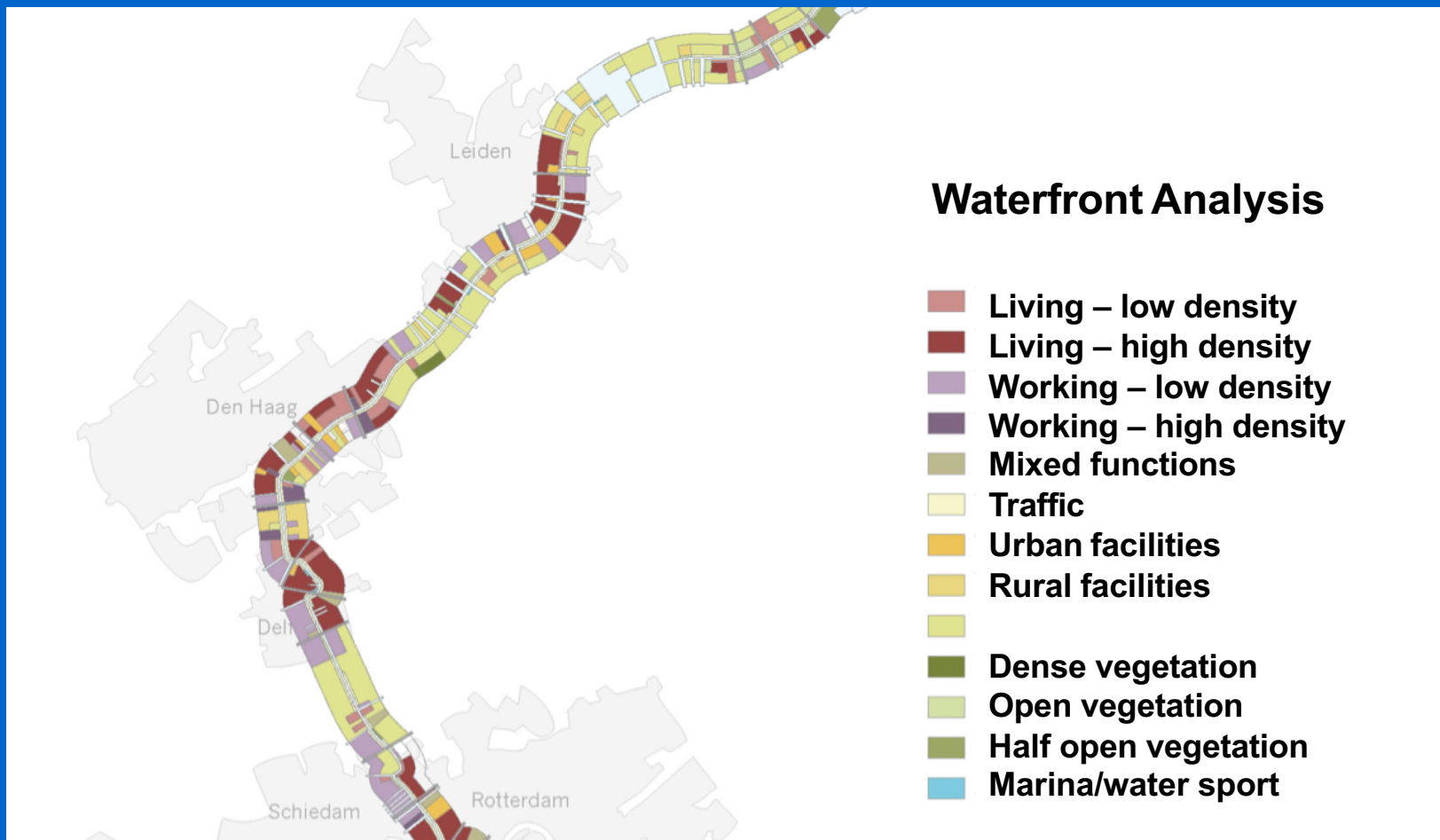


Revenue = € X + 40,000

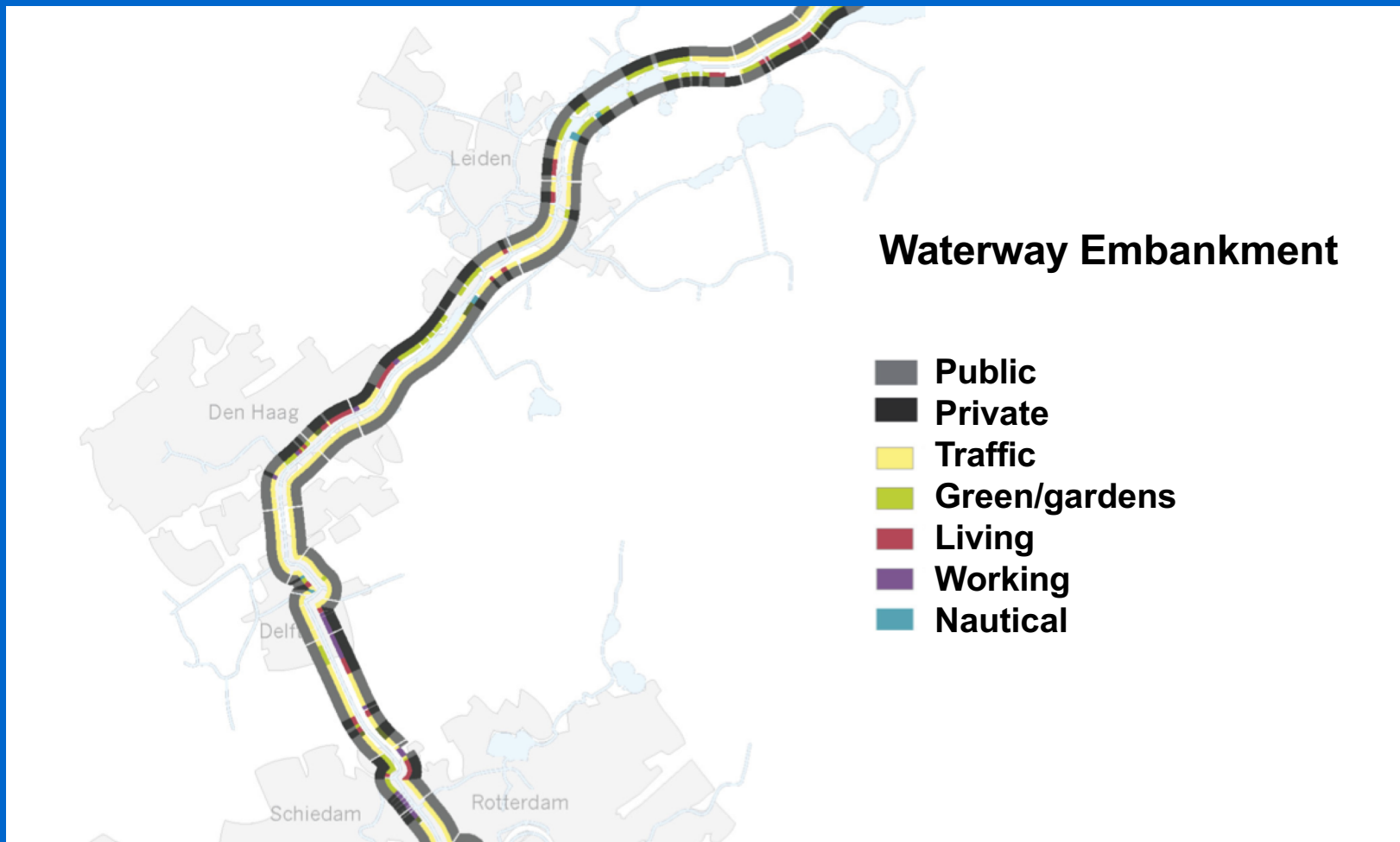
The social-economic significance of water-related tourism / recreation is self-evident and shows in the total revenues and employment figures.

Furthermore waterway improvement leads to higher values of real estate along the waterfront.

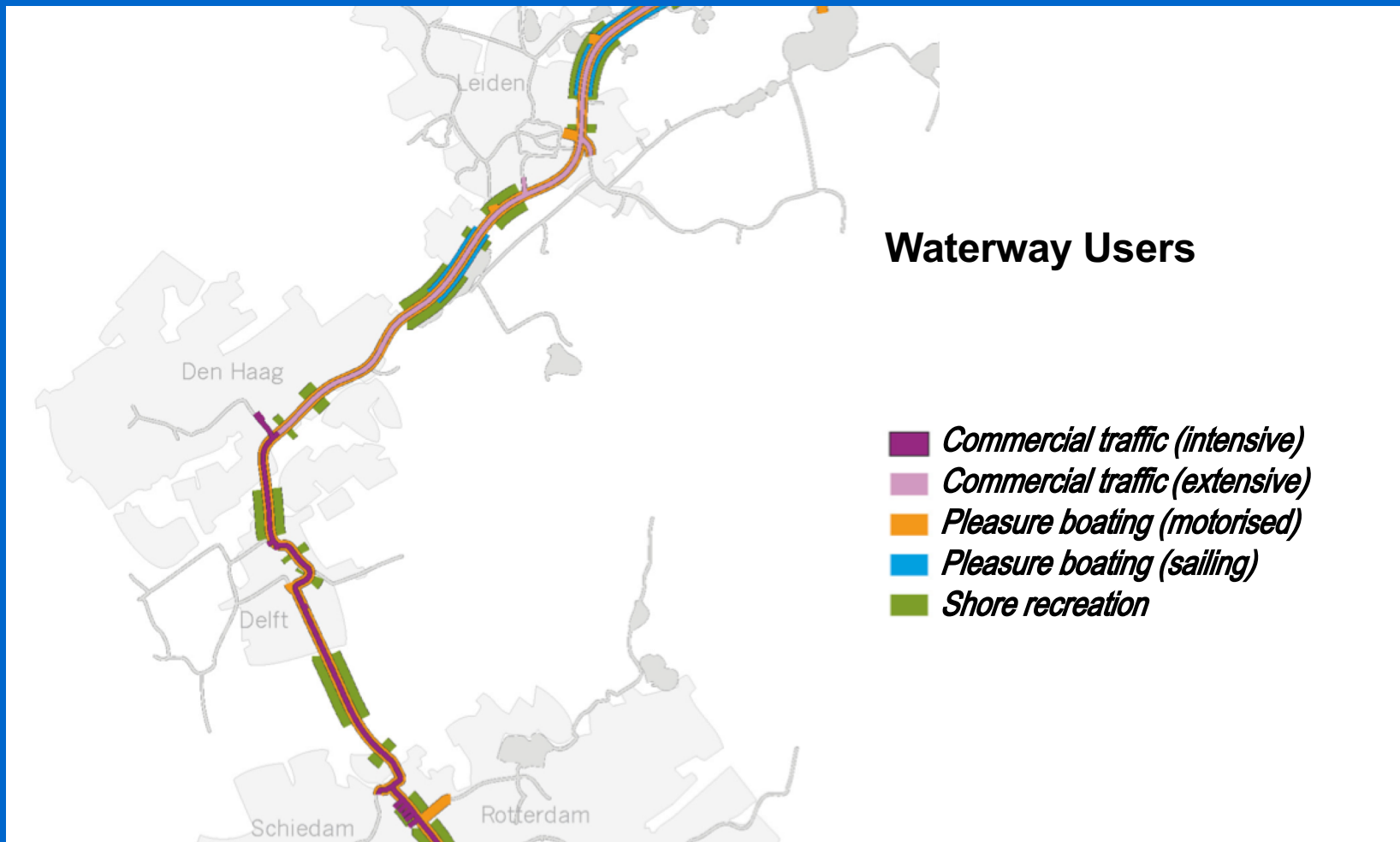
WATERWAY & WATERFRONT CHARACTERISTICS



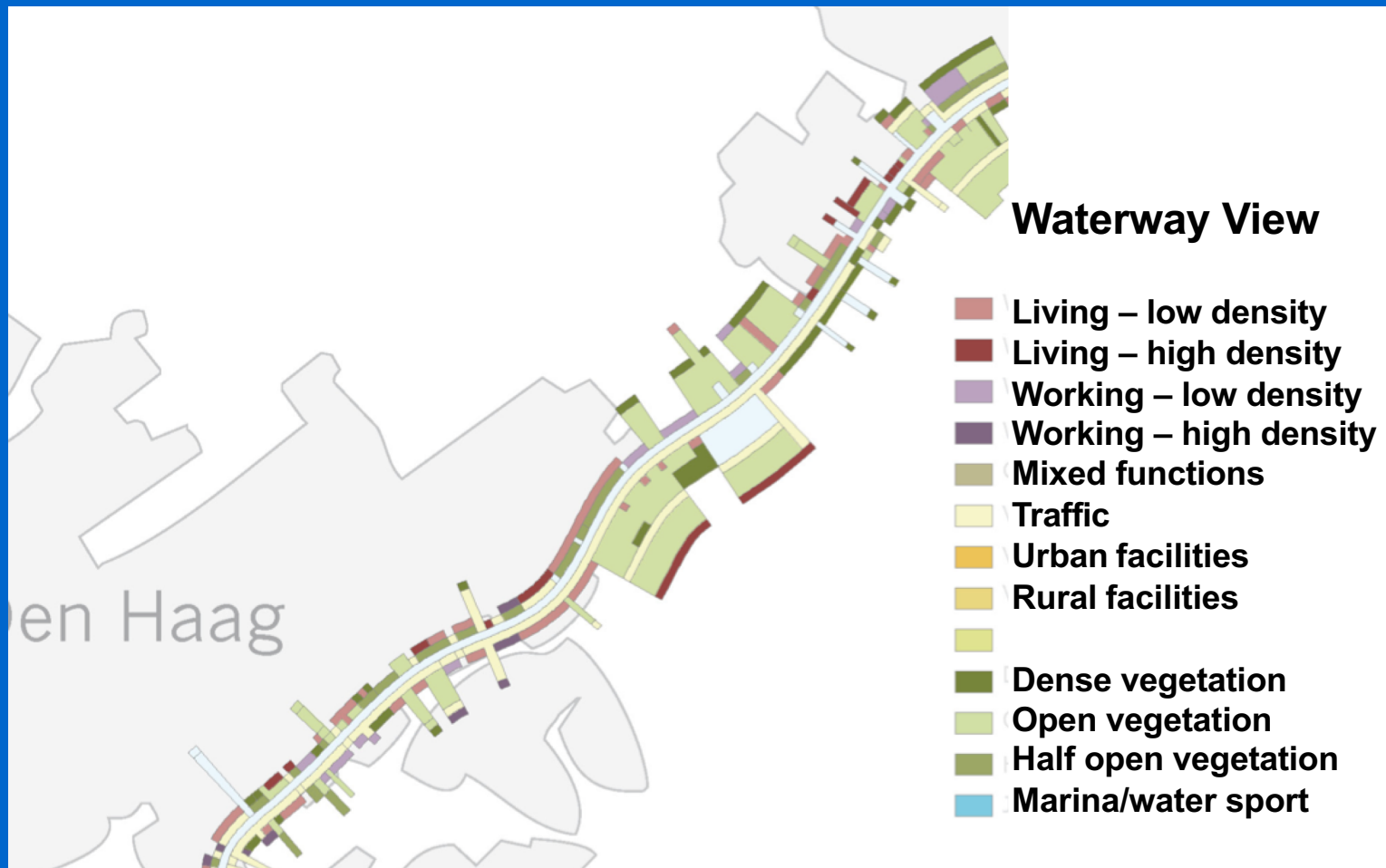
WATERWAY & WATERFRONT CHARACTERISTICS



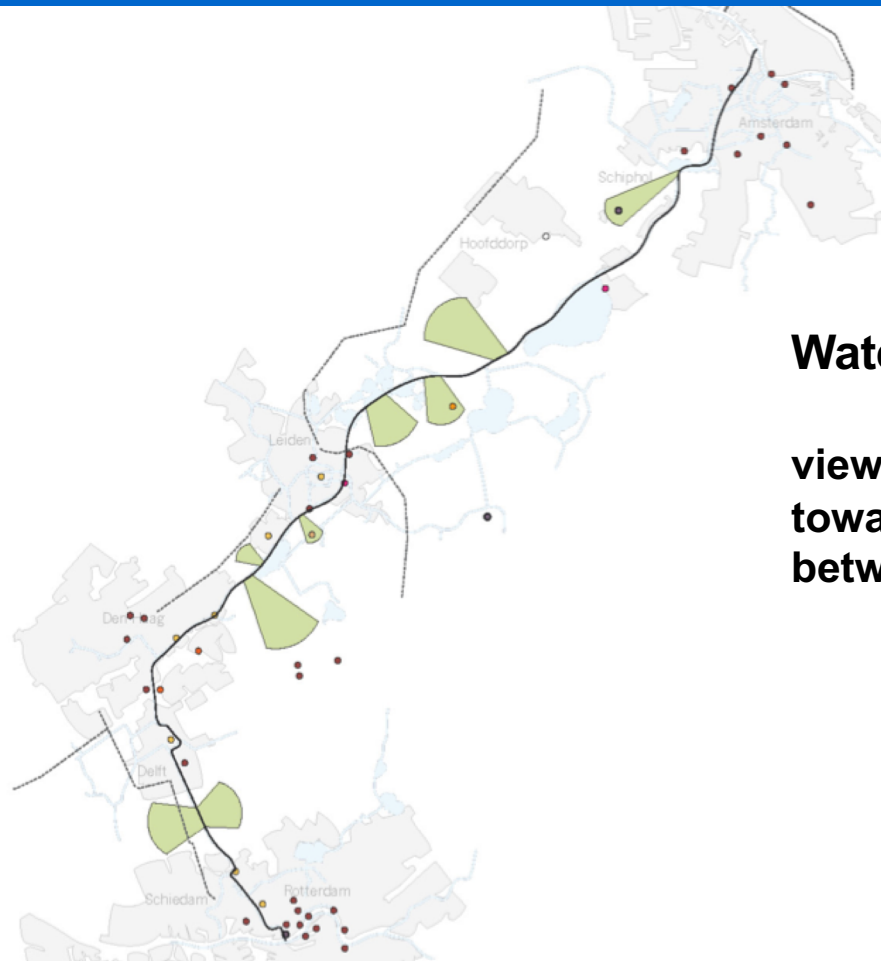
WATERWAY & WATERFRONT CHARACTERISTICS



WATERWAY & WATERFRONT CHARACTERISTICS



WATERWAY & WATERFRONT CHARACTERISTICS



Waterway Panoramas

views from the waterway
towards the rural areas
between the cities

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Environmental measures

1. Introduction of environment-friendly banks / shores
2. Improving overall water quality and aquatic & terrestrial ecosystems
3. Implementation of Water Framework Directive for canals, rivers & lakes
4. Conservation of protected species within Natura 2000 and other designated sites
5. Controlling of invasive flora en fauna species (AIS) in inland waterways, using innovative methods e.g. bio-degradable mats
6. Waterway improvement by cutting overgrowth and by removal of excessive aquatic plants
7. Waterway quality improvement by aeration, a.o. through placing stones in shallow streams and air bubble screens; increasing waterflow
8. Monitoring before, during & after measures for improving water quality
9. Introduction of electrically powered vessels

Under jurisdiction of and financed by central, regional, local governments or private sector; e.g. depending on classification of waterways / waterfronts.

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Environmental measures

10. Waste water storage, transport & treatment both on shore as on pleasure crafts
11. Environment-friendly dredging methods to achieve and maintain channel depths
12. Re-introduction of indigenous flora and fauna species
13. Creating conditions for nature development (Building with Nature)
14. Intermodal transition from motorway to waterway transport for freight and persons (boat bus) using Eco-calculator models
15. Measures against eutrophication through waste water purification and by reducing use of fertilizers in agriculture
16. Improving environment – nature – landscape through education & active volunteer participation
17. Promotion of eco-tourism in and near Nature 2000 areas / sites
18. Introduction of the Blue Pennant as environmental quality mark for vessels
19. Introduction of the Blue Flag for municipalities to promote good swimming water quality for the public waters

Under jurisdiction of and financed by central, regional, local governments or private sector, e.g. depending on classification of waterways / waterfronts.

