SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature®



Dr. R.E. Waterman MSc
January 2013





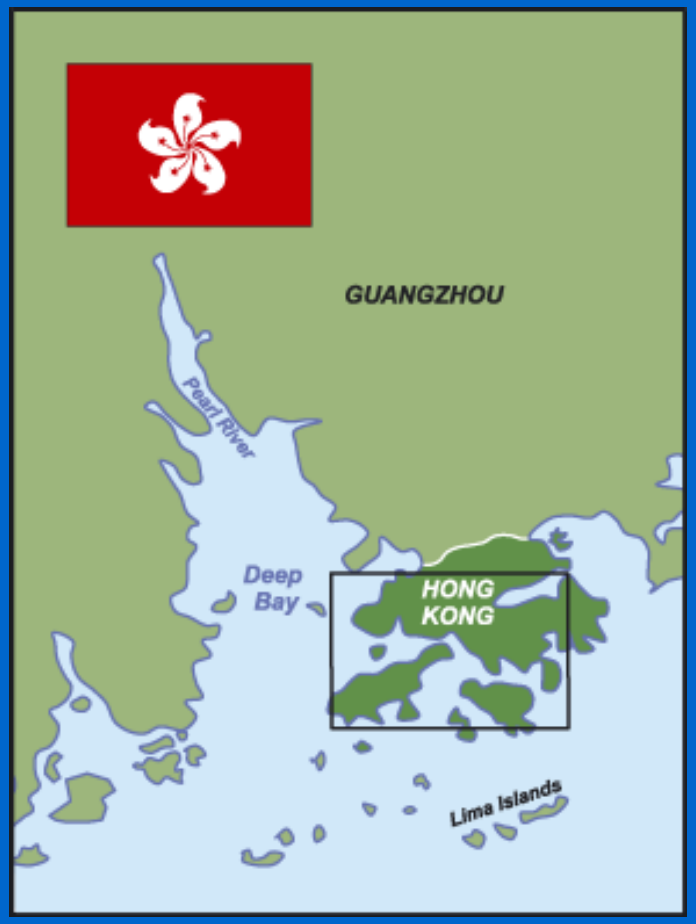
Peoples Republic of China
The Netherlands