SUSTAINABLE FUTURE OF INLAND WATERWAYS

Special berths with facilities



SUSTAINABLE FUTURE OF INLAND WATERWAYS

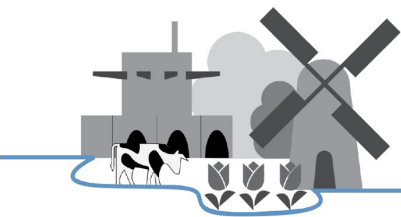
Special berths
with facilities



Value of Water Recreation



Culture History



Relation Urban - Rural



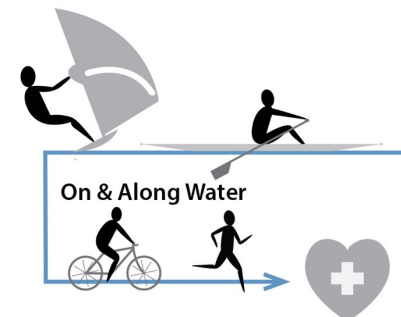
Residential Quality



Societal & Business Quality



Health



On & Along Water



Water Recreation in The Netherlands (2015)

2.600.000 vacationers
507.800 vessels
1.160 yachting harbours
18.690.000 shipping days
20.370 employees
4.200 businesses

Turnover:
€ 4.500.000.000 / year

Source:
Waterrecreatie
Nederland



GIS MAPS TOURISM & RECREATION SOUTH-HOLLAND



Waterways Network

Waterway Physical
Waterway Organisation
Waterway Network Routes

Bridge
Sluice
Aqueduct
Servicing
Blue Wave

Harbours
Passer-by Births
Shopping Jetty
Anchorage
Waiting Station

Trailer Slope
Portage

Nautical Safety

Internet/Apps/Signing

Waterfronts

Horeca
Attractions
Events

Cars
Public Transport
Ferry
Touristic Transfer Point

Walking Path
Cycling Path
Public Space

Arrangements

Environment

Nature Landscape

Water Quality
Flora & Fauna
Nature Development
Landscape



GIS MAPS TOURISM & RECREATION SOUTH-HOLLAND



Usage

River & Canal Cruise
Waterbus / Watertaxi

Sailing Boat
Motorboat
Sloop
Canoe
Swimming
Diving
Fishing
Surfing
Kiting
Speedboating
Rowing
Scouting

Thematic Routes

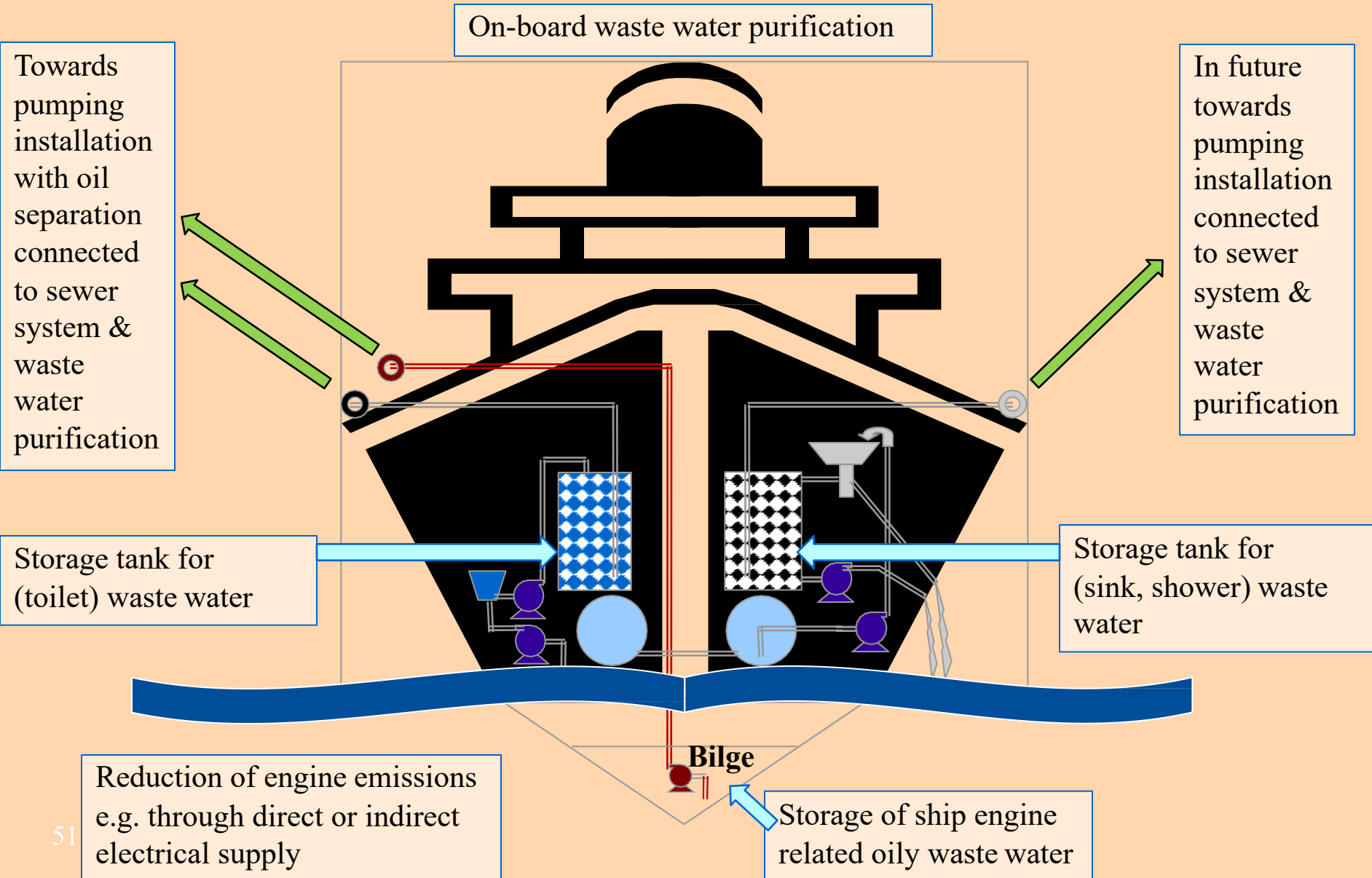
Culture History

Countryside
Urban Site
Nautical Site

Landscape Structure
Urban Structure
Nautical Structure

Landscape Heritage
Industrial Heritage
Water related Heritage
Nautical Heritage
Shipping Heritage
Geopolitical Heritage
Musea

On-board technical provisions starting 2009



SUSTAINABLE FUTURE OF INLAND WATERWAYS

**New inland
container terminal
for brewery**



**New sluice
for shipbuilding**



Types of vessels

ECMT Category

Spits

I



14X



Length 38.50 m - width 5.05 m -
draught 2.20 m - cargo capacity 350 t

Campine vessel

II



22X



Length 55 m - width 6,60 m -
draught 2,59 m - cargo capacity 655 t

Dortmund-Eems canal vessel

III



40X



Length 67 m - width 8.20 m -
draught 2.50 m - cargo capacity 1,000 t

Rhine-Herne canal vessel (Europe vessel)

IV



54X



Length 85 m - width 9.50 m -
draught 2.50 m - cargo capacity 1,350 t

Large Rhine vessel

Va



120X



Length 110 m - width 11.40 m -
draught 3.00 m - cargo capacity 2,750 t

Extended large Rhine vessel

Va



160X



Length 135 m - width 11.40 m -
draught 3.5 m - cargo capacity 4,000 t

Two lighter pushing unit

Vb



220X



Length 172 m - width 11.40 m -
draught 4.00 m - cargo capacity 5,500 t

Four or six lighter pushing unit

Vib



440/660X



Length 193 m - width 22.80 / 34.20 m -
draught 4.00 m - cargo capacity 11,000 / 16,500 t

Standard tank vessel

Va



120X



Length 110 m - width 11.40 m -
draught 3.50 m - cargo capacity 3,000 t

ECMT Category

Large tank vessel

Vb



380X



Length 135 m - width 21.80 m -
draught 4.40 m - cargo capacity 9,500 t

Car vessel

Va



60X



Length 110 m - width 11.40 m -
draught 2.00 m - cargo capacity 530 cars

Container vessel (Campine class)

III



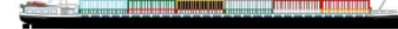
16X



Length 63 m - width 7 m -
draught 2.50 m - cargo capacity 32 TEU

Standard container vessel

Va



100X



Length 110 m - width 11.40 m -
draught 3.00 m - cargo capacity 200 TEU

Large container vessel

Vb



250X



Length 135 m - width 17 m -
draught 3.50 m - cargo capacity 500 TEU

Ro-ro vessel

Va



72X



Length 110 m - width 11.40 m -
draught 2.50 m

Coupled formation (vessel with pushed lighter)

Vib



240X



Average length 185 m - width 11.40 m -
draught 3.50 m - cargo capacity 6,000 t

Coupled formation (vessel with pushed vessel)

Vib

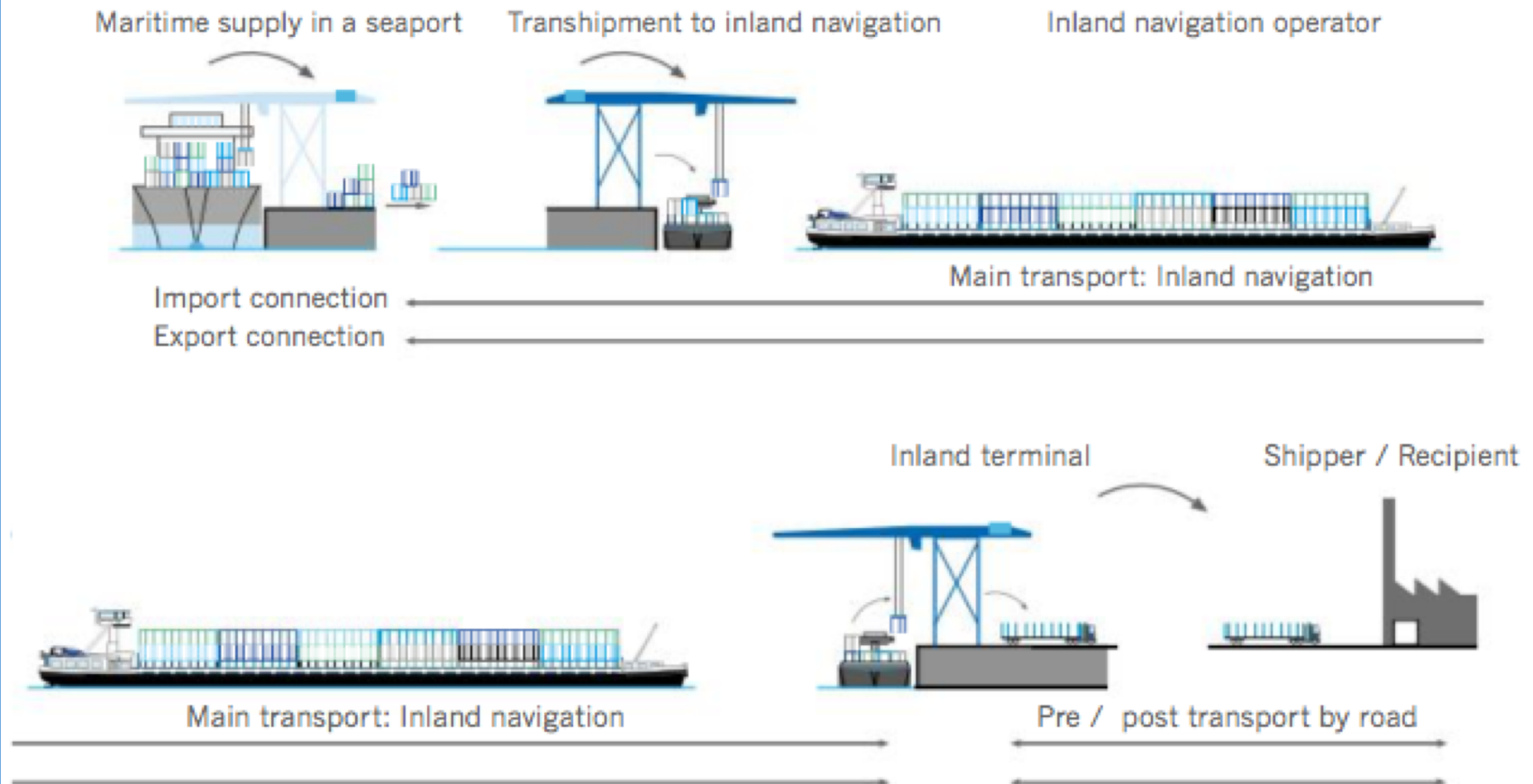


240X



Average length 185 m - width 11.40 m -
draught 3.50 m - cargo capacity 6,000 t

Hinterland transport by means of inland navigation for maritime transport chains





SUSTAINABLE FUTURE OF INLAND WATERWAYS

- **Climate change leads to:**

Rise in temperature,
sea level rise,
higher frequency & intensity of storm surges,
more inland: higher frequency & intensity of rainfall
with intermittently periods of drought.
Seasonal varieties of wet and dry periods.
More extremes.

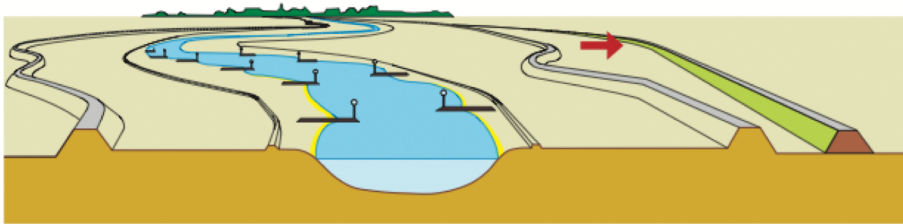
In addition we have to deal with:
land subsidence, salt water intrusion,
a higher % hard surfaces, deforestation,
with a quicker run off towards canals and rivers,
resulting in high water levels,
with in between periods of low water levels
invasive flora & fauna species
bank & shore erosion



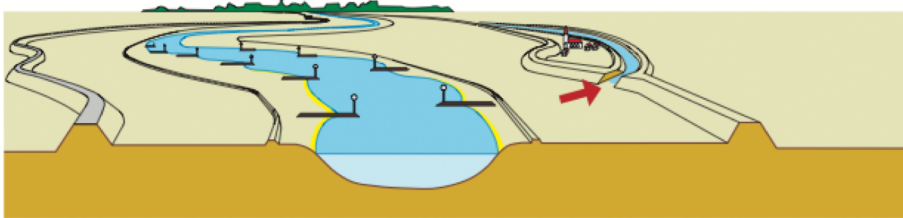
UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Adequate measures for Climate Change:

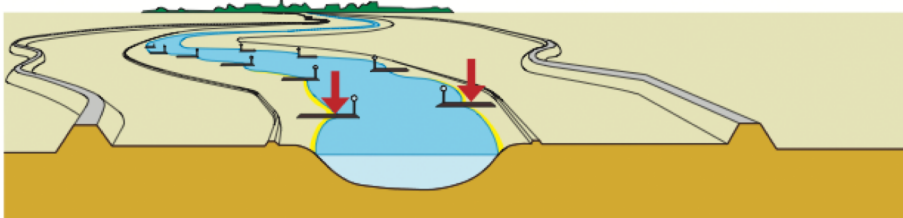
1) Room for the waterway



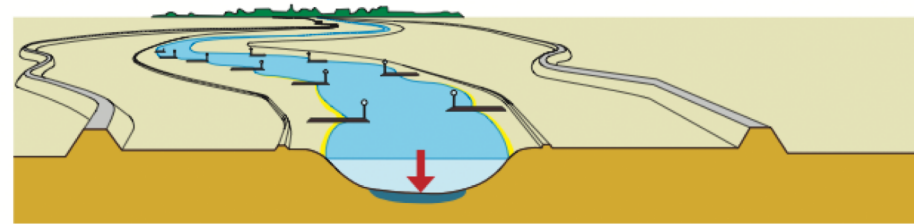
I. Large-scale relocation of the dikes to increase the overflow area between river and dikes



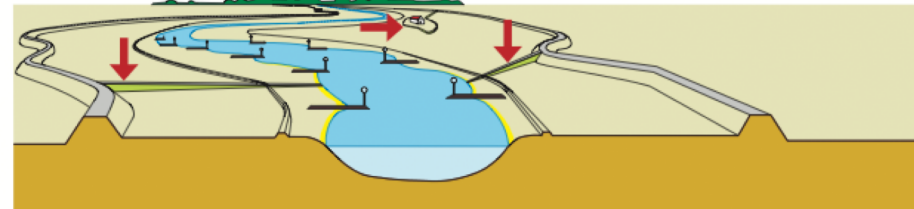
II. River by-pass construction to be used in case of periodic high water levels



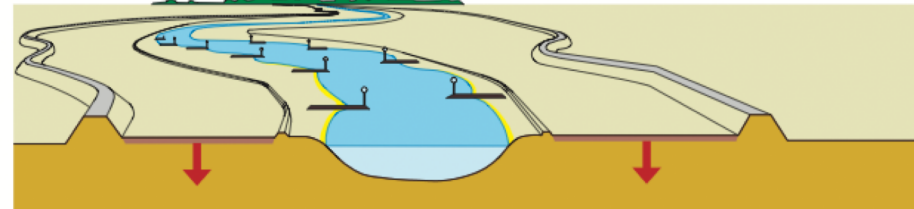
III. Lowering of the groynes



IV. Lowering the riverbed



V. Removal of hydraulic obstacles from the riverbed and the adjacent flood plains



VI. Lowering of the flood plains

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Mitigation measures with regard to climate change

Flood prevention through

1. Room for the river
2. River bank protection using as much as possible 'Building with Nature' methods
3. Dune/beach widening/heightening along the sea shore through 'Building with Nature'
4. Introduction of calamity storage basins
5. Adequate drainage pumping systems for water level regulation
6. Creation of storm surge barriers
7. Enlarging coastal wetlands for wave energy dissipation & nature development
8. Reduction of hard surfaces
9. Improving soil permeability & infiltration
(green roofs, water storage under buildings & infrastructure)
10. Creation of artificial high grounds

Under jurisdiction of and financed by central, regional, local governments or private sector, e.g. depending on classification of waterways / waterfronts.

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

Mitigation measures with regard to climate change

Flood adaptation through

1. Adaptation of land-water use, spatial planning & zoning
2. Flood proof / dry proof buildings and infrastructure
3. Early warning systems, evacuation plans

Drought prevention

1. Provision of retention basins
2. Adequate choice of vegetation and use of drip irrigation

Fighting salt water intrusion

1. Dune / beach widening / heightening creating larger fresh water lenses
2. Double air bubble screens & fresh water injection; creation of thresholds

Under jurisdiction of and financed by central, regional, local governments or private sector, e.g. depending on classification of waterways / waterfronts.

UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

To achieve the necessary results cooperation of all the relevant stakeholders is imperative.

Therefore:

- Stakeholder meetings
- Stakeholder involvement
- Stakeholder participation



UPGRADING WATERWAY SYSTEMS THROUGH AQUAPUNCTURE

To achieve the necessary results cooperation of all the relevant stakeholders is imperative.

In order to achieve:

- Territorial & Social Cohesion
- Raising Awareness
- Community Engagement
- Consensus Approach
- Volunteer Participation

For the necessary improvement of the waterway system, through e.g. physical measures, funding is required. This can be achieved through public and/or private financing.



SUSTAINABLE FUTURE OF INLAND WATERWAYS

Promotion of HERITAGE TOURISM

based on urban & rural
cultural heritage values
on and near the waterway

ICT, using creative multi-
media for interactive
map-based websites of
the waterway and its
surrounding areas



SUSTAINABLE USE OF INLAND WATERWAYS

Promotion of sustainable use of inland waterways and their surrounding areas through:

- **Education - stimulating of awareness of terrestrial & aquatic ecosystems starting with the young generation**
- **Active volunteer participation in achieving sustainable use of the waterways and their waterfronts**
- **Organising special events**
- **Marketing through promotion of the multi-faceted significance of the inland waterways and their surrounding areas.**



-
-
-

SUSTAINABLE USE OF INLAND WATERWAYS

In all cases good governance should be ensured on the basis of documents, communication and cooperation between public & private stakeholders.

European and national water & environmental laws, directives, regulations and standards have to be taken into account.

Development of Business Plans and Societal Cost/Benefit Analyses.

Priority sequence should be established with regard to the necessary mitigating measures.

Best practices for each (European) region have to be developed and knowledge transfer has to be ensured.

SUSTAINABLE FUTURE OF INLAND WATERWAYS

DELIVERABLES

- A sound basis for more integrated regional policies to boost the socio / economic development of inland waterways and adjacent areas in a balanced way, while respecting environment, nature & landscape.
- Improved governance by creating better structures and models to: streamline national and regional regulations to organize a more integrated approach between the various policy sectors to have a balanced structure of responsibilities for the management of waterways, resulting in a jointly defined best governance model for regional waterways
- Strengthening the multi-functional use of regional inland waterways, while reducing negative effects on environment, nature & landscape, taking into account: WFD policies for river basins & effects of climate change on these waters. Ensuring in all cases safety.

Spatial plan based on a six layer system



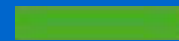
Atmosphere Layer



Occupation Layer



Infrastructure Layer



Agriculture &
Aquaculture Layer



Terrestrial &
Aquatic Nature Layer



Soil / Subsoil /
Hydrosphere Layer

Spatial plan based on a six layer system

1. Underground Layer (Soil / Hydrosphere)

The underground layer with its composition and structure and all its natural resources serves a whole series of natural functions. In addition to these natural functions, it fulfils and can fulfil a series of human-initiated and humanmade functions in and on the underground layer, which are and have to be based on its soil, sub-soil and hydrosphere characteristics.

This underground layer serves as a basis for:

- *landscape & seascape*
- *agriculture, fishery, aquaculture*
- *exploitation of composite minerals, ores*
- *foundation for building sites and infrastructure*
- *storage for waste products, energy, water and CO₂*
- *terrestrial & aquatic nature values*
- *extraction groundwater & surface water*
- *geothermal energy, water energy, fossil energy*
- *tunnels, cables, pipelines, geodetic domes*
- *preservation historic and archaeological sites.*

The composition and structure of the underground layer are of vital importance for the following layers.

-
-
-

Spatial plan based on a six layer system

2. Green-Blue Layer

This layer contains all valuable terrestrial & aquatic nature values, including landscape and seascape, rivers, lakes, ponds and waterways that are in constant need of conservation.

3. Agriculture – Fishery – Aquaculture Layer

This production layer contains all forms of agriculture (greenhouse horticulture, forestry, cattle & poultry breeding, dairy farming); fishery & aquaculture (including mariculture); the production of microorganisms and their metabolic products.

This layer has a clear overlap and interaction with the green-blue layer, especially since production and nature protection are increasingly combined.

-
-
-

Spatial plan based on a six layer system

4. Occupation Layer

The occupation layer contains all building sites for living, working and recreation with all additional facilities amongst others related to education, health care & welfare, religion, shopping, sports and culture.

5. Infrastructure Layer

This layer contains all forms of infrastructure: waterways, roads (including motorways, cycle paths, and footpaths), railroads, pipe / tube / cable, air lanes, electronic highway. In this infrastructure layer, are also present all construction / engineering / structural works such as bridges, tunnels, viaducts, aqueducts, sluices, weirs, railroad stations, metro stations and bus stations, airports, pumping stations, transformers, transceiver stations, sensors, electronic signalling and control equipment. This infrastructure layer serves to link cities, ports and urban, rural & sea areas.

-
-
-

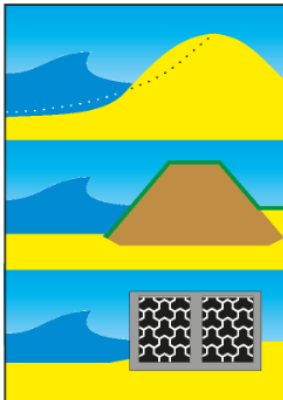
Spatial plan based on a six layer system

6. Atmosphere Layer

This umbrella layer is essential for the climate cycle, hydrological cycle as well as other cycles. It is also an important medium for transportation of electromagnetic waves, sound waves and matter in all its diversity.

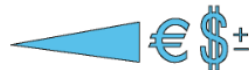
Although these six layers are separately defined, which in itself is very useful, clearly the six layers are strongly interrelated and partly overlapping each other.

In the spatial planning process with regard to the separate and interrelated layers, special attention must be given to the composition of the underground layer and thereby in general to the third dimension.



SAFETY with regard to:

- flooding
(including effects:
sea level & river level rise)
- drought
- coastal erosion
- land subsidence
- salt water intrusion
- natural disasters
- human activities



01



ENVIRONMENT (IN GENERAL)

environmental
compartments:

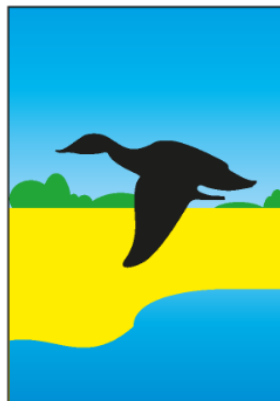
- air
- water
- land



02

NATURE

- micro-organisms, flora,
fauna (incl. people)
- eco-systems
- nature conservation
- nature development
- bio-diversity
- bio-diversification



LANDSCAPE

- landscape conservation
- landscape development

SEASCAPE



03

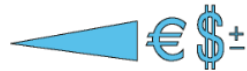


04

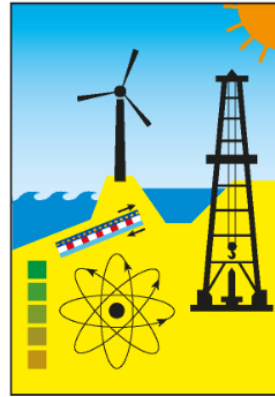


**WATER RESOURCES
MANAGEMENT**

- water quantity
- water quality
- groundwater
- surface water
- dune infiltrated water
- (desalinated) sea-water
- sewer systems
- waste water purification



05



ENERGY

- natural gas, oil, coal, etc.
- biomass (wood, etc.); organic wastes
- nuclear energy
- solar-, wind-, water-, geo-energy
- combined cycle, isolation, etc.

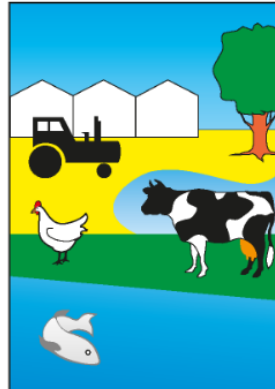


06

AGRICULTURE
horticulture, forestry,
cattle & poultry breeding

FISHERY

AQUACULTURE



**MINING / EXTRACTION
& STORAGE**

in / on

Land / Sea-bed / Sea /
Air



07

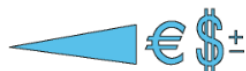


08



BUILDING SITES FOR LIVING & WORKING

- houses & apartments
+ facilities
- industries & offices
+ facilities
- urban development



09



RECREATION & TOURISM



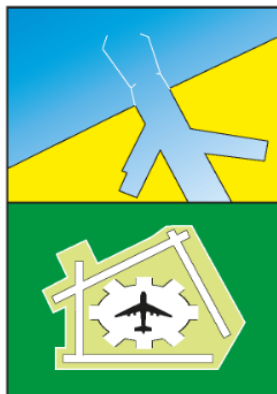
10

TRANSFER / DISTRIBUTION CENTRES & RELATED ACTIVITIES

- seaport
- riverport,
- lake port
- airport,
- landport



11



INFRASTRUCTURE

- roads
- railroads
- waterways
- underground systems
- airlines
- electronic highway



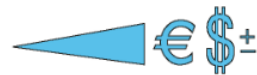
12





TRANSPORT MODULES

- bicycle, motor-car, bus, tram, train, maglev (magnetic levitation train),
- metro
- ship,
- container
- drone, airplane, rocket, satellite



13



INFORMATION COMMUNICATION TECHNOLOGY

DATA ACQUISITION
DATA STORAGE
DATA TRANSMISSION
DATA PROCESSING

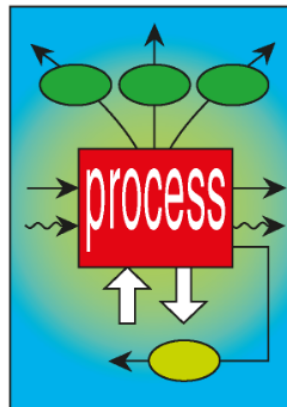
A.I.



14

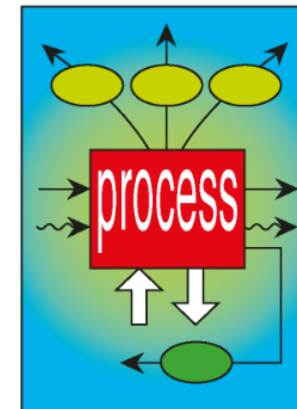
ENVIRONMENT (IN PARTICULAR)

Air- / Water- / Soil-quality
by improvement of
conversion processes
and by end of pipe
purification



ENVIRONMENT (IN PARTICULAR)

solid waste reduction
by improvement of
conversion processes and
by environmental friendly
collection - transport -
storage - processing -
recycling - usage

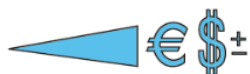


15

16



GOVERNMENTAL
INSTITUTIONS
NON-GOVERNMENTAL
INSTITUTIONS
CITIZEN GROUPS
INDIVIDUAL CITIZENS
PEOPLE'S
PARTICIPATION
LAW - JUSTICE - ORDER



17

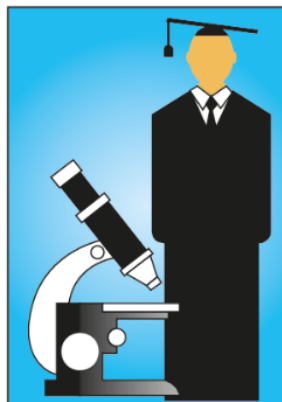


HEALTH & WELFARE
SPORT / PLAYGROUND
HISTORY & CULTURE
RELIGION
PHILOSOPHY OF LIFE
VALUES & STANDARDS
SOCIOSPHERE



18

EDUCATION
&
RESEARCH



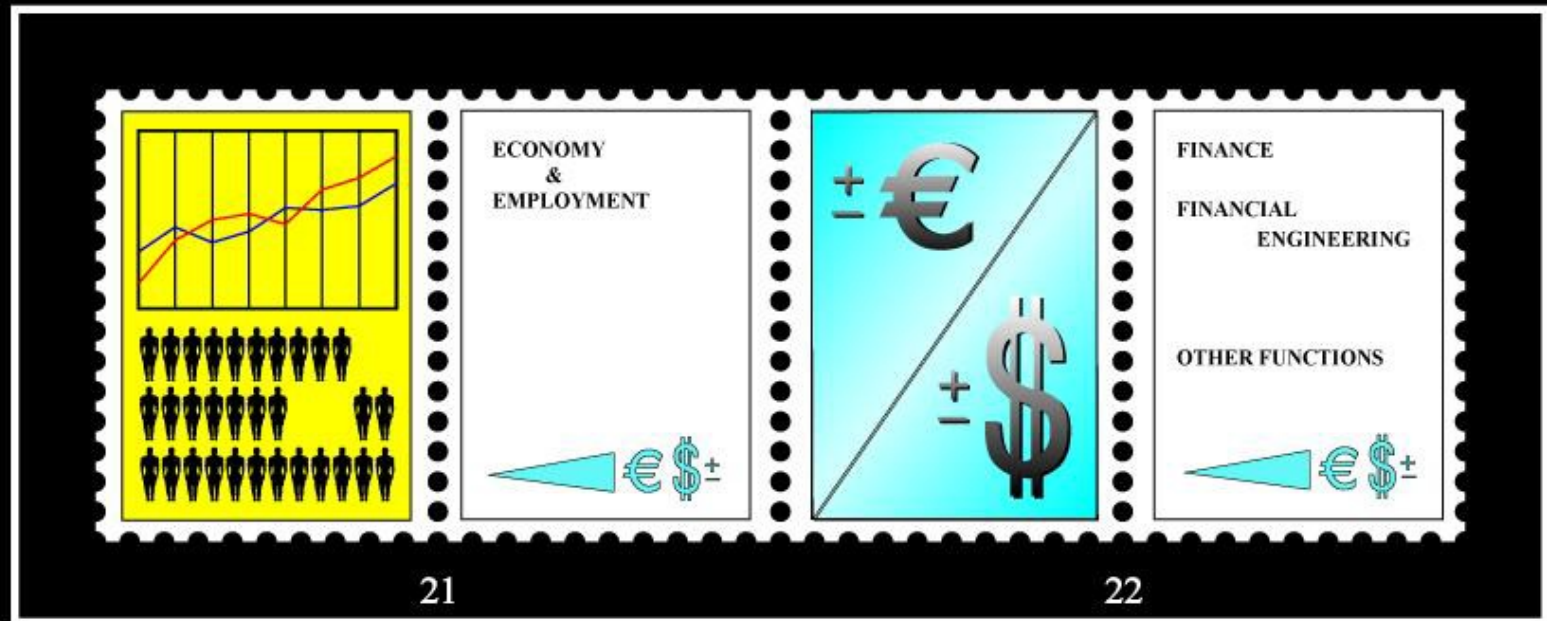
DEFENCE
&
RISK MANAGEMENT

SAFETY & SECURITY



19

20



© R.E. Waterman

The great challenge of the 21st century

**Introduction and implementation of methods that simultaneously
Strengthen the Economy and Improve the Environment
to achieve Sustainability.**

European
Inland
Waterways



SUSTAINABLE USE OF INLAND WATERWAYS

- **Considering the various themes we have to take into account the differences and similarities between the regions.**

Differences with regard to:

- 1) Type & capacity of the waterways: river, lake or canal**
- 2) Functions & use of the waterway**
- 3) Direct connection with the sea or not**
- 4) Terrain conditions (high/lowland, type of soil, nature reserve areas)**
- 5) Water level differences along the length of a canal or river
(a.o. number of sluices, ship elevators, aqueducts)**
- 6) Domination of urbanised or rural territory**
- 7) Population density and visitor potential**
- 8) Climate with regard to yearly & seasonal temperature, rainfall, drought**

-
-
-

SUSTAINABLE USE OF INLAND WATERWAYS

- **Considering the various themes we have to take into account the differences and similarities between the regions.**

Similarities with regard to:

- 1) Necessity of improving environment, nature, landscape**
- 2) Necessity of water management (quantity & quality)**
- 3) Necessity of mitigating measures with regard to negative effects of climate change**
- 4) Necessity of socio-economic development**
- 5) Necessity of nautical safety and ensuring overall safety**
- 6) Necessity of safeguarding / restoring & using heritage values**

SUSTAINABLE USE OF INLAND WATERWAYS

UK WALES (British Waterways)

**UK NORTHERN IRELAND
(Waterways Ireland)**

**REPUBLIC OF IRELAND (Waterways
Ireland & South Tipperary County
Council)**

THE NETHERLANDS (SRN/VRW)

FRANCE (French Waterways)

NORWAY (Telemark County Council)

**SWEDEN (County Adm. Board of
Värmland)**

FINLAND (Savonlinna Region)

ITALY (Navigli Lombardi)

ITALY (Province of Ferrara)

**SPAIN (Ass. Riverside Towns of the
Castilla Channel)**

LATVIA (Vidzeme Planning Region)

POLAND (Municipality of Brzeg Dolny)

**HUNGARY (Municipality of
Dunaujvaros / Central Dir. of Water &
Environment)**

**SERBIA (Vode Vojvodine Executive
Council)**

UK WALES British Waterways

Montgomery Canal

Monmouthshire &
Brecon Canal



SUSTAINABLE USE OF INLAND WATERWAYS

Montgomery Canal



SUSTAINABLE USE OF INLAND WATERWAYS



Falkirk Wheel





REPUBLIC OF IRELAND

Waterways Ireland

South Tipperary County Council

**Royal Canal & Grand Canal
with connection from Dublin to
Shannon-Erne Waterway and
via Barrow River / Canal
to Waterford.**

**River Suir from Tipperary to
Waterford**

UK NORTHERN IRELAND

Waterways Ireland

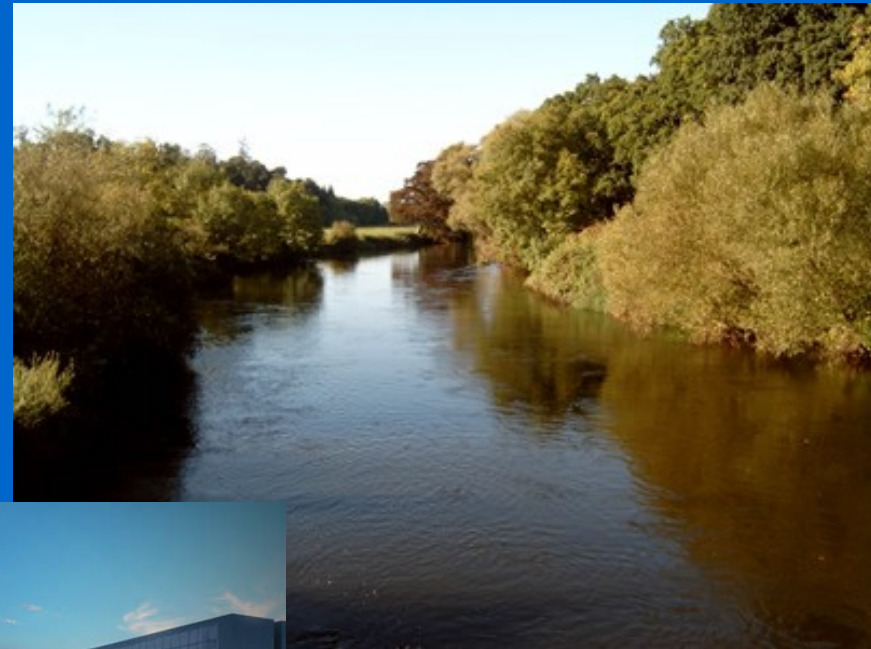
**Ulster Canal from
Lough Neagh to
Shannon-Erne Waterway**

SUSTAINABLE USE OF INLAND WATERWAYS

Ulster Canal



River Suir 184 km 3rd longest river



Royal Canal Dublin



Heritage Boats on the Grand Canal, Dublin



The Cutts, Lower Bann



Dromineer, Shannon Navigation



Rowing on the Bann



Kayaking in Carrick-on-Shannon

World Pike Fishing Competition





NETHERLANDS

Dutch Recreational Waterways (SRN)

Association Region Water (VRW)

Rhine-Schie Canal with adjacent waterways

Randstad Waterway System



Ministry of Infrastructure & Environment

Map of Water System of Randstad Holland

Basic Grid



Ministry of Infrastructure & Environment

Map of Water System of Randstad Holland

Water Levels & Sluices & Pumping Stations



Pumping station
Obstacle
Sluice



Ministry of Infrastructure & Environment

Map of Water System of Randstad Holland

Recreation

Yachting Harbours in Waterway System



Ministry of Infrastructure & Environment

Map of Water System of Randstad Holland

Inventory of Plans

-  Policy Plan
 -  Missing Links
 -  Stimulating Measures
- Policy Plan
Missing Links
Stimulating Measures



FLANDERS CLIMATE RESILIENT & WATER PROOF

SUSTAINABLE COAST & DELTA ZONE DEVELOPMENT

through

BUILDING WITH NATURE[®] & AQUAPUNCTURE[©]



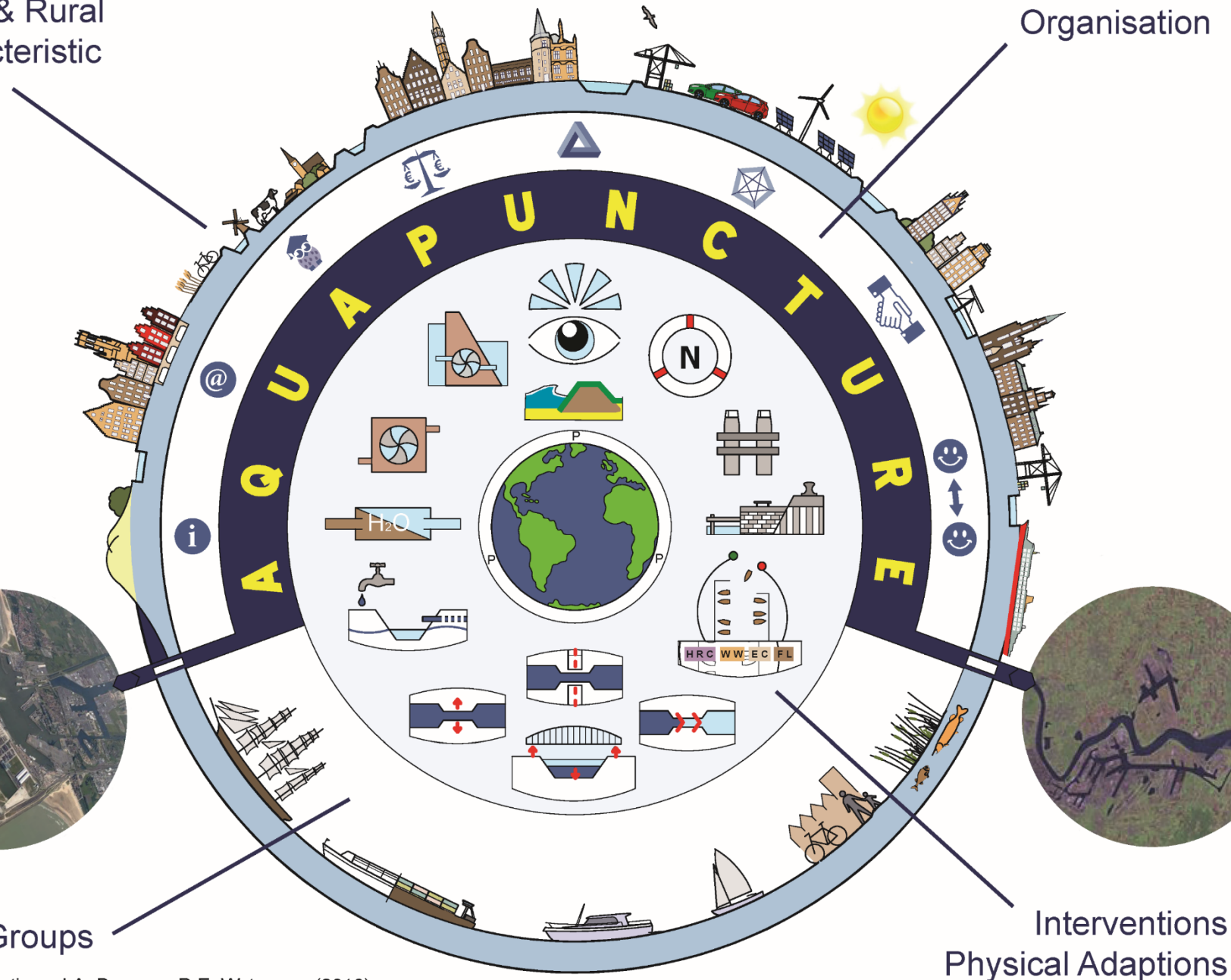
Prof. Dr. R.E. Waterman MSc

**OP WEG NAAR EEN KLIMAATBESTENDIG,
WATERVEILIG & WELVAREND VLAANDEREN**

KVAB

21 maart 2018

Paleis der Academiën



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Interventions
Physical Adaptions



Waterways West- Vlaanderen

Schelde

Dijle

Leie

Dender

Rupel

IJzer

Grote & Kleine Nete

Zenne

Molenbeek

Albertkanaal

Boudewijnkanaal

Leopoldkanaal

Kanaal Gent – Terneuzen

Kanaal Gent – Oostende

Zeekanaal Brussel – Schelde

Kanaal Leuven Dijle

Upgrading waterways through Aquapuncture©

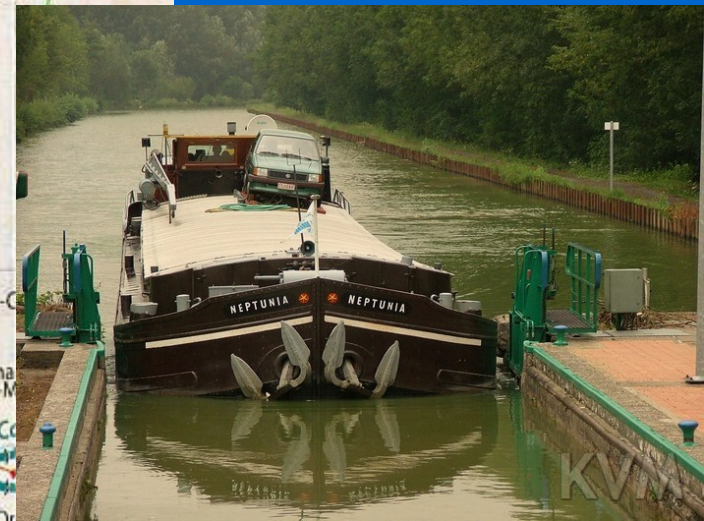
FRANCE

(French Waterways)

Sambre

Canal de la Sambre à l'Oise.

Noyon - Ribemont - Vadencourt -Maubeuge - Charleroi









SWEDEN (Värmland)

Göta Älv –

Trollhättan Kanal –

Vänern – Klarälven

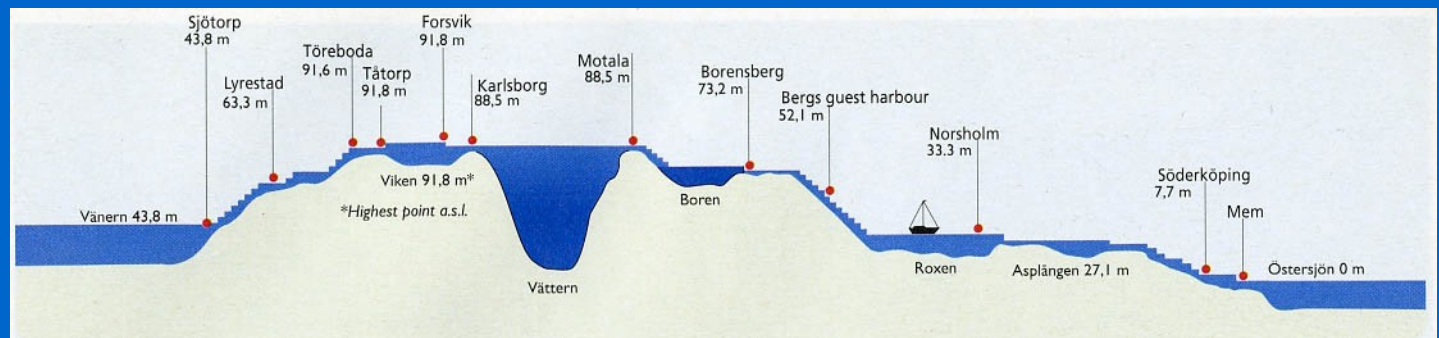
Göta Kanal –

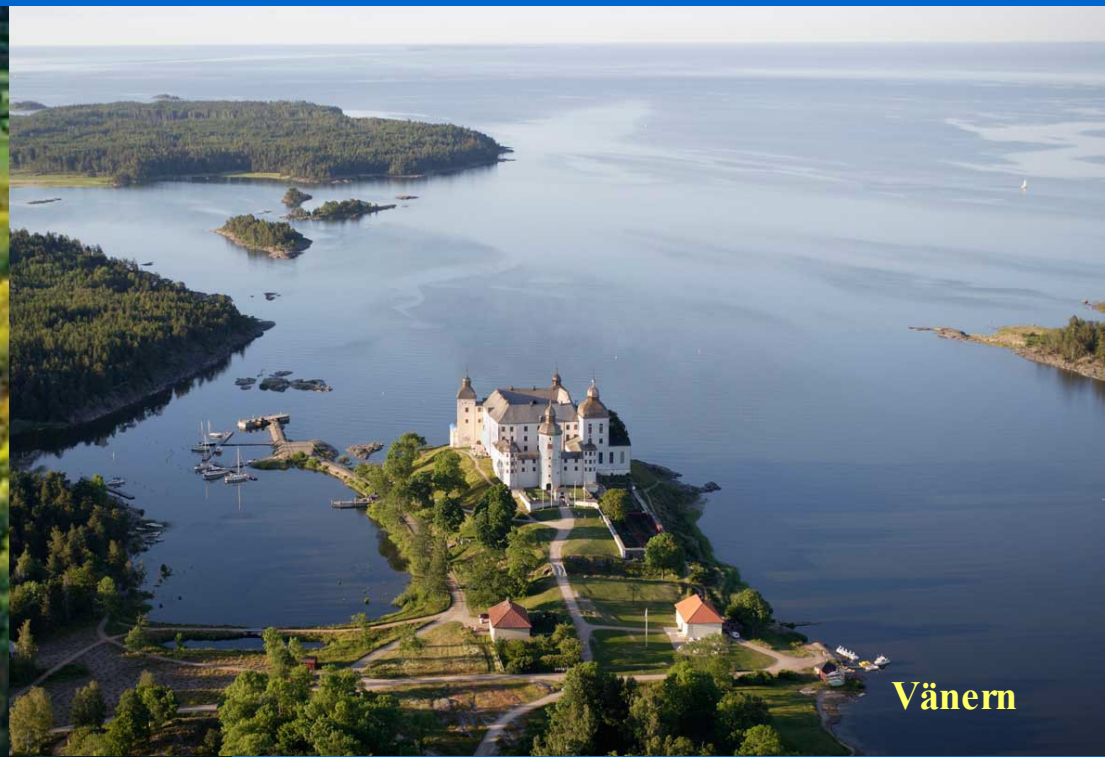
Vättern Kanal –

Göta Kanal

Waterway between

Kattegat & Baltic Sea





Vänern

Göta Kanal





FINLAND

(Savonlinna Region)

Saimaa River system

Saimaa Canal

Mäntyharju Canal



SUSTAINABLE FUTURE OF INLAND WATERWAYS



AQUAPUNCTURE©



Dr. Ronald E. Waterman MSc
co-author:
Jaap A. Brouwer MURb



**Città
Metropolitana
di Milano**

2017-2018-2019



ITALIA



**Città
metropolitana
di Milano**





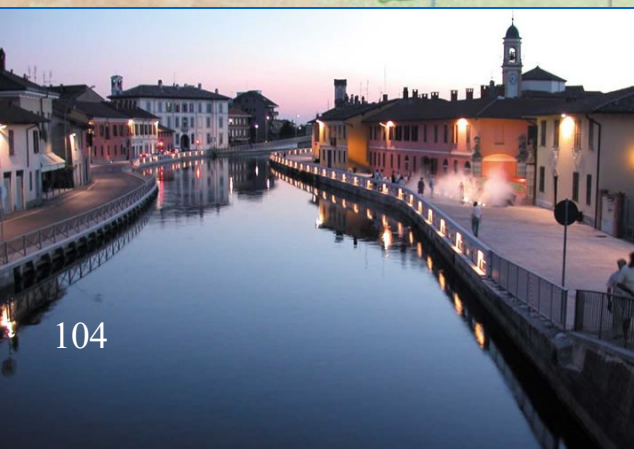
ITALY

**Navigli
Lombardi
s.c.a.r.l.**

**Milano
Province**

**Lombardi
Region:**

**canal system
250 km
in an area of
1,800 km²**



**Lombardi Canals /
da Vinci Canals
between
Milano – Lago Maggiore
Lago di Como
Ticino River – Po River –
Adda River**





ITALY

Ferrara Province



Po River system



Region Castilla y León (SIRGA)

Association of Riverside Towns along Canal de Castilla

Canal de Castilla (207 km) from Palencia to Valladolid with connection towards Duero River, from Palencia to Medina de Rioseco, from Palencia to Alar del Rey.