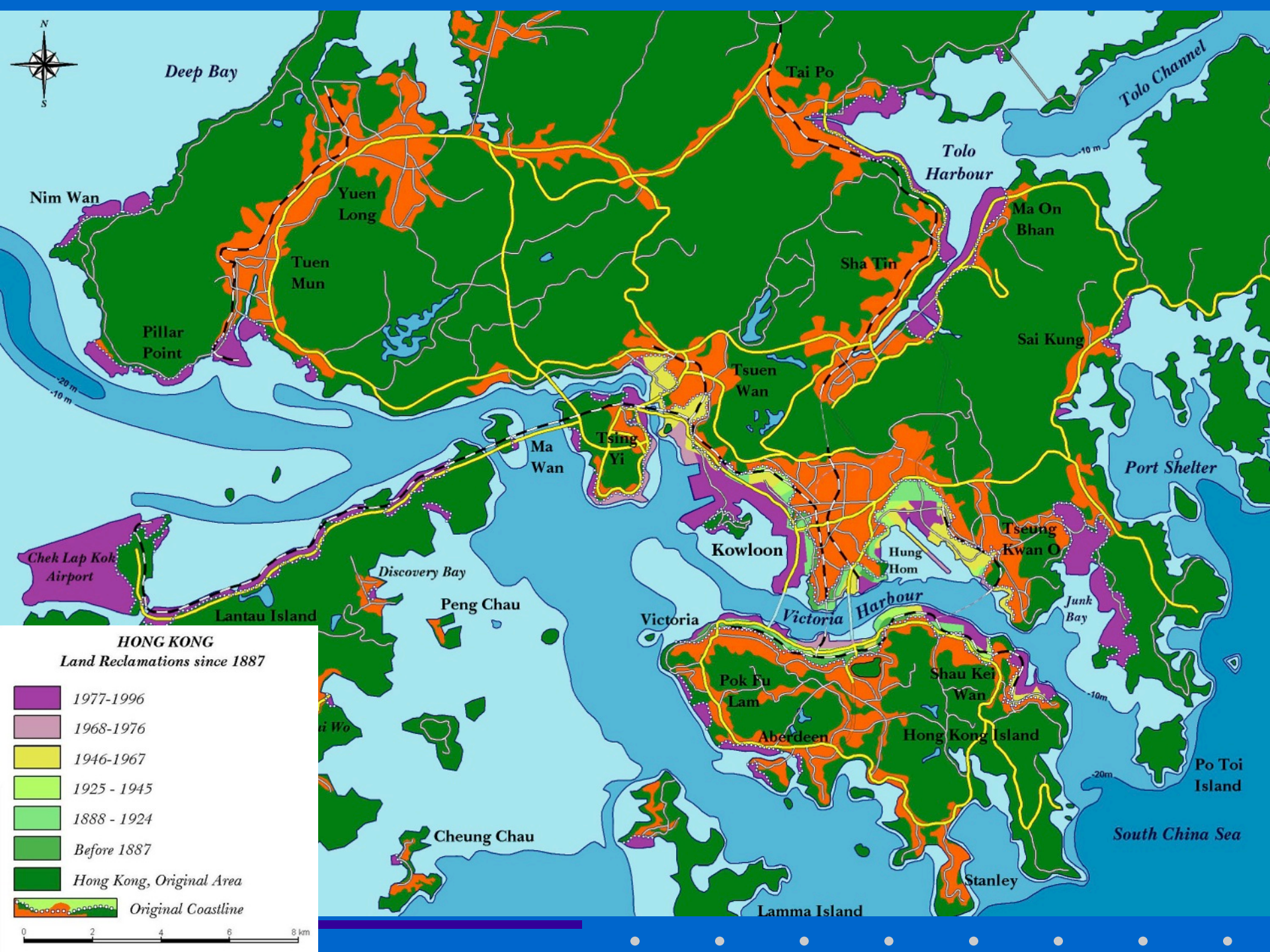
BUILDING WITH NATURE



China, Hong Kong



Hong Kong


N
S
Deep Bay
Tai Po
Tolo Channel
Tolo Harbour
-10 m
Nim Wan
Yuen Long
Tuen Mun
Ma On Bhan
Sha Tin
Pillar Point
Sai Kung
-20 m
-10 m
Tsuen Wan
Tsing Yi
Ma Wan
Port Shelter
Chek Lap Kok Airport
Kowloon
Hung Hom
Tseung Kwan O
Discovery Bay
Peng Chau
Lantau Island
Victoria
Victoria Harbour
Junk Bay
Pok Fu Lam
Shau Kei Wan
Aberdeen
Hong Kong Island
-10m
-20m
Po Toi Island
South China Sea
Cheung Chau
Stanley
Lamma Island
HONG KONG
Land Reclamations since 1887
1977-1996
1968-1976
1946-1967
1925 - 1945
1888 - 1924
Before 1887
Hong Kong, Original Area
Original Coastline
0
2
4
6
8 km







Hong Kong International Airport





Hong Kong





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Integrated Coastal & Deltaic Policy via Building with Nature®



Dr. R.E. Waterman MSc

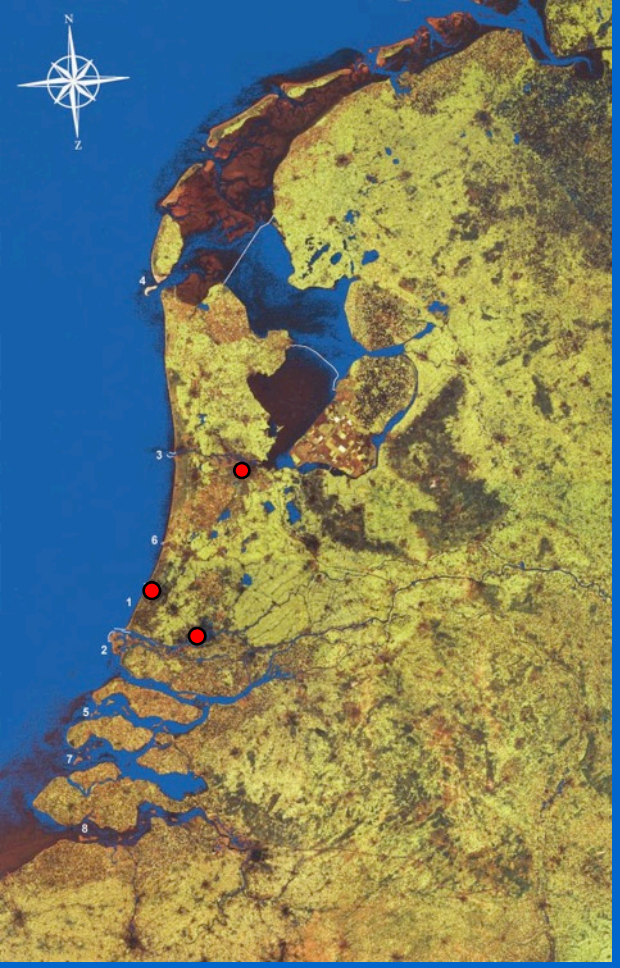
FUJIAN
March 2012





Peoples Republic of China
The Netherlands





THE NETHERLANDS

Surface Area 41,526 km²

Inhabitants 17 million



FUJIAN

Surface Area 121,400 km² Inhabitants 36.9 million


Jinjiang Weitou Bay
Tongan
Anhai
Hongjian Shan
514
Dongshi
562
406
1767
Jimei
WEITOU WAN
Weitou
XIAMEN DAO
XIAMEN
337
252
JINMEN DAO
Xiaojinmen Dao
Jinmen
Liaoluo Wan
Obstns
Obstn
PA
Beiding Dao
Fl(2)10s36m11M
Explos
Rep(2005)
Rep(2006)
XIAMEN GANG
Dadan Dao
Fl.3s10M
Qing Yu
Fl(4)20s18M
FORMER MINED AREAS
(see Note)
Fl.R.4s
Wk
2kn
M.S
24° 30′
25′
35′
40′
45′

Jinjiang Weitou Bay Reclamation

ca.15 x 3 km : land 34 km² water 10.7 km²





Xiamen
3.5 million inhabitants

Jinjiang
1 million inhabitants

13 neighbourhoods

a. Residential Area
b. Ocean park
c. Business & sports





YUNXIAO

Development Zone
LED Technology Centre
& Fishing Harbour
with Residential Area



GULEI PENINSULA

Harbour Development
Zone



DONGSHAN

High Tech Industry
Industry & Logistics
Green Axis
Ecological Farmland
Residential Area
Marine Industry Area
Tourism Area