SPAIN

Computerised system within restored building for water control catchment area Duero River



SPAIN

(Association of Riverside Towns
along Castille Channel, Region
Castille et León)

Canal de Castille (207 km) from
Palencia to Valladolid with
connection towards Duero River,
from Palencia to Medina de
Rioseco, from Palencia to Allar del
Rey.







LATVIA - Vidzeme Planning Region

235,000 inhabitants; 15,257 km²

4 rivers: Gauja, Salaca, Pededze, Aiviekste.

3 lakes: Aluksne, Burtnieks, Lubans.

Aeration with oxygen of rivers & canals by placing stones in the water

Removal of excess beaver dams

Removal overgrowth by trees and bushes of river banks

River bank maintenance

Eco-education and volunteer participation





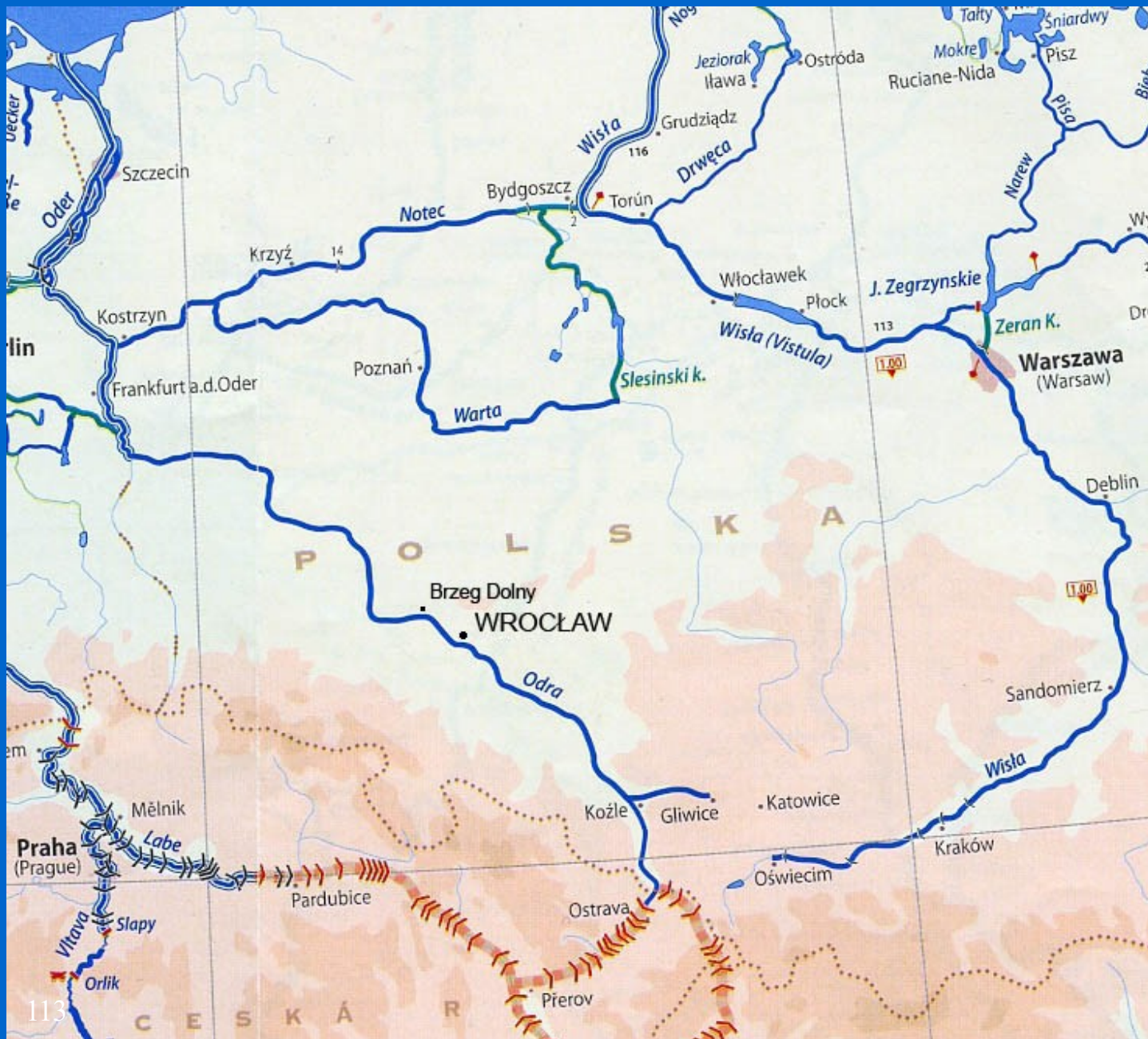
POLSKA

Brzeg Dolny

Municipality

Odra River

**From Kozle to
Brzeg Dolny
the first 186 km
is canalised**

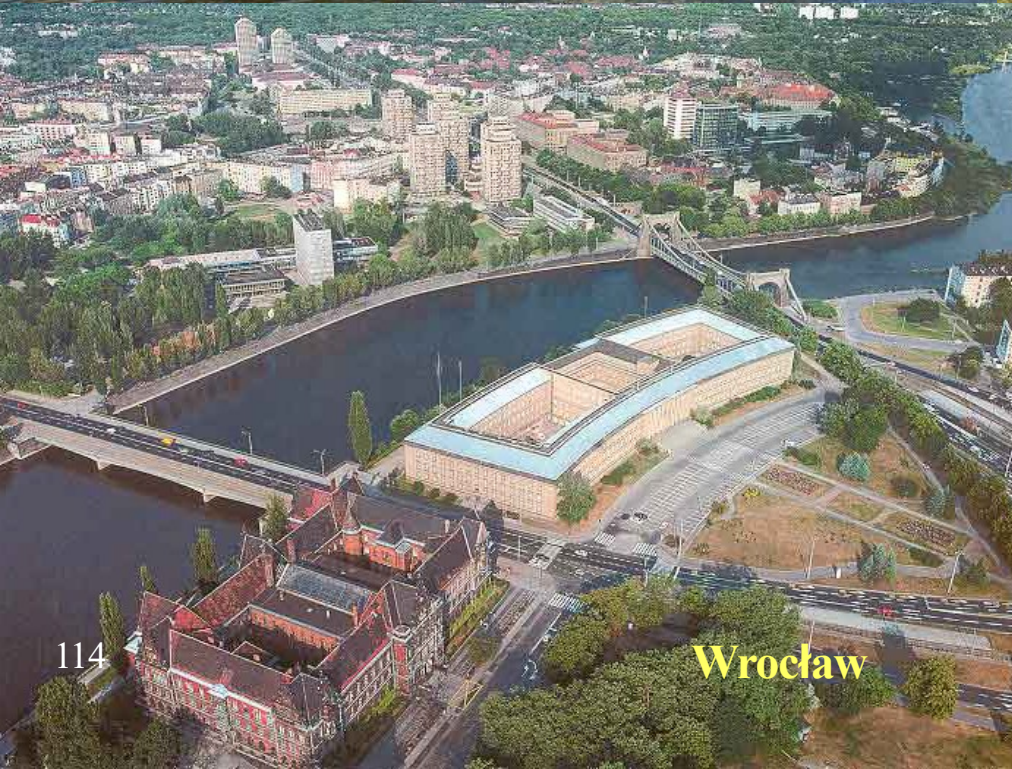




Brzeg Dolny



Brzeg Dolny



Wrocław



Kozle





HUNGARY

**Dunaujvaros
Municipality /
Central Directorate
Water & Environment**

**Hungary:
10 million inhabitants
Dunaujvaros:
60,000 inhabitants
Duna - Tisza - Balaton**

Dunaujvaros specific problems:

- deterioration water quality
caused by industry.

Therefore improvement of
industrial conversion processes
& waste water purification and
implementation of laws,
regulations & standards.

- instability / erosion löss wall.

Therefore necessity adequate
löss wall protection.



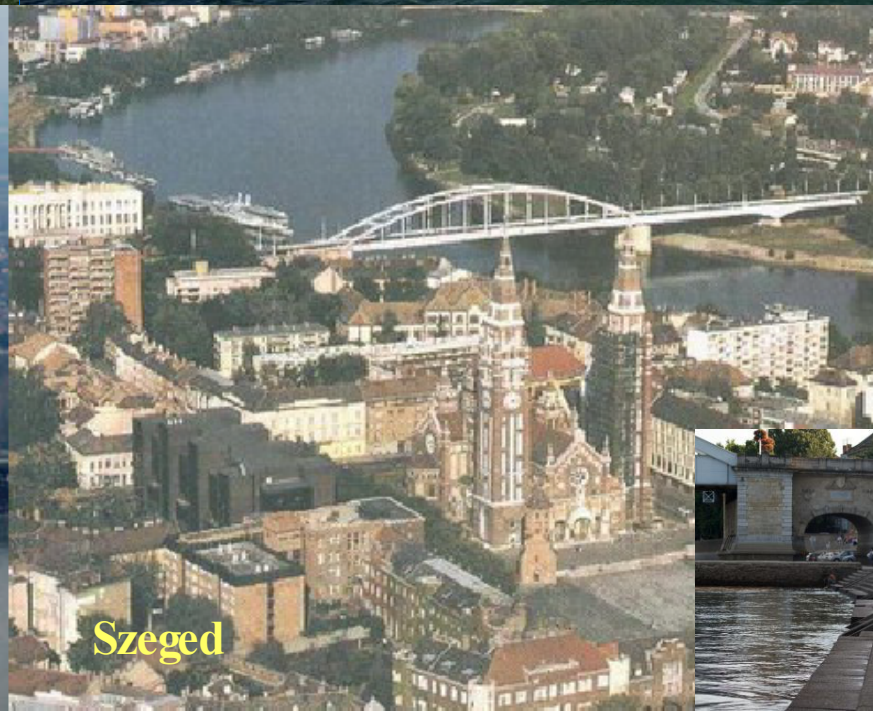
Budapest



Balaton



116
Dunaujvaros



Szeged



SERBIA
Vode Vojvodine
Executive Council

Canal system linked to Danube and Tisza.



-
-
-

SUSTAINABLE USE OF INLAND WATERWAYS

SINGAPORE

**Transformation of rivers & canals
into blue-green artiries**

Kallang River Transformation

INDONESIA

**Jakarta land reclamation
combined with Aquapuncture**

MEXICO

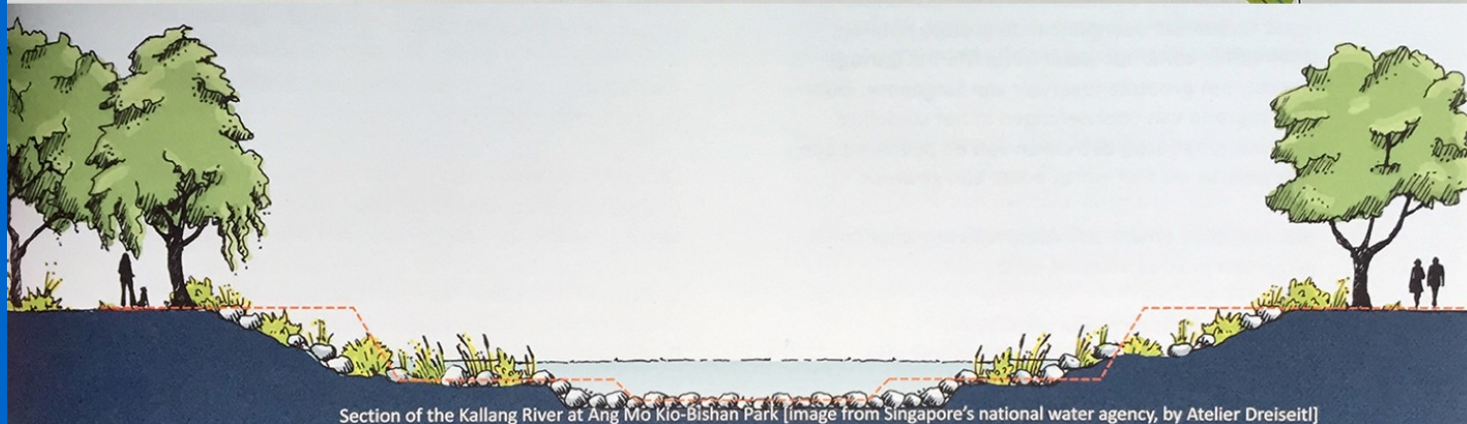
**Mexico City back to the future
through Aquapuncture**

COLOMBIA

**Recuperación del Canal del Dique
Revitalisación Rio Medellin,
Rio Bogota, Rio Cauca & Rio Cali
via Aquapuncture**

SUSTAINABLE USE OF INLAND WATERWAYS

SINGAPORE - Transformation of rivers & canals into blue-green artiries

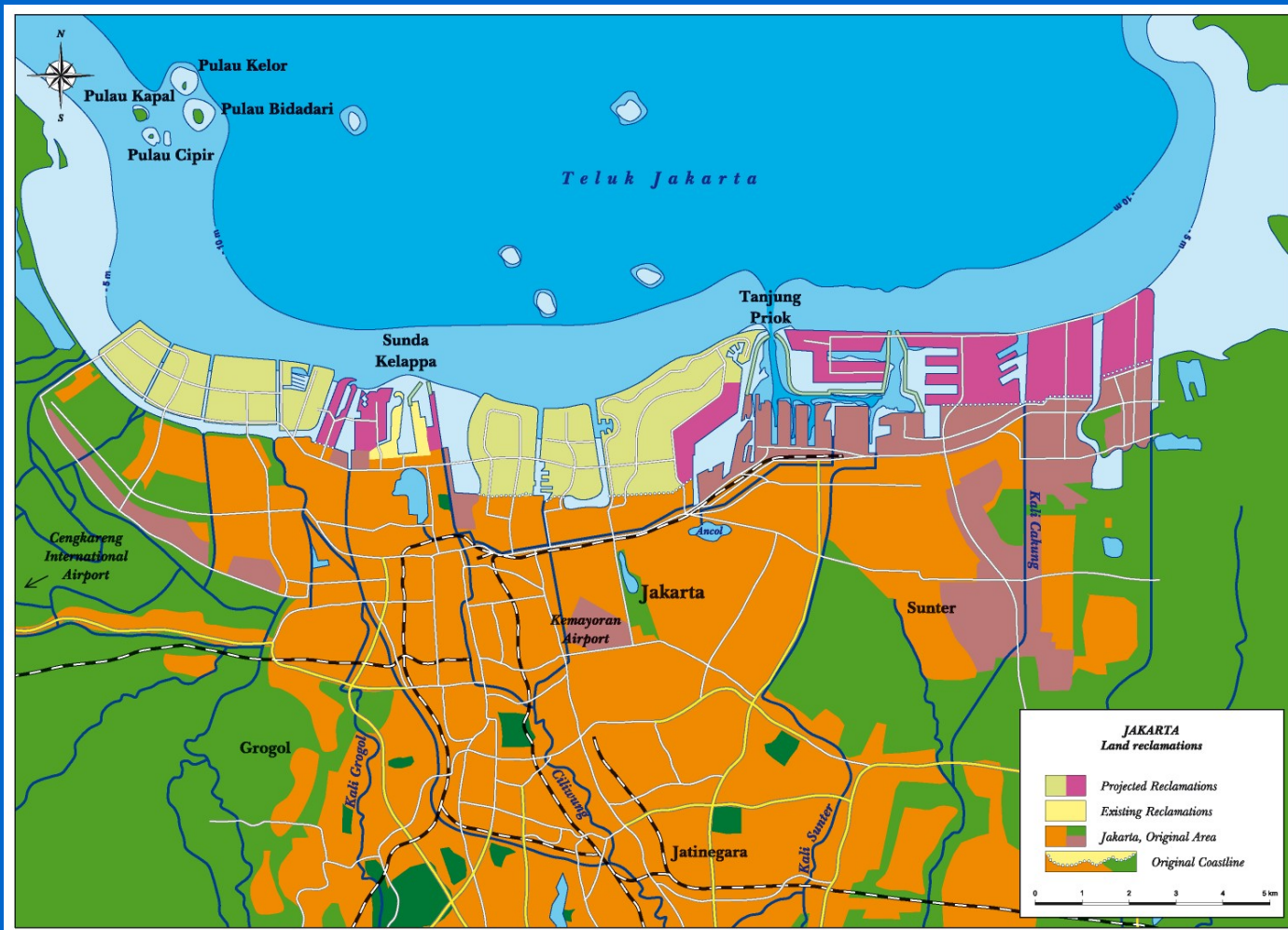


SINGAPORE – Kallang River before and after transformation



SUSTAINABLE USE OF INLAND WATERWAYS

INDONESIA - Jakarta land reclamation combined with Aquapuncture

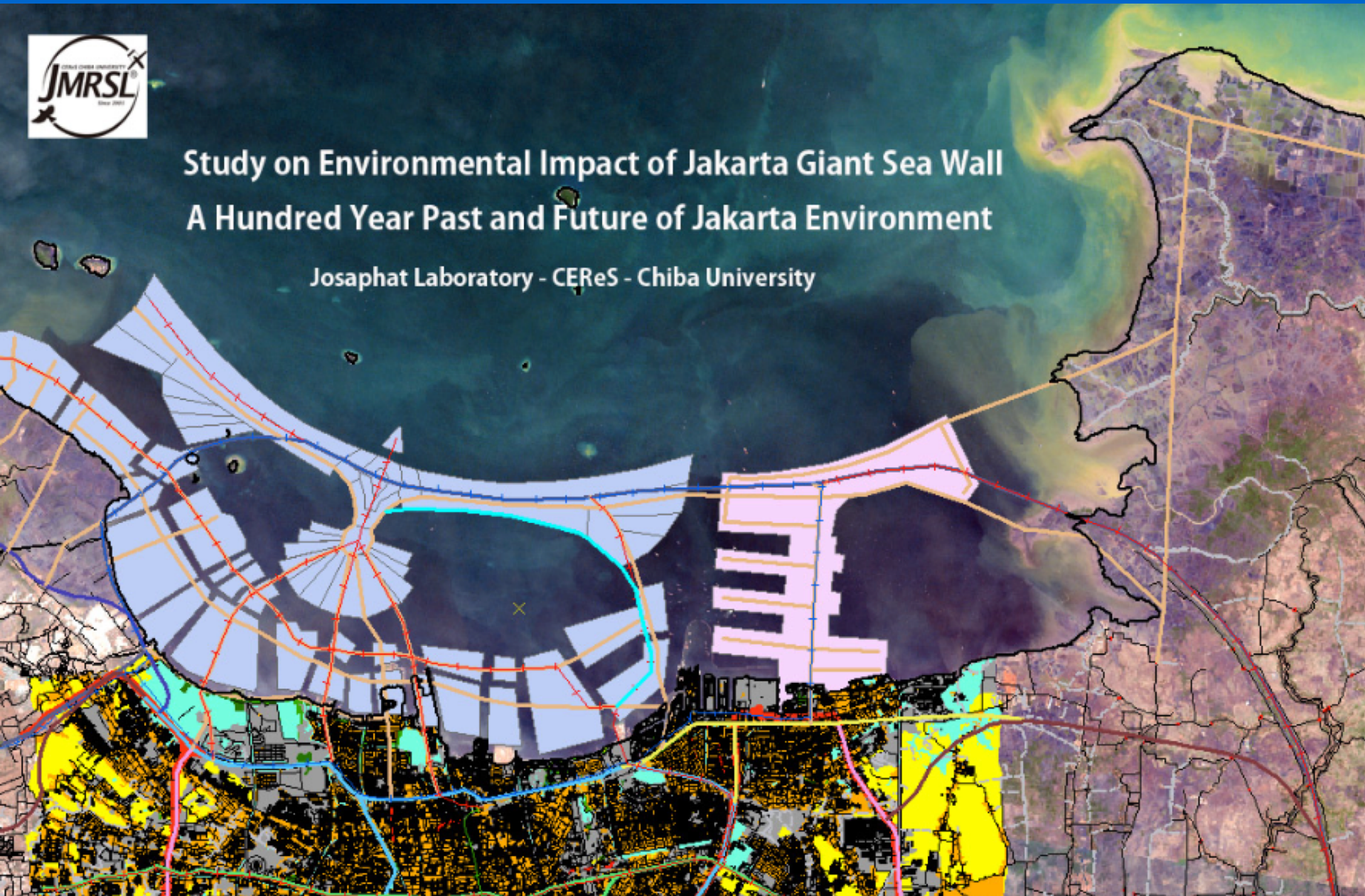


INDONESIA - Jakarta land reclamation combined with Aquapuncture Land reclamation in Teluk Jakarta: Great Garuda + Extension Tanjung Priok



Study on Environmental Impact of Jakarta Giant Sea Wall A Hundred Year Past and Future of Jakarta Environment

Josaphat Laboratory - CEReS - Chiba University



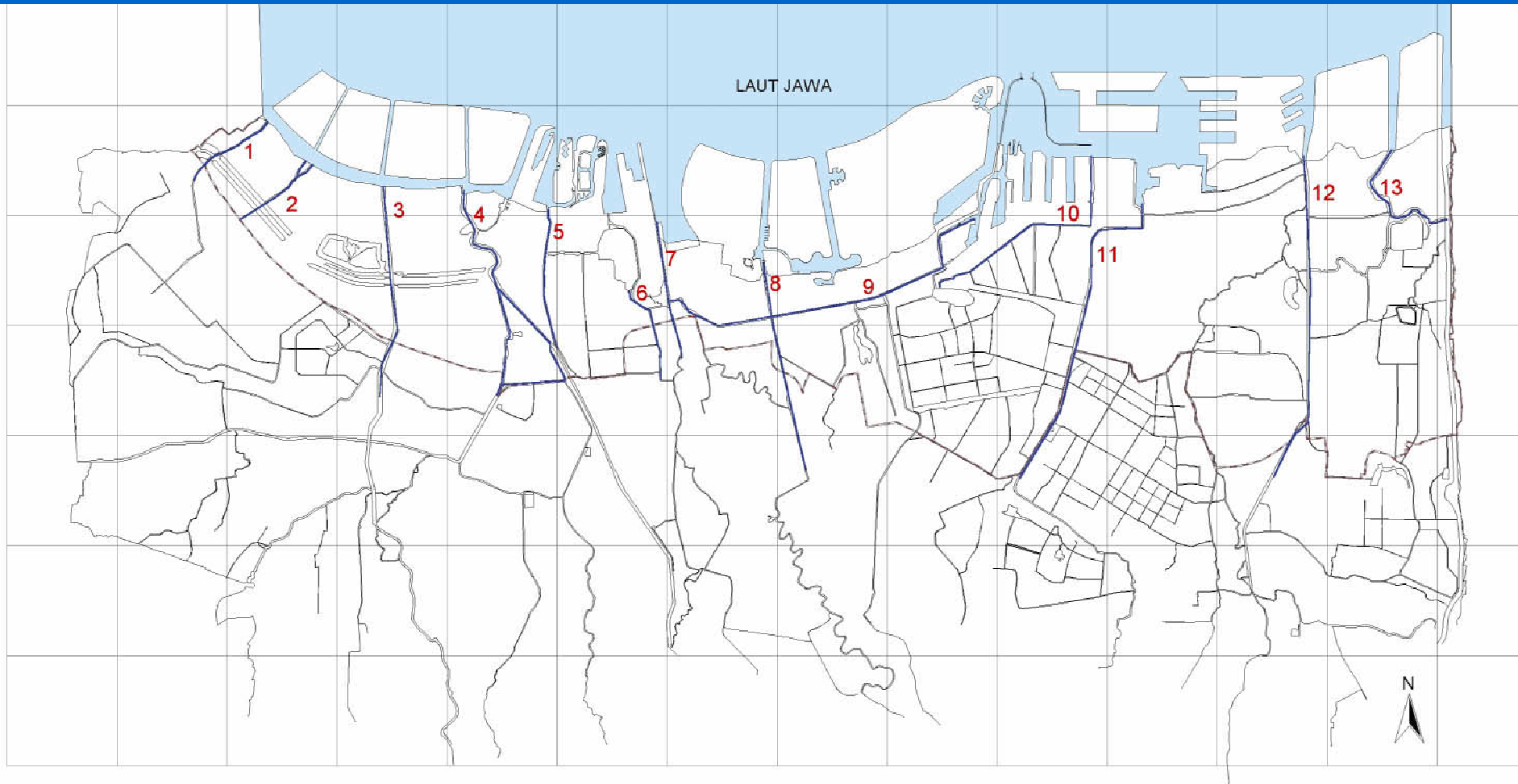






LOCATION OF 11 RIVERS & 2 DRAINAGE CANALS IN PANTURA ZONE OF JAKARTA

Necessity of upgrading waterway system through Aquapuncture



PETA LOKASI 13 SUNGAI DI KAWASAN PANTURA JAKARTA

KETERANGAN :

- | | | | |
|---------------------|-------------------------|------------------|-------------------|
| 1. KALI KAMAL | 5. KALI DURI LEDENG | 9. KALI ANCOL | 13. KALI BLENCONG |
| 2. KALI TUNJUNGAN | 6. KALI OPAK | 10. KALI LAGOA | |
| 3. CENGKARENG DRAIN | 7. KALI ANAK CILIWUNG I | 11. KALI SUNTER | |
| 4. KALI MUARA ANGKE | 8. KALI CILIWUNG/MARINA | 12. CAKUNG DRAIN | |



PEMERINTAH DAERAH KHUSUS IBUKOTA JAKARTA
BADAN PELAKSANA REKLAMASI
PANTAI UTARA JAKARTA
JAKARTA WATERFRONT DEVELOPMENT



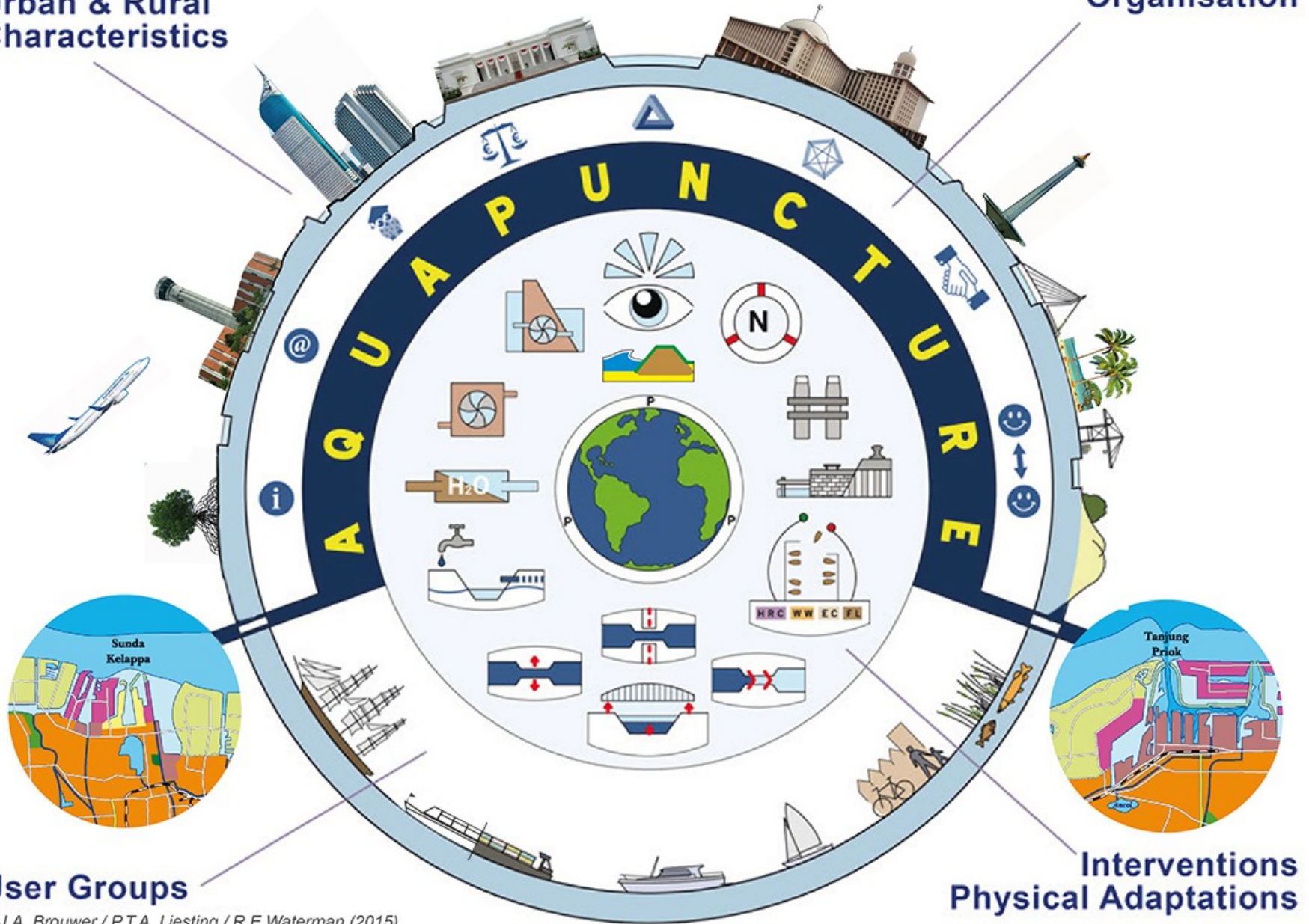
Upgrading river & drainage canals and waterfronts through Aquapuncture

- dredging of water system
- prevention of garbage & waste dropping in water system
- waste water treatment
- waste collection, transport, storage & treatment
- elevation of bridges for navigability
- clearing water fronts for accessibility
- social resettlement inshore and offshore
- stopping of ground water extraction
- fresh water supply through piping from upstream water reservoirs

Long term mobilisation of double workforce of each 10,000 men to achieve this

Urban & Rural Characteristics

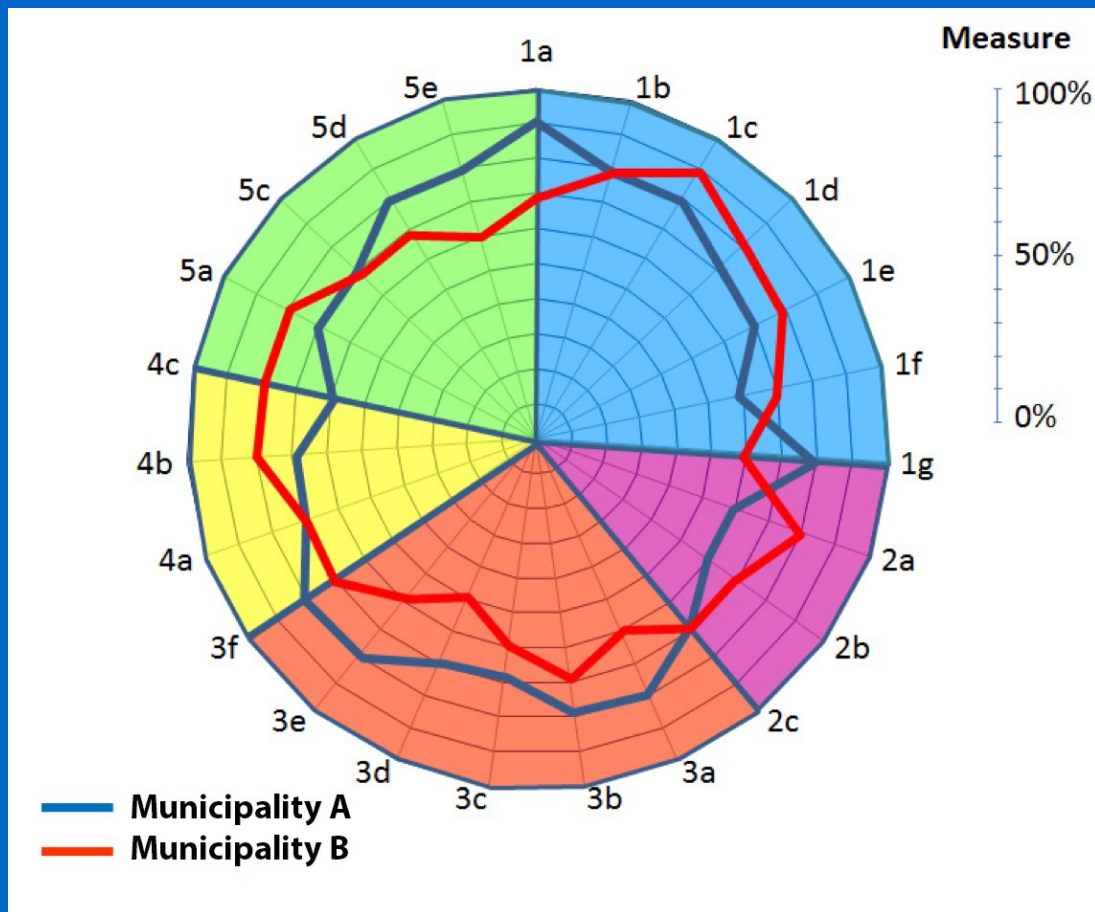
Organisation



© J.A. Brouwer / P.T.A. Liesting / R.E. Waterman (2015)

Values	Objectives
1. Water quantity	a) Ensure flood protection b) Surface water & ground water regulation c) Drainage, irrigation for agriculture & aquaculture d) Drinking water supply e) Cooling water f) Process water g) Water flow, thermal, osmotic energy
2. Water quality	a) Improvement of water quality for environment b) Improvement of water quality for nature c) Improvement of water quality for health
3. Navigability	a) Commercial transport of persons b) Commercial transport of goods c) Tourism and recreation d) Special events on/at water e) Water related sports f) Waterway classification & connectivity
4. Water front revenues	a) Increased liveability b) Economic activities c) Increased value of property
5. Spatial quality revenues	a) Improved urban & rural environment b) Preservation & restoration of cultural heritage c) Attractive residential & business areas d) Leisure parks, sustainable industrial parks e) Overall sustainability, also with regard to climate & climate change

Aquapuncture - Shared Value: Societal Costs & Benefits Measurement Model



Jaipur



**Capital of Rajasthan
6 million inhabitants**

INDIA

DRAVYAVATI RIVER REJUVENATION PROJECT

To transfer Jaipur into
a Clean Smart City

INVESTMENT:

+/- 210 Mln EUROS

CONSTRUCTION (3 YEARS):

170 Mln

MAINTENANCE (10 YEAR):

30 Mln

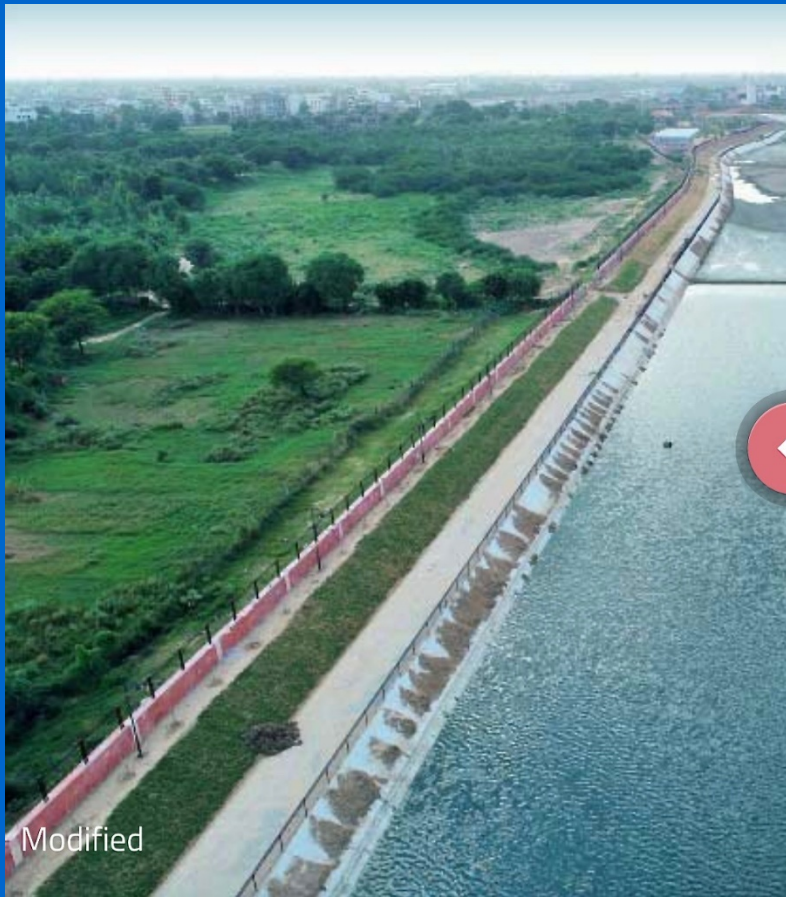


DRAVYAVATI River Rejuvenation Project:

- 47.5 km River Front**
- 18,000 Trees**
- 65,000 sqm Green Area**

Pollution Reduction
Rain Water Harvesting
Sewage Water Treatment
(5 Plants – 170 mln l / day)
Flood Control
Green Spaces
Social Spaces

Cleaner Air
Better Public Health
Improved Quality of Life
100% LED light
Attract Investments
a.o.



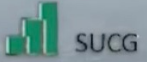
Modified



Original

DRAVYAVATI River Rejuvenation Project

TATA PROJECTS



DRAVYAVATI River Rejuvenation Project



Project Benefits



Experience Centre



Recreational Zones



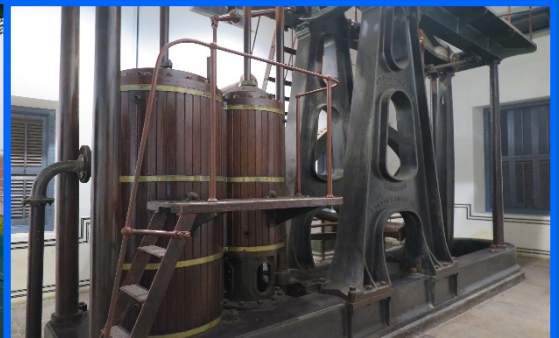
WIFI Hotspots / VCS



Botanical Garden



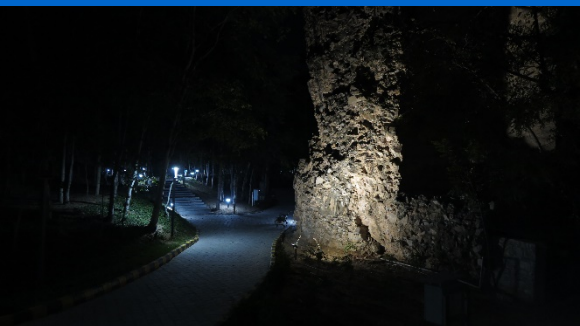
Landscape Park (leisure)



Heritage Waterworks Museum



Walking, Cycle & Jogging Tracks



Bird Park



Food Plazas

SUSTAINABLE USE OF INLAND WATERWAYS

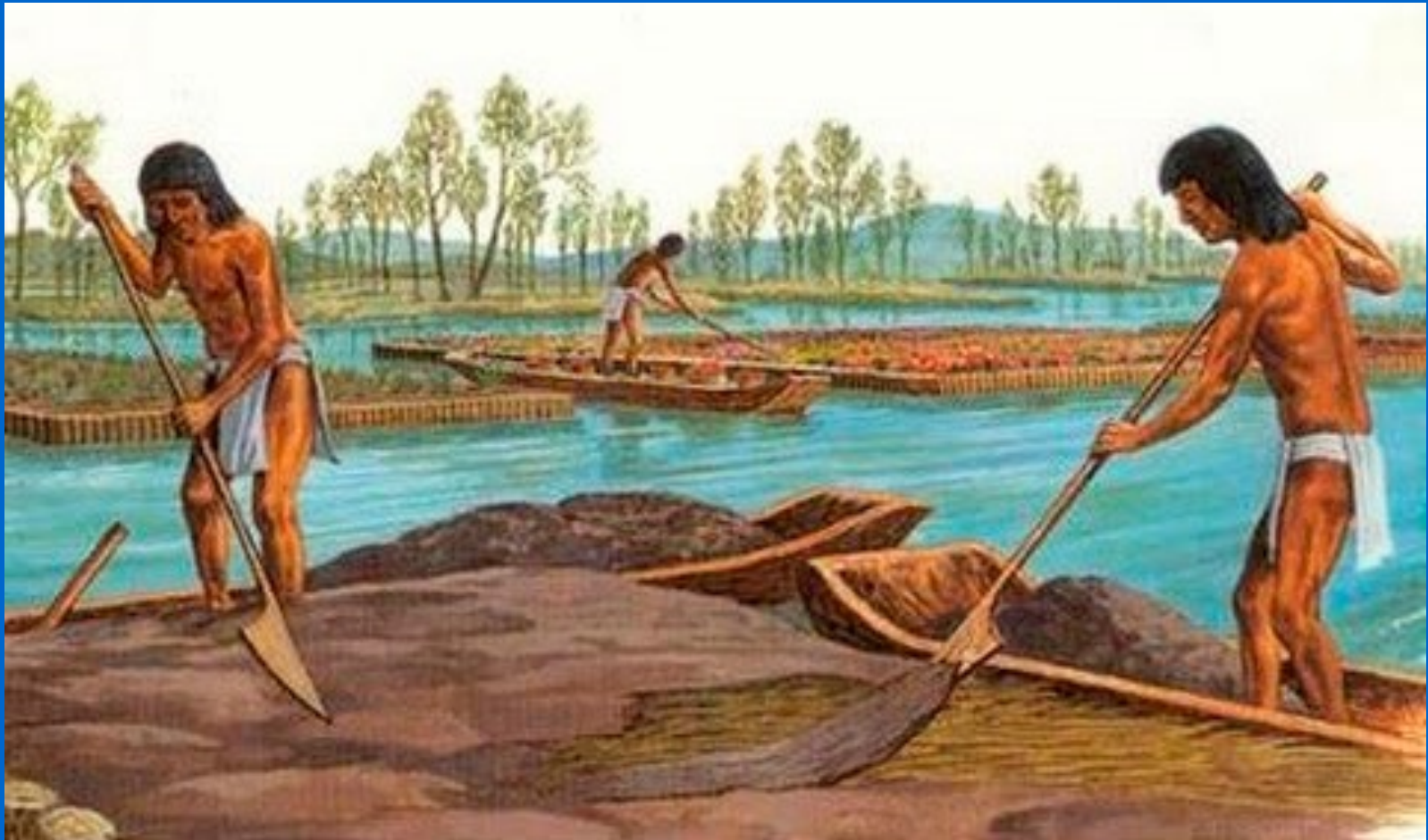
MEXICO - Mexico City back to the future through Aquapuncture
Aztec period > Tenochtitlan > Mexico City



Xochimilco – Chinampas – World Heritage Site



Xochimilco – Chinampas – World Heritage Site



Xochimilco – Chinampas – World Heritage Site



SUSTAINABLE USE OF INLAND WATERWAYS

COLOMBIA - Recuperación del Canal del Dique



Length 120 km, from Catagena to Río Magdalena & Calamar

Recuperation complete with dikes, new locks & marsh improvements

AGUAPUNTURA®
for the optimal use & adaptation of the waterway
and the waterfronts for economy, employment, environment, nature & landscape



Revitalisation Rio Medellin, Rio Bogota, Rio Cauca & Rio Cali via Aquapuncture

Rio Magdalena



**Rio Magdalena –
Length 1540 km**

AGUAPUNTURA®
for the optimal use & adaptation of
the waterway and the waterfronts for
economy, employment,
environment, nature & landscape

Rio Bogotá



The relation between Bogotá and the Río Bogotá should be improved through AGUAPUNTURA®

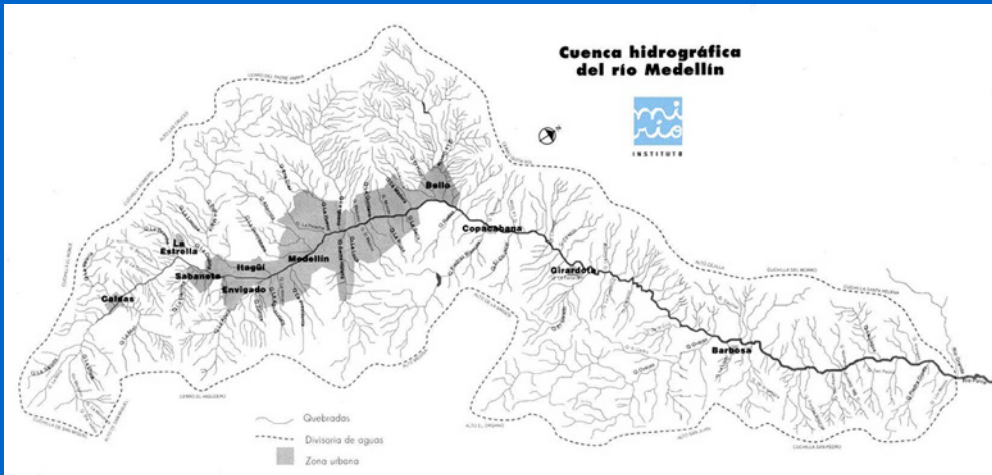
AGUAPUNTURA® for the optimal use & adaptation of the waterway and the waterfronts for economy, employment, environment, nature & landscape

Bogotá

7.3 million inhabitants



Rio Medellin



Medellin - 2.2 million inhabitants

**Rio Medellin -Length 100 km
(60 km Medellin & 40 km Porce)**

AGUAPUNTURA®
for the optimal use & adaptation of the
waterway and the waterfronts for
economy, employment, environment,
nature & landscape

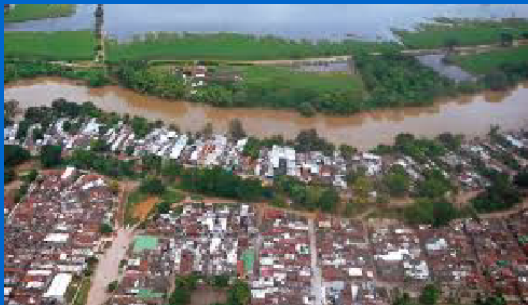


Rio Cauca



**Rio Cauca –
Length 965 km**

**AGUAPUNTURA®
for the optimal use &
adaptation of the
waterway
and the waterfronts for
economy, employment,
environment, nature &
landscape**



Rio Cali



**Santiago de Cali –
2.0 million inhabitants**

Rio Cali

AGUAPUNTURA®
for the optimal use & adaptation of the
waterway and their waterfronts for
economy, employment, environment,
nature & landscape





Network Recreational Waterways

4714 km in various navigational classes

1005 fixed bridges

1107 open bridges

258 ship locks

1100 marinas with 178,000 berths
40,000 berths outside marinas

Employment Water Recreation

30,000 jobs

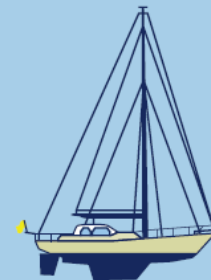
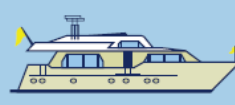
€ 4 billion total revenue

400,000 pleasure boats

2,000,000 water sport participants

€ 75 spending per boat per day

Recreational Navigation Classification



DESIGNATION	OPEN BOAT	CABIN CRUISER	MOTOR YACHT	SAILING BOAT	MOTOR BARGE
CLASS	RA	RB	RC	RD	I
MAX . LENGTH (M)	5.5	9.5	15.0	15.0	38.5
MAX. BEAM (M)	2.0	3.0	4.0	4.0	5.05
DRAUGHT (M)	0.5	1.0	1.5	2.0	1.8 – 2.2
MIN. HEIGHT UNDER BRIDGES (M)	2.0	3.25	4.0	30.0	4.0

SUSTAINABLE USE OF INLAND WATERWAYS

Rhine-Schie Canal with adjacent waters in use for:

- Commercial craft for shipment of bulk cargo (raw materials, industrial & domestic wastes, finished products)
- Passenger cruises for visiting old Dutch cities: Leiden, Gouda, Schiedam, Delft, Vlaardingen, Alphen a/d Rijn en Katwijk
- Water buses & Water taxis
- Yachts of all sizes; heritage ships
- Water related sports: rowing, canoeing, rafting, fishing/angling, sailing
- Special events like floating flower shows, naval parade of historical vessels, concerts on



Association Region Water (VRW)



Promotes the sustainable use of the waterway system with attractive waterfronts for tourism, recreation & sport.

Participants in this association: 13 Cities & 2 Water Boards with representation from Chamber of Commerce, hotel / restaurant / café-sector, leisure parks, water sport sector, fishing, canoeing, rowing, sailing, motor boating.

Close cooperation with Dutch Recreational Waterways Foundation (SRN), Province South-Holland & Local Harbour Masters (safe guarding nautical safety).

Taking into account laws and regulations on the various governmental levels.

ROTTERDAM

Waterfront development along river & harbours



Bron: Programma Rivieroevers - Toekomstperspectief
en Uitvoeringsprogramma - Gemeente Rotterdam

ROTTERDAM

Waterfront development along river & harbours

- **Attractive routes along river and harbours with emphasis on walking & cycling**
- **Introduction of green spaces**
- **Special attractions along the waterfront**
- **More and improved shipping connections**
- **Sustainable river development: cleaner, more natural and climate proof**
- **Strengthening liveability and identity of the river and its waterfronts**

ROTTERDAM

Waterfront development along river & harbours



ROTTERDAM

Waterfront development along river & harbours



ROTTERDAM

Waterfront development along river & harbours



ROTTERDAM

Waterfront development along river & harbours

Artist impression stadspark Maasboulevard

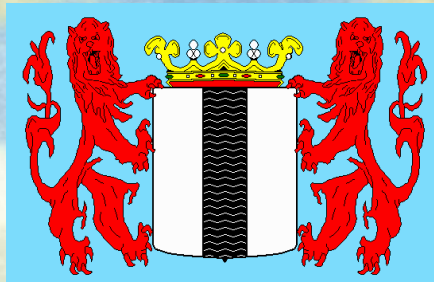


ROTTERDAM

Waterfront development along river & harbours

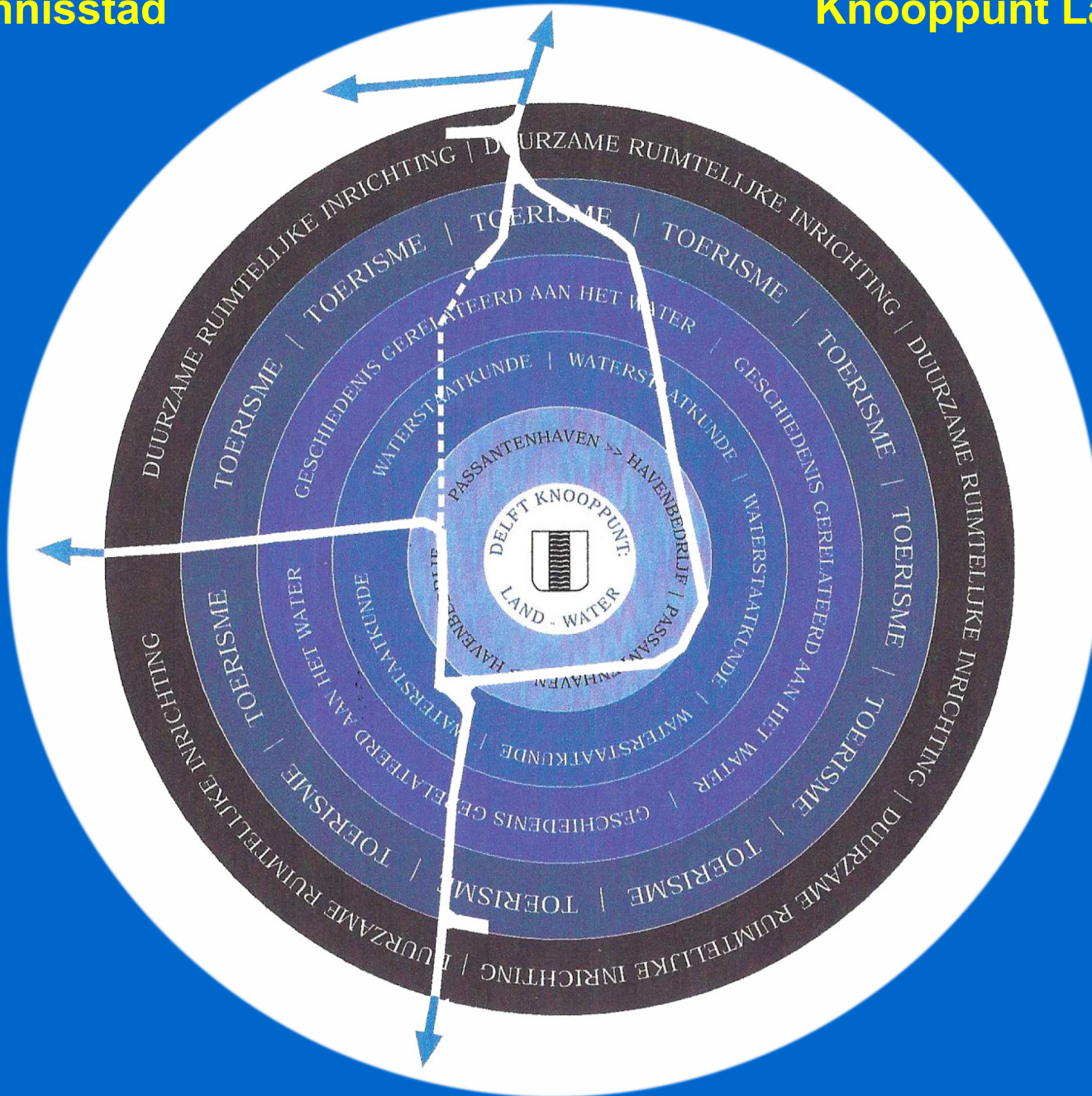


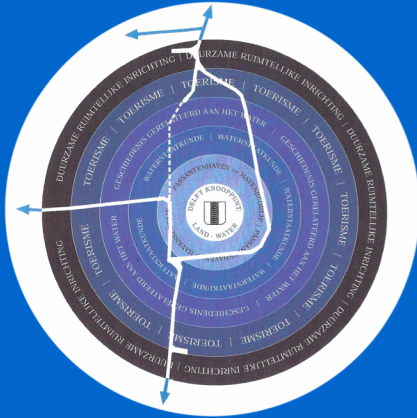
RELATIE DELFT - WATER



Dr. Ir. Ronald E. Waterman







HISTORIE DELFT – WATER

‘Delven’ – Delfshaven, Oude Delft, Delft VOC-stad, Hoogheemraadschap Delfland, Zeehelden (Piet Hein, Maarten HPZ Tromp), Hugo de Groot (zeerecht),

Antonie van Leeuwenhoek (ontdekker micro-organismen in water), Vermeer (Gezicht op Delft),

Cultuurhistorie Delftse grachtenpanden, Watergerelateerde bedrijvigheid (bierbrouwerijen, leerlooierijen, VOC-handelshuizen, Armamentarium) Beroepsvaart (jaagpad, groente- en fruit, afval, mest, stro, turf, zand, grind, kolen, melk, vee, melasse, trek- en pakschuit), NGSF - Gist Brocades - DSM

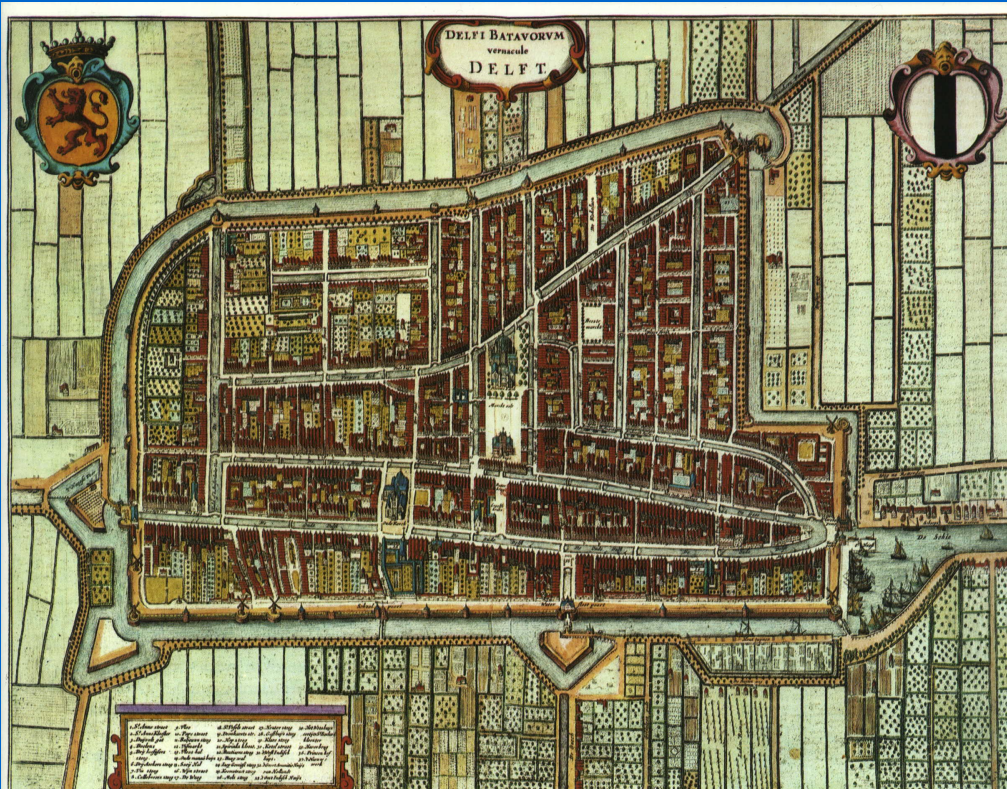
Geschiedenis van de techniek (Watercentrum: waterkwantiteit & -kwaliteit, oppervlaktewater, grondwater, drinkwater, afvalwater, waterzuivering, natte infrastructuur, waterbouw) Roeiverenigingen (DDS, LAGA, PROTEUS-ERETES)

WATERSTAATKUNDE

Deltares, TU Delft CiTG, UNESCO-IHE-Water Education Institute, TNO, Rijkswaterstaat Geo-Info., Hoogheemraadschap Delfland

DUURZAME RUIMTELIJKE STEDELIJKE INRICHTING

TOERISME & RECREATIE



**Sustainable
whispering route**

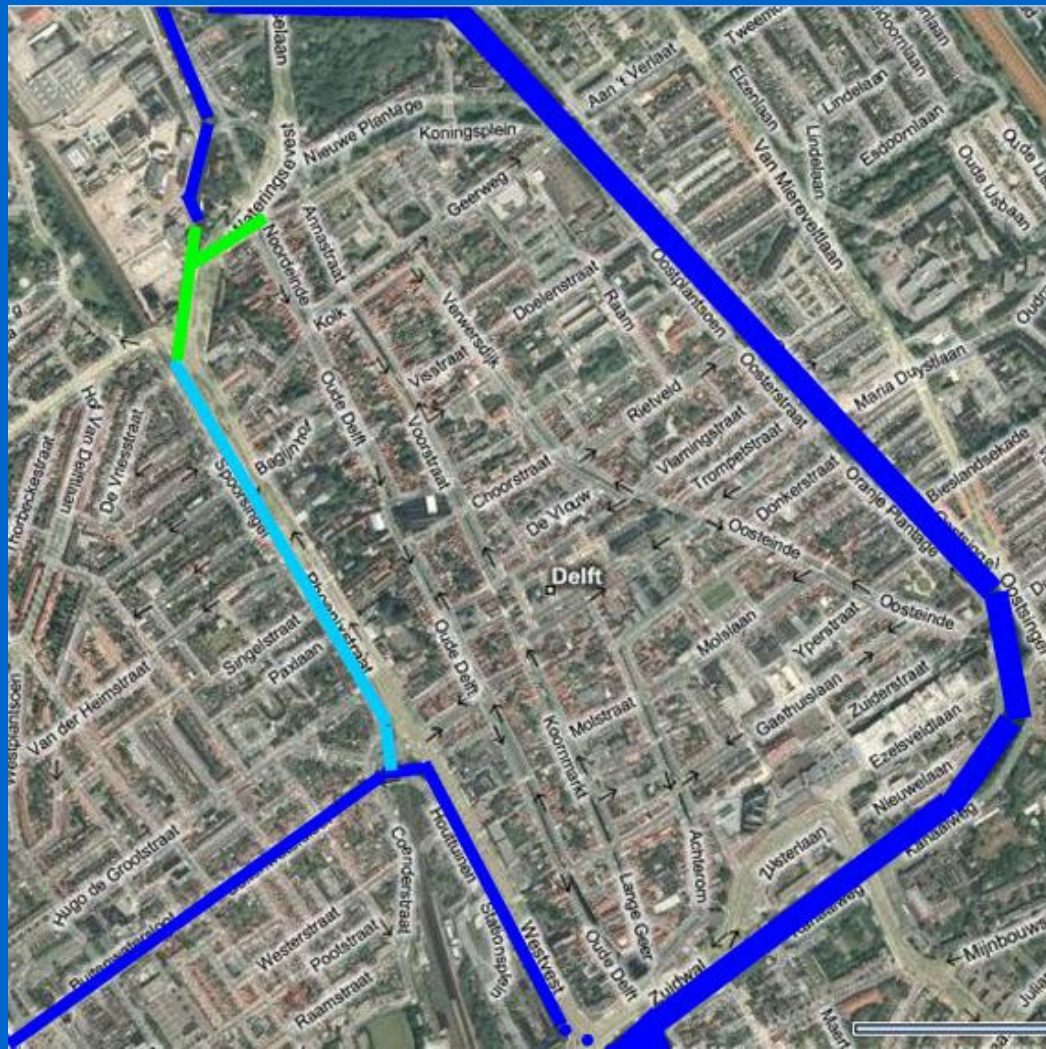
**Duurzame fluisterroute
in de historische
binnenstad**

**Met speciale smalle,
elektrisch aangedreven
vaartuigen met een beperkt
aantal zorgvuldig gekozen
aanmeerplaatsen**

*Good plans have their roots in the past and
are pointing towards the future*

*Goede plannen wortelen in het verleden en
wijzen naar de toekomst*





**Canal Cruise
Rondvaarboten**

&

**Sustainable
whispering route**



SUSTAINABLE USE OF INLAND WATERWAYS



**"Als het Water weer gaat stromen,
krijgt Gouda zijn ziel terug"**

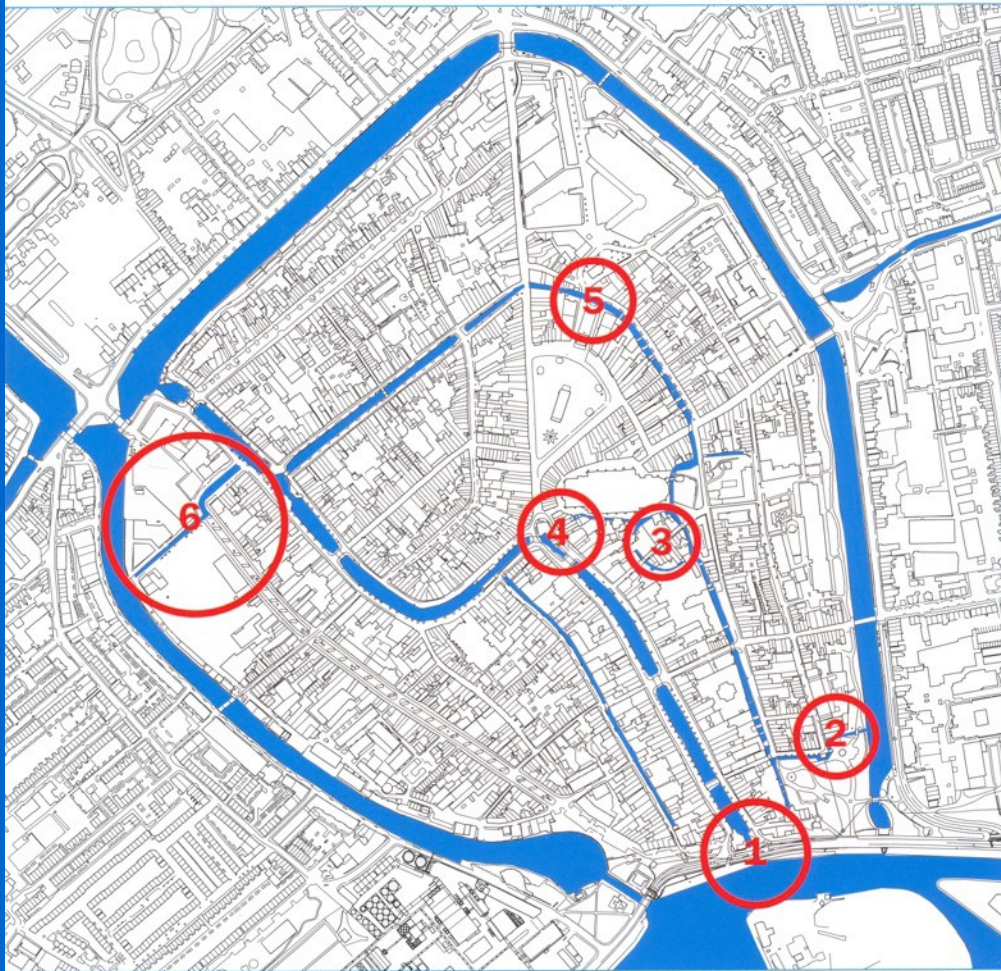


SUSTAINABLE USE OF INLAND WATERWAYS



Gouda met waterverbindingen – vroeger en nu

SUSTAINABLE USE OF INLAND WATERWAYS



**Knelpunten oplossen via
Aquapunctuur**

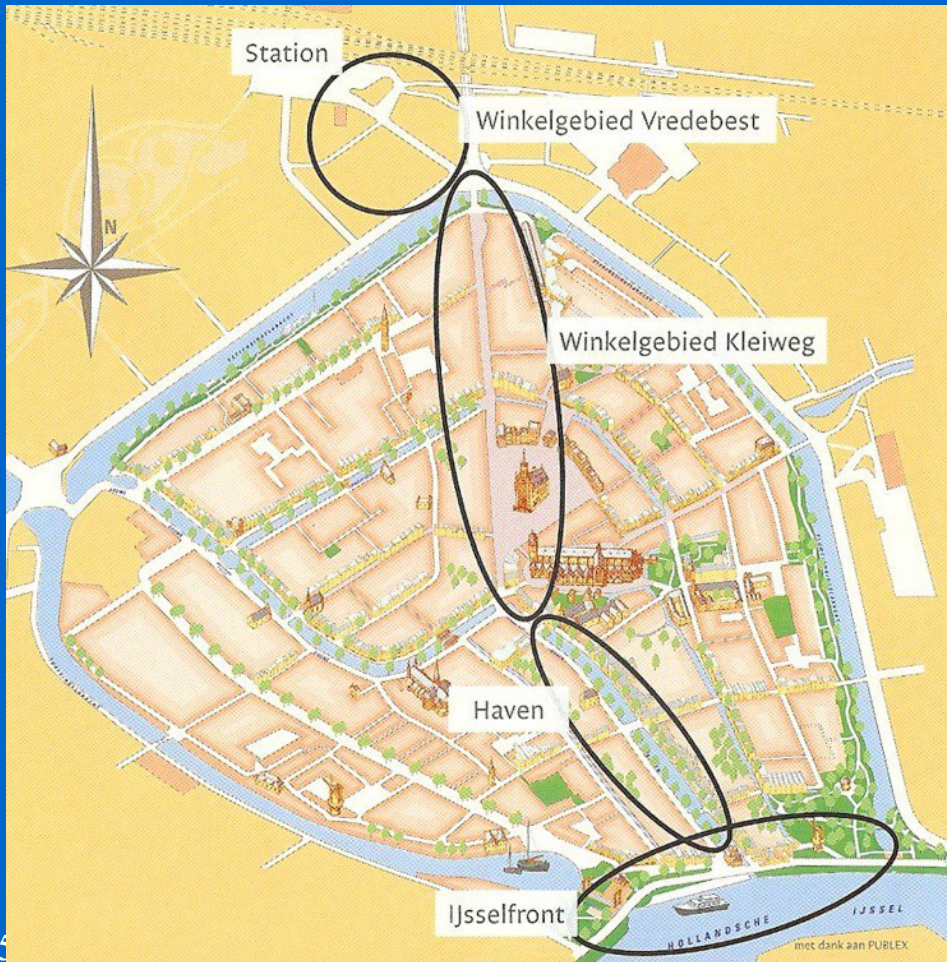
- a) Sluis & sluiscapaciteit
- b) Brughoogte
- c) Baggerdiepte
- d) Overige maatregelen

KNELPUNTEN

- 1 Havensluis
- 2 Vijverstraat
- 3 De Motte
- 4 Donkere Sluis / de Onderdoorgang
- 5 Achter de Waag
- 6 Nonnenwater / Verlorenkost

**Waterfrontontwikkeling -
Accent op cultuurhistorie**

SUSTAINABLE USE OF INLAND WATERWAYS



**Gouda als Waterstad
in Zuid-Hollands en
Europees perspectief**



Binnen-Dieze & Maximakanaal



Aftakking Zuid-Willemsvaart



Association Region Water (VRW)

- Improving Canal conditions for navigation referring to depths, widths, canal bank conditions and slope. Loading / unloading platforms, container terminals
- Height under bridges, ship lock adaptation, bridge and lock servicing, maintenance dredging
- River canalization, river / canal / training works with regard to critical sections
- Provision for safe mooring, berths, marina's, yachting harbours together with adequate facilities. These facilities are: drinking water supply, pumping stations for delivery of domestic wastes and bilge water, sewer systems, toilets, showers, electrical current supply, sign posting
- Ensuring navigational safety for all users of the waterway, with special attention for interaction between commercial craft and recreational vessels

Association Region Water (VRW)



- Development of Waterfronts with attractive boulevards with green elements, real estate developments, sufficient hotel – restaurant – café capacity, museums, shops & water related companies.
- Towing paths, footpaths, bicycle tracks, parking space, loading/unloading platforms along the waterways and eco zones.
- Promotion, restoration and maintenance of cultural heritage values and of region specific products & services.
- Conservation and development of landscapes along the waterway in between the towns.
- Introduction of cruises with music and catering aboard.
- Introduction of special boating events such as floating flower shows, concerts on water, naval parade of historical vessels, regattas, rowing competitions, revival of historical journeys on the waterway, water taxis linking historical sites.



Association Region Water (VRW)

- Linkage of the inland waterway with the North Sea
- Katwijk on Sea with special design of a yachting harbour linked through portage or sluice/shiplock with Old Rhine River and Rhine Schie Canal.
- The design is coupled with dune-beach widening on each side of the river mouth for reasons of climate change in order to protect the hinterland from flooding.





Association Region Water (VRW)

- Linkage of the inland waterway with the North Sea
- Katwijk on Sea with special design of a yachting harbour linked through portage or sluice/shiplock with Old Rhine River and Rhine Schie Canal.
- The design is coupled with dune-beach widening on each side of the river mouth for reasons of climate change in order to protect the hinterland from flooding (+ under dune parking facility).



Scheveningen 4th harbour
with dune/beach expansion
on each side

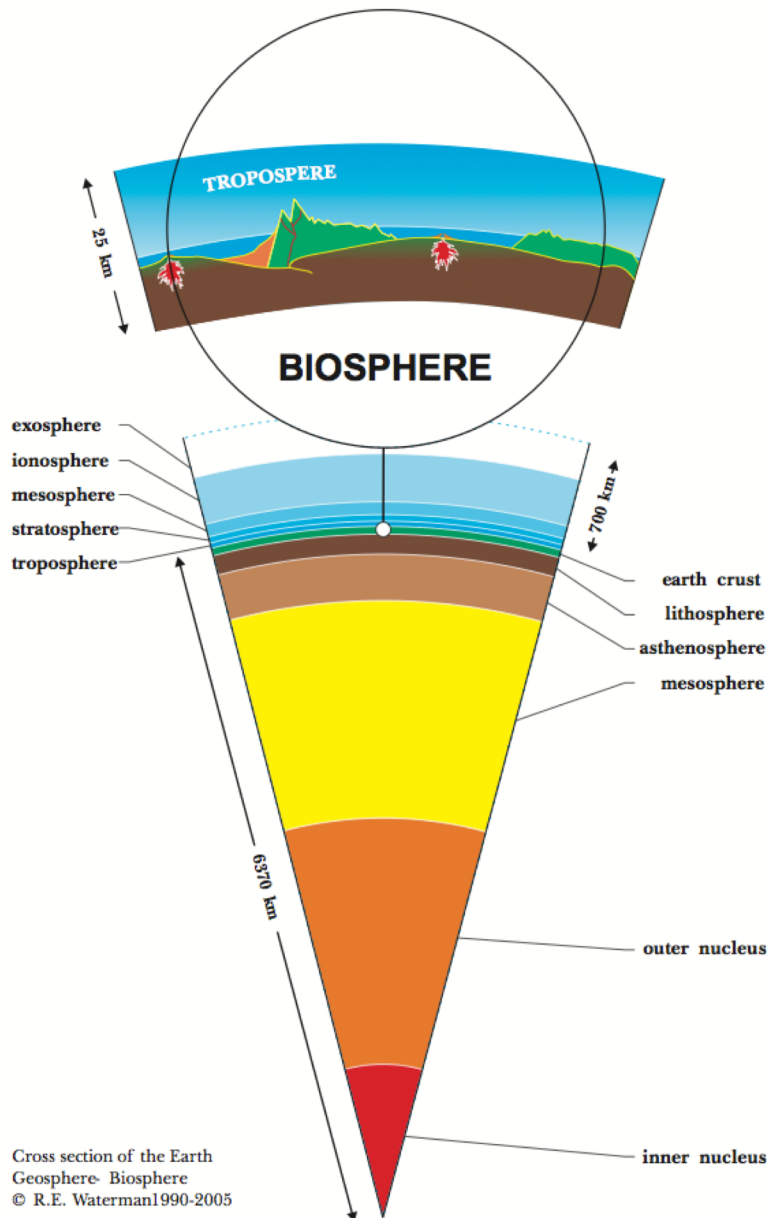
Linkage of inland waterway
with Scheveningen harbour
Complete with sluice



Environment

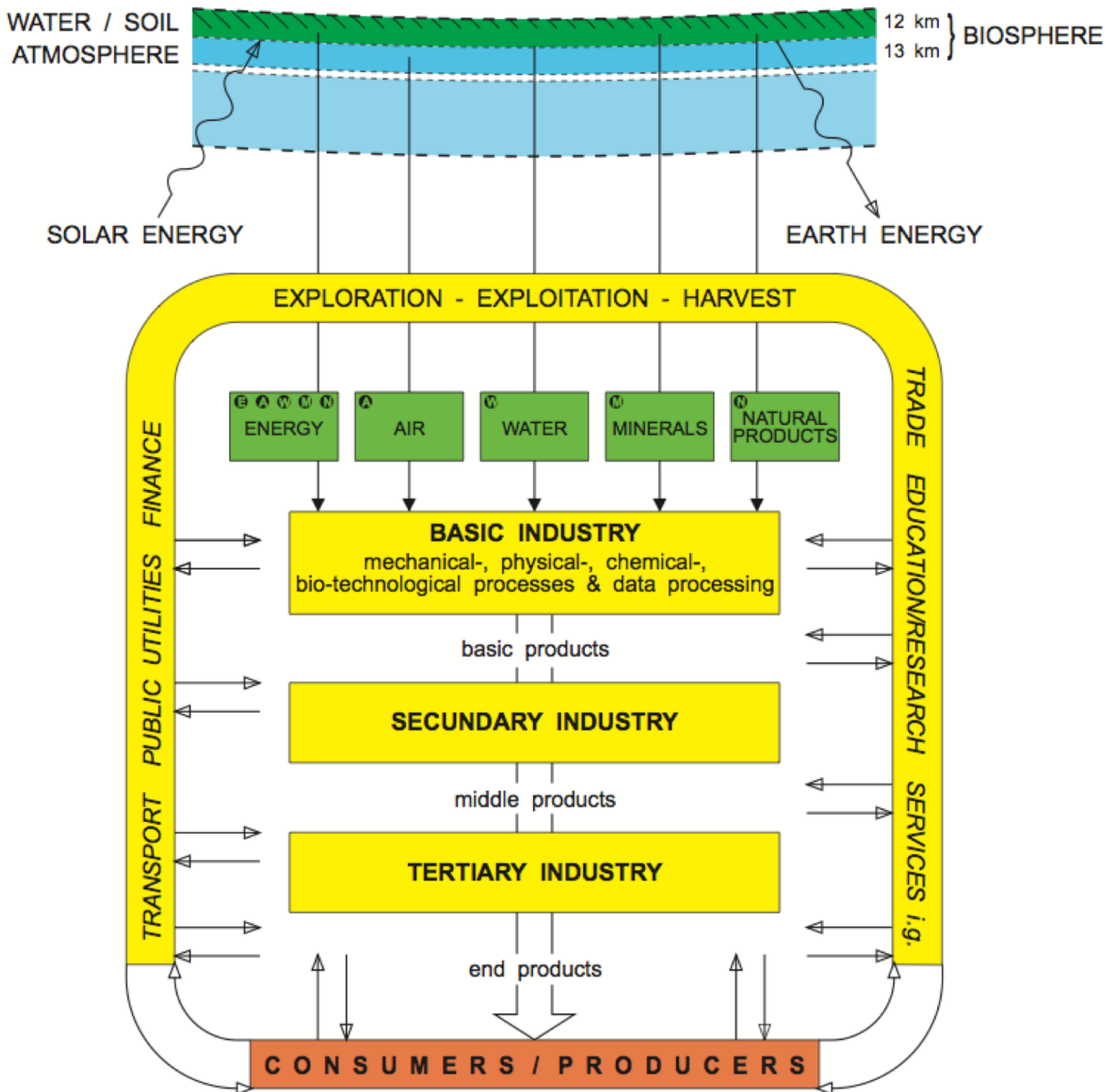
Apart from space travel all human activities take place in a thin shell around the earth: the geosphere - biosphere – sociosphere system

There we find the environmental compartments
Air – Water – Soil
and all the material expressions of human activities



EARTH

Earth radius: circa 6370 km
Total surface area / land + water: $510 \cdot 10^6 \text{ km}^2$
Environmental compartments: AIR/WATER/SOIL
Micro-organisms - Flora - Fauna incl. people



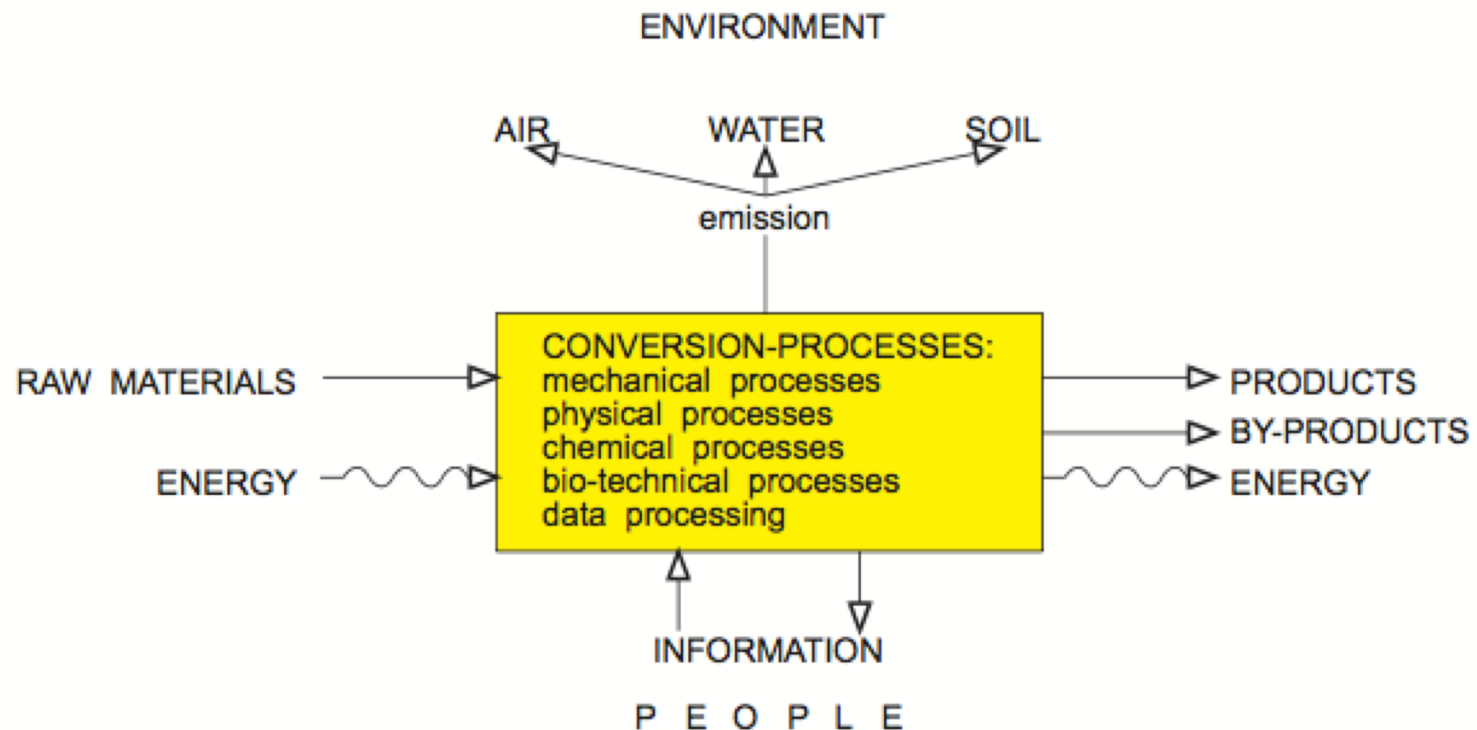
Environment

MANKIND extracts
from / in the
geosphere
raw materials
and energy

Every human being
is at the same time

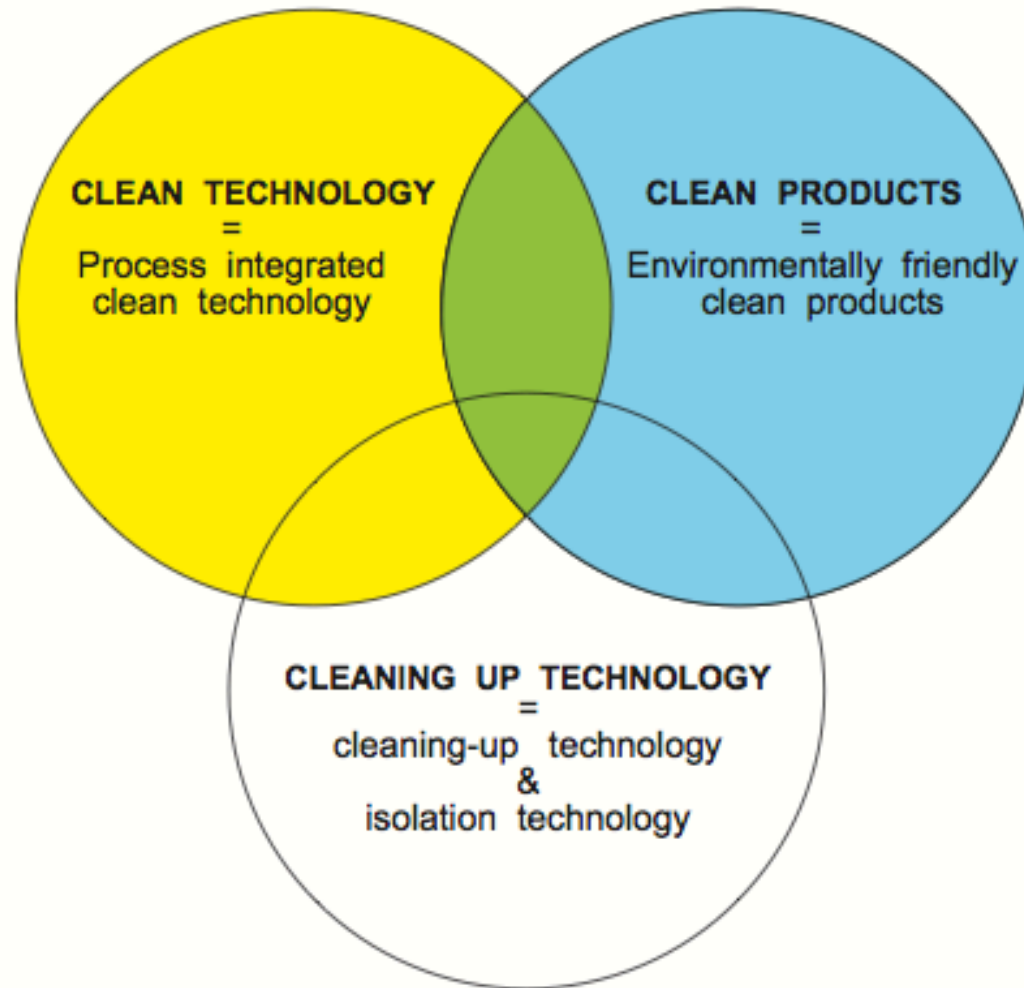
**PRODUCER &
CONSUMER**

Process innovations take place in the environment and are initiated, developed and managed by people



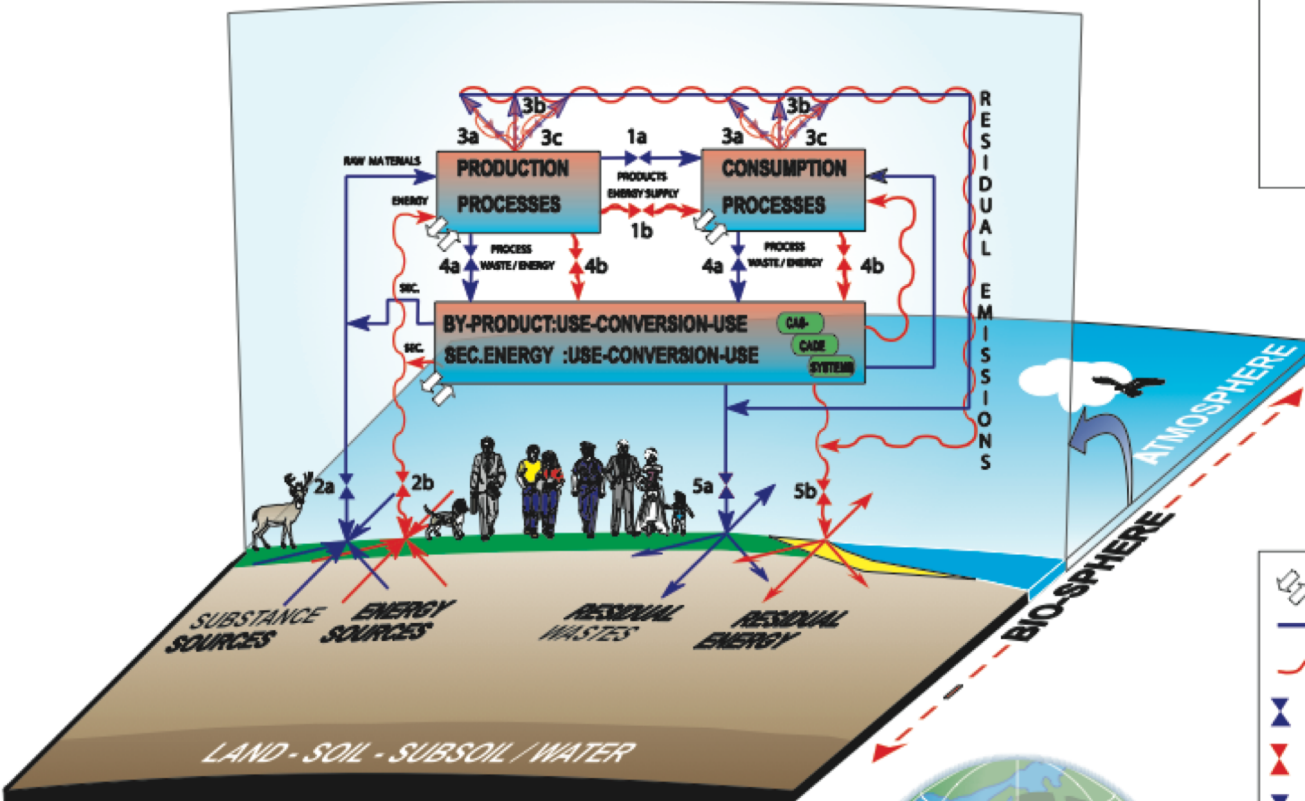
The great challenge of the 21st century is to develop and implement conversion processes in such a way that at the same time the economy is strengthened and the environment improved

Environmental Technology



Triple - C approach

TOWARDS A (CLOSED) MASS / ENERGY - CYCLE IN A SUSTAINABLE SOCIETY (in which up- and downgrading occurs)

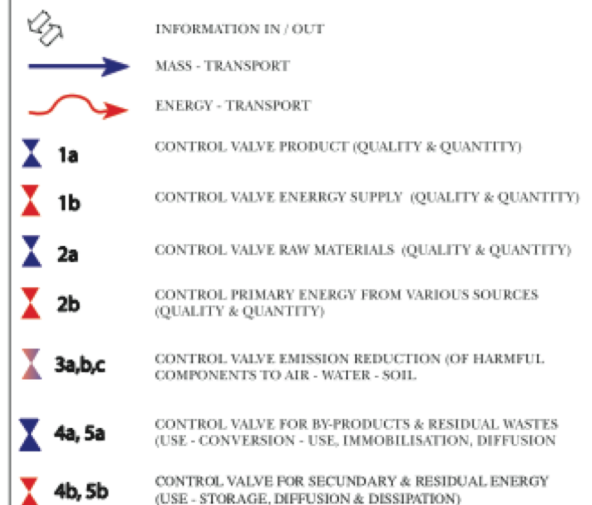


- The conversion processes take place in the environment. They are often initiated, developed and managed by people.
- Those processes should be developed whereby with less raw materials and less energy, valuable products can be produced at a higher yield, with less hazardous emissions to air/water/soil.
- In so far by-products are produced, these should be transformed into environmentally friendly products. If this is not feasible these by-products should be safely stored in order to protect the environment.
- Space- and time-factors should also be taken into account.

BIO-SPHERE :

- ENVIRONMENTAL COMPARTMENTS, AIR - WATER - SOIL
- MICRO-ORGANISMS, FLORA, FAUNA (INCL. PEOPLE)
- ECO - SYSTEMS
- ALL MATERIAL EXPRESSIONS OF HUMAN ACTIVITIES
- MASS SOURCES } VIA EXPLORATIONS, EXPLOITATION, MINING, CULTIVATION, HARVEST, ETC.
- ENERGY SOURCES }
- RESIDUAL WASTES } IMMOBILISATION / DIFFUSION & DISSIPATION
- RESIDUAL ENERGY }

ENVIRONMENTAL FOOT IMPRINT (IN HA)
=
FUNCTION (POPULATION, LIFESTYLE, TECHNOLOGY)

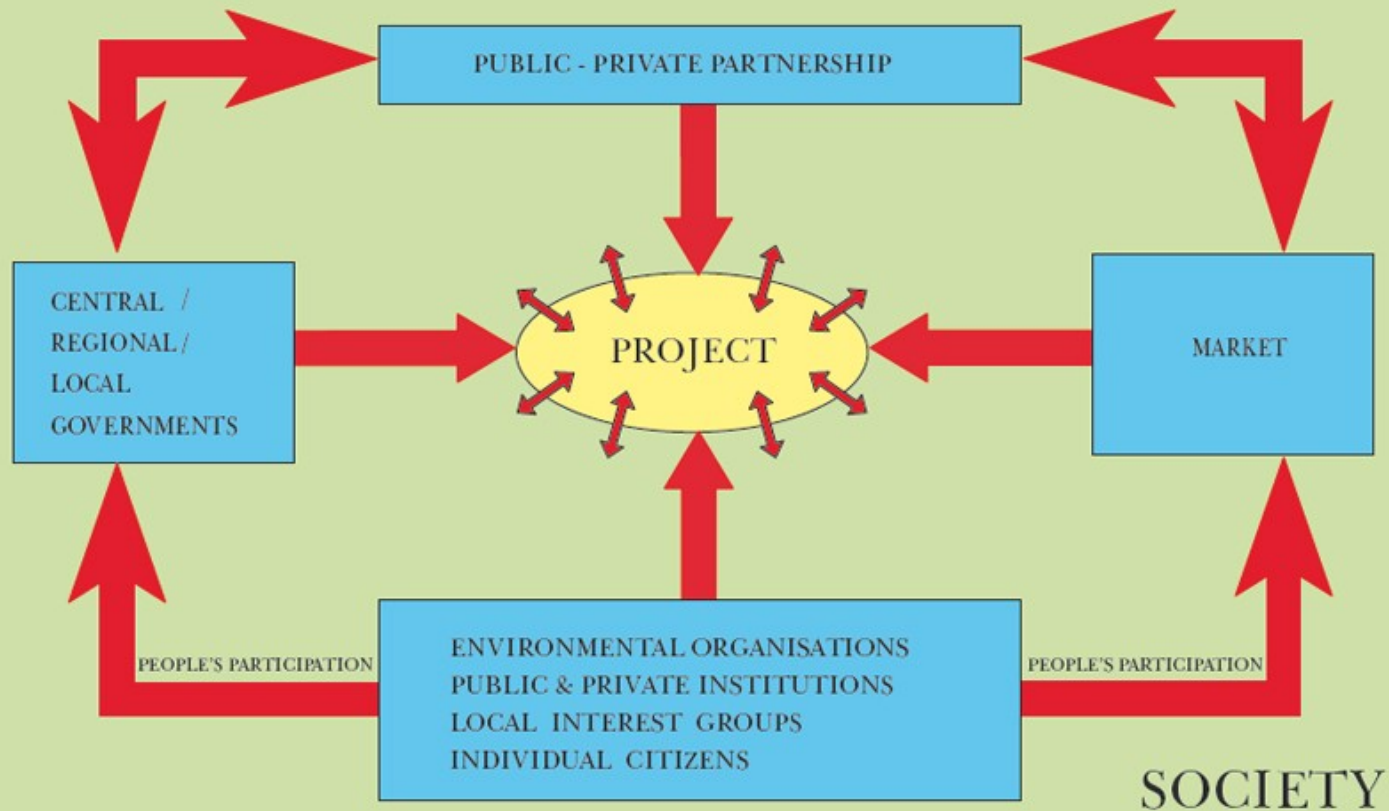


INTERACTIVE PLAN DEVELOPMENT



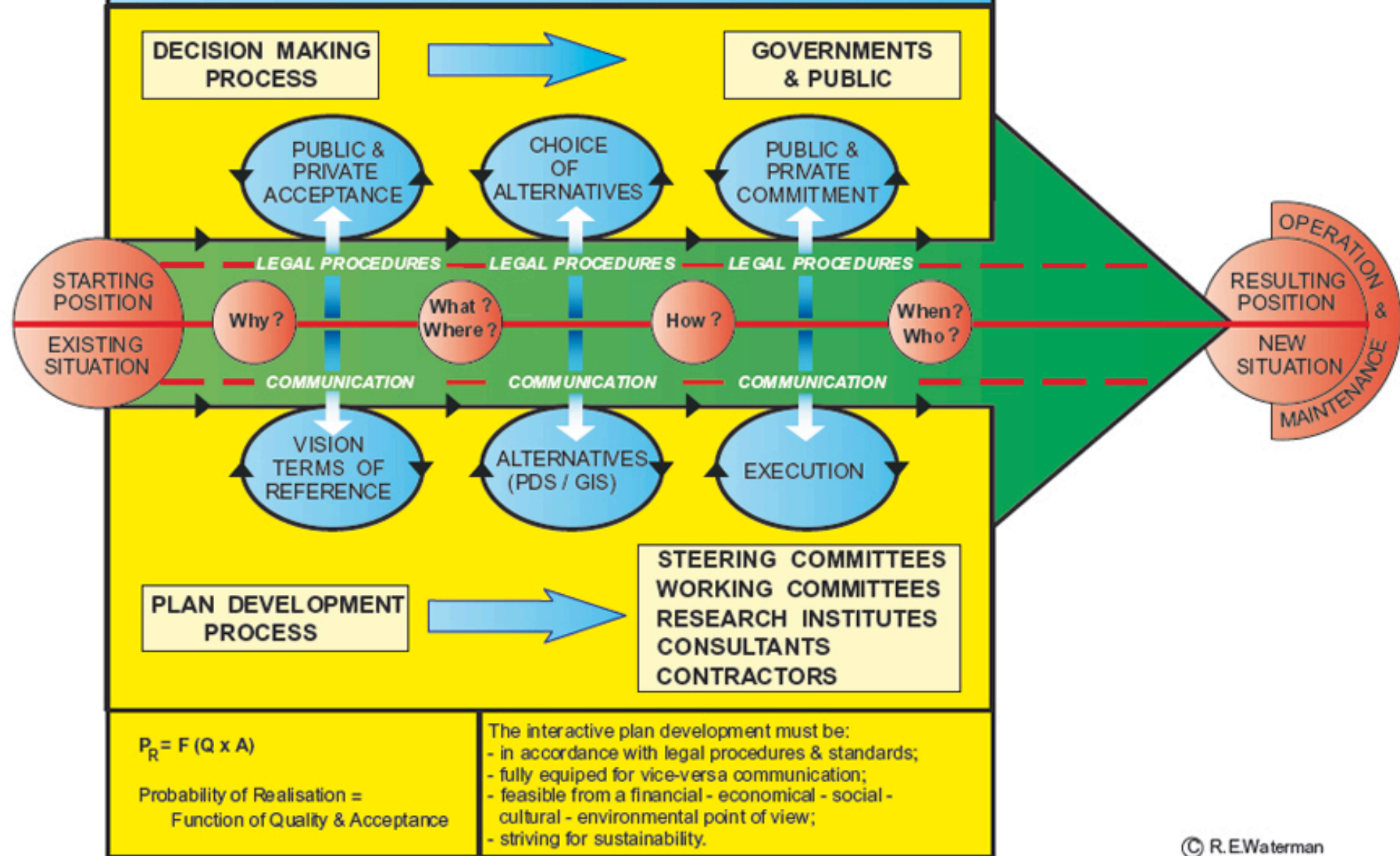
Plan Development in the past

ENVIRONMENT



A project - including its plan development - is situated and takes place in the environment and is initiated, propagated, criticised and executed by people. The project influences the environment and is influenced by the environment.

INTERACTIVE PLAN DEVELOPMENT



SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

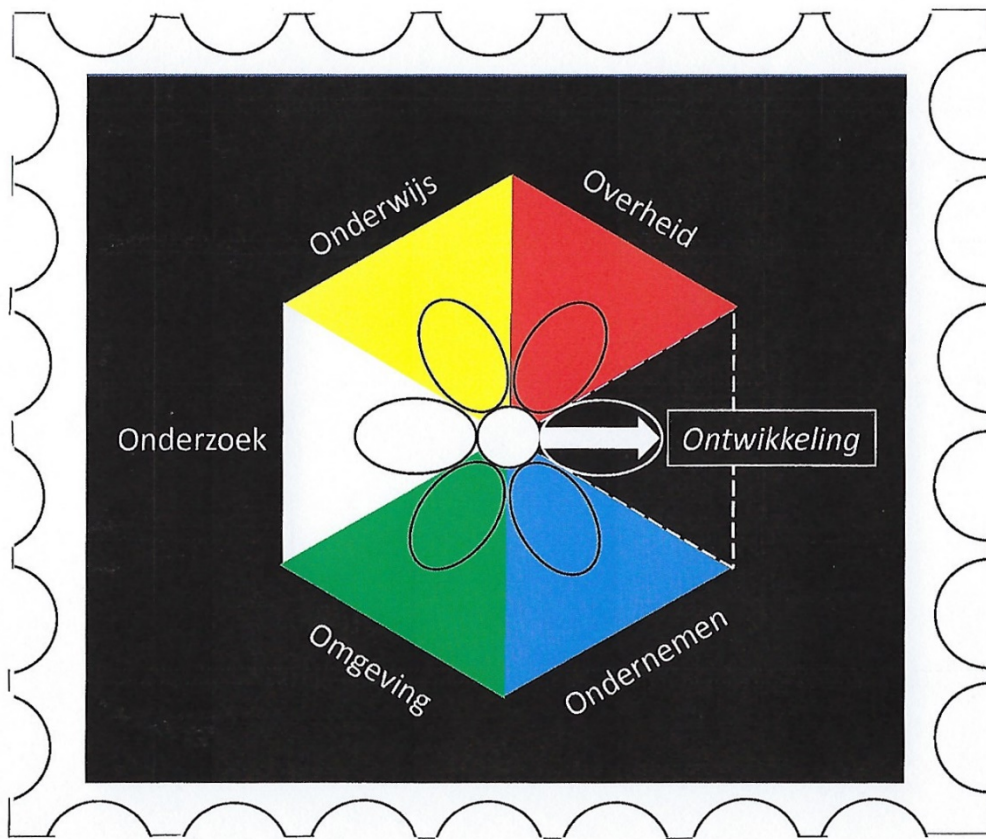
The described method is scientifically based and can be broadened and deepened.

Application can be realised on the basis of flexible masterplans, which can be executed phase after phase, segment after segment. Usage of an interactive plan development according the scheme is recommended.

To achieve sufficient support active co-operation of at least five sectors is necessary:

- governments**
- education**
- research**
- companies**
- environment, nature, landscape, social society, media**

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE



**5 O's leidend tot een
6^e O van Duurzame,
Bio-based Circulaire
Ontwikkeling**

- governments
- education
- research
- companies
- environment, nature, landscape, social society, media

**Leading to Sustainable,
Bio-based Circulaire
Development**

INTERACTIVE PLAN DEVELOPMENT

Vision

Vision plays a crucial and essential role from start to finish in any interactive plan development process.

Without vision neither an excellent plan design, nor its development can be achieved.

Every plan development is or should be based on a well-founded vision.

Ideally, this vision, placed in time and space, should be based on knowledge, insight, sensory perception, analytical skill, sound rational reasoning and intuition, inspiration and creativity.

1.1 “Creative Thinking – Thoughtful Acting.”
Motto Royal Dutch Institute of Engineers

1.2 “A Living Nation is Building its Future.”
Dr. Ir. C. Lely (1854 – 1929), the Netherlands

1.3 “Luctor et Emergo.” (“I struggle and emerge”)
Motto Province of Zeeland, the Netherlands

INTERACTIVE PLAN DEVELOPMENT

Vision

2.1 *"Nature is a brilliant source of inspiration and an excellent teacher for the development of well-designed plans."*

R.E. Waterman

2.2 *"Well-designed plans have their roots in the past and are pointing to the future."*

R.E. Waterman

2.3 *"The great challenge in this era is to develop methods that simultaneously improve the environment and strengthen the economy"*

R.E. Waterman

2.4 *"The most valuable resource available to us is our brain. Therefore let us together use these brains for the benefit of the environment, the economy and our fellow human beings."*

R.E. Waterman

2.5 *"Sharing knowledge is multiplying knowledge."*

Anonymous

2.6 *"Think Long-Term – Act Short-Term."*

P.J.A. van Hessen

3.1 *"If you will, it is no fairy-tale."*

Th. Herzl (1860-1904),
"Altneuland" (1899-1902)

3.2 *"Who doesn't believe in dreams, is not a realist."*

D. Ben Goerion (1886-1973)

3.3 *"Dream great dreams and take practical steps to turn them into reality."*

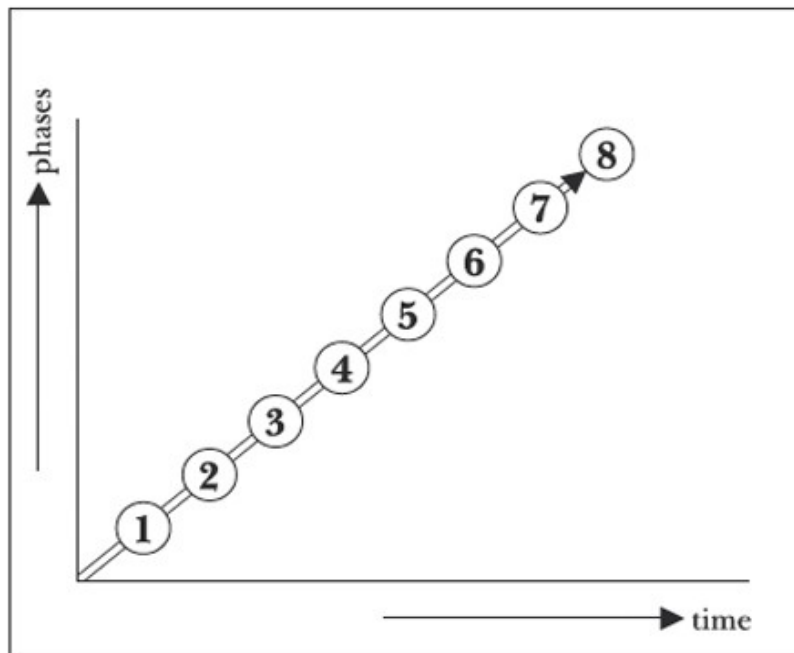
Henrietta Szold (1860-1945)

3.4 *"Dreams are not to soothe us asleep, but to shake us awake."*

R. Magritte (1898-1967), 1929

INTERACTIVE PLAN DEVELOPMENT

1. PLAN DEVELOPMENT & EXECUTION



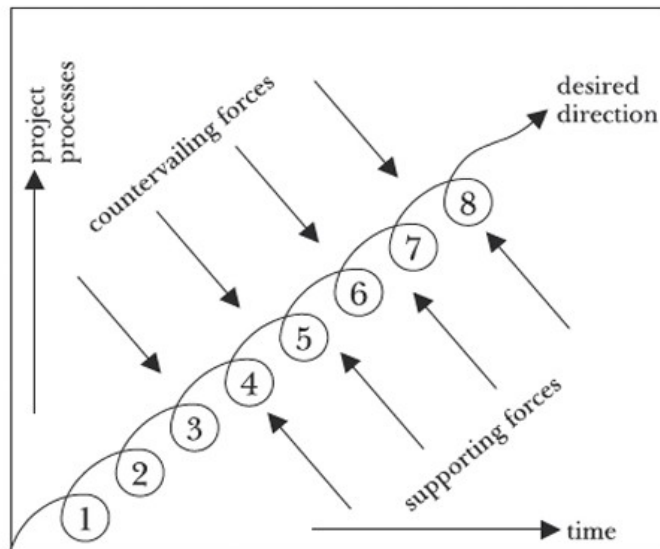
In the development and execution of a plan many phases can be distinguished. All other interacting processes, although of extreme importance, have been left out.

1. Existing situation.
2. Vision for a future situation.
3. Conceptual plan based on acquired data, trends, careful analysis and additional research.
4. From conceptual plan towards a number of concrete plans.
5. Fine tuning and final choice of selected plan.
6. Execution of chosen plan.
7. Wished for resulting situation.
8. Operation and maintenance of executed plan.

Additional Instruments

INTERACTIVE PLAN DEVELOPMENT

2. SERIES OF CYCLIC PROCESSES IN "FORCES FIELD"



- Mapping of Field Forces
- Field Force Analysis
- Weighing forces for and against a project

Weighing factor = f (availability & power to influence change)

3. SWOT ANALYSIS



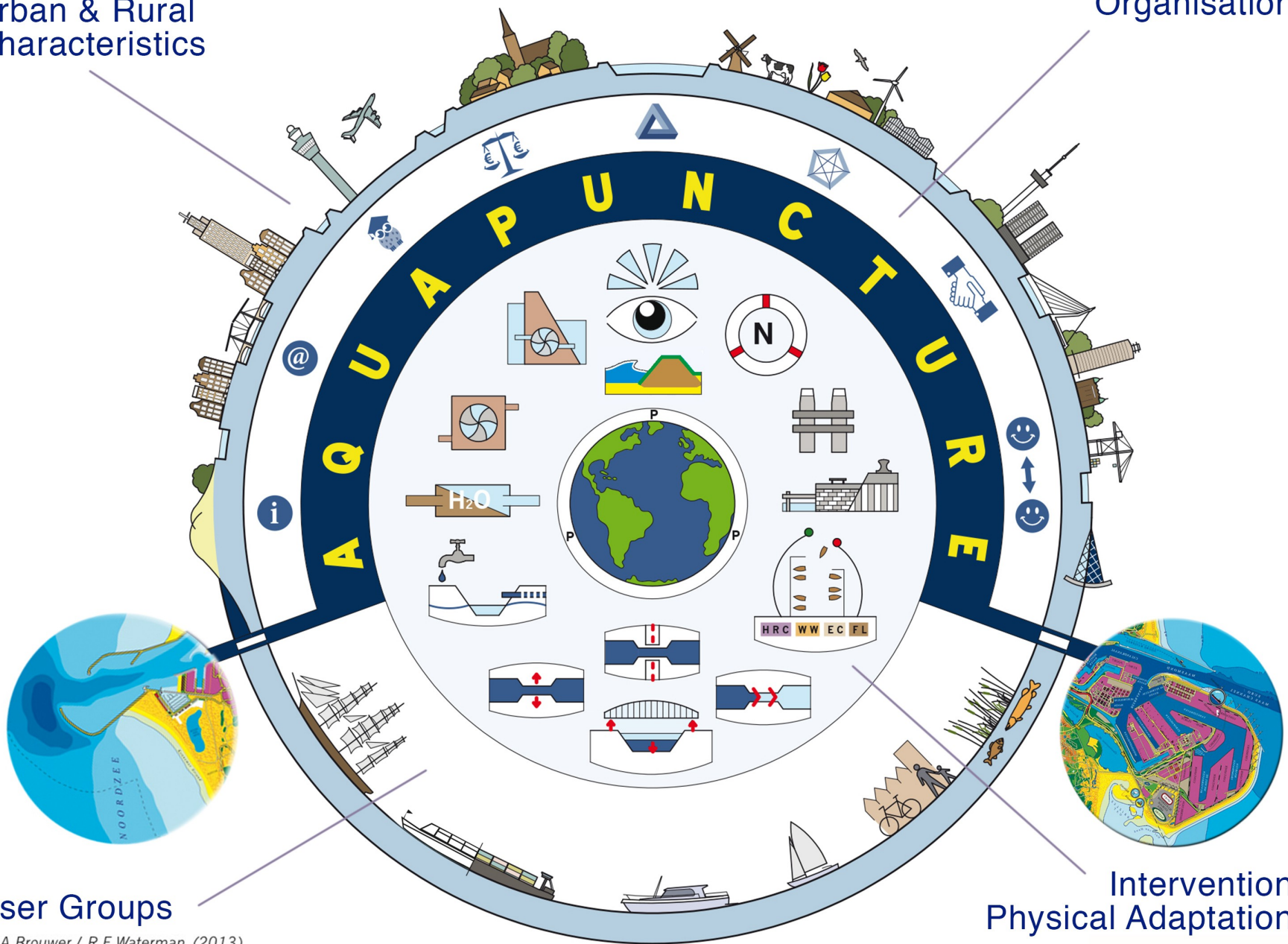
4. MULTI-CRITERIA ANALYSIS

Multi-criteria Analysis which weighs factors for comparative model research, whereby each relevant function from a to z is weighed qualitatively and quantitatively. This is an additional instrument to compare and evaluate a series of plans.

Additional Instruments

Urban & Rural
Characteristics

Organisation



User Groups

Interventions
Physical Adaptations