DONGSHAN DAO & DONGSHAN WAN

BUILDING WITH NATURE

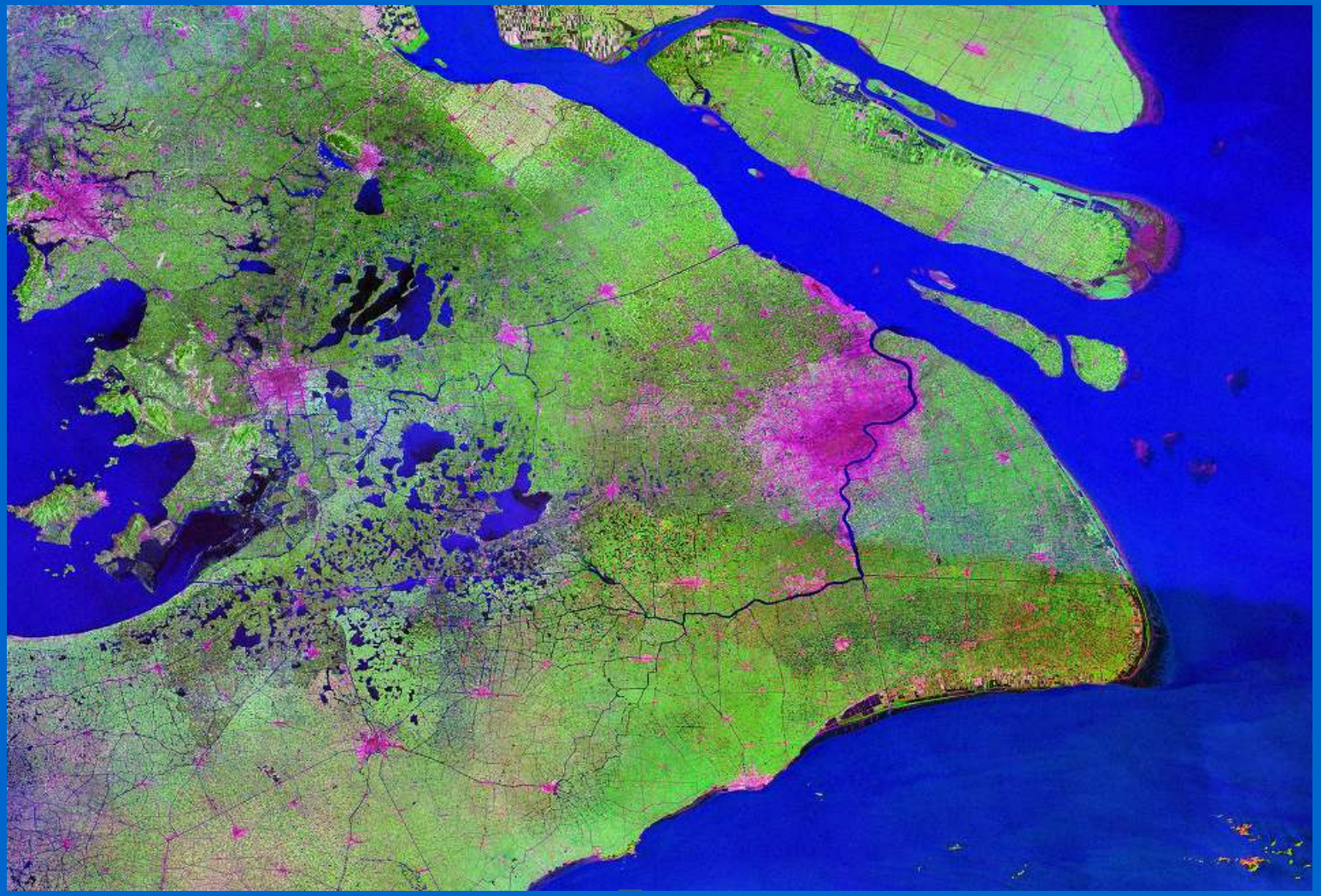


China, Shanghai



Shanghai

BUILDING WITH NATURE



Shanghai

Shanghai





Chongming
Yangtze
Nanbu
Chaoyang
Chong Ming Dao
Shangxing Dao
Beigang Shuidao
Fast Railway Connection
Wusong
Nangang Shuidao
Hengsha Dao
Airport
Shaughai
Gao Miao
Suzhou
Pudong
Chuansha
Nancao Shuidao
Kangqiao
Zhoupu
Duhang
Nanhui
Pudong International Airport
Xinchang
Minhang
Huangpu
Datuan
Yellow Sea
Lu Chao New Port City
Nanqiao
Nicheng
Fengcheng
Donghai Bridge
Dajishan
Sijiaohan
Xugong Dao
Xiaoyangshan Dao
Tanxushan
Baishan
Hangzhou Bay
Dayangshan
Yangshan Port
Qushan Dao
Dayushan
Daishan Dao
Dachangjiashan
SHANGHAI
Land Reclamations
Projected Reclamations

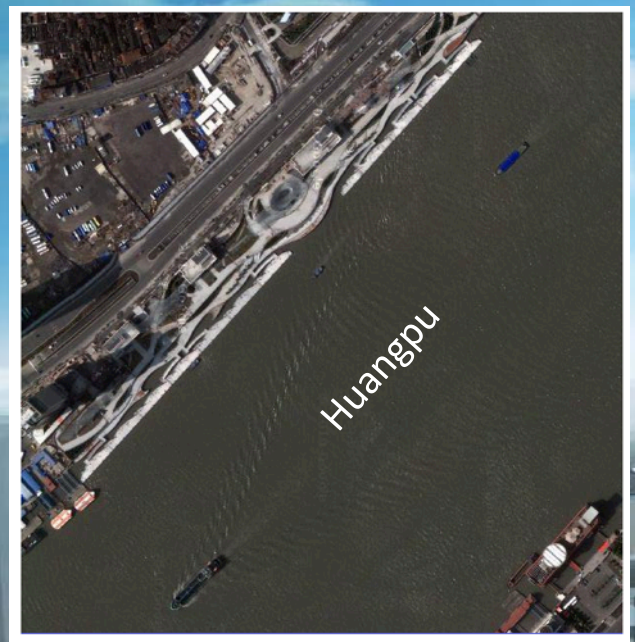
Shanghai







Shanghai – Bund New Horizon Marina River Zone Development





Shanghai – New Horizon Marina

River Zone Development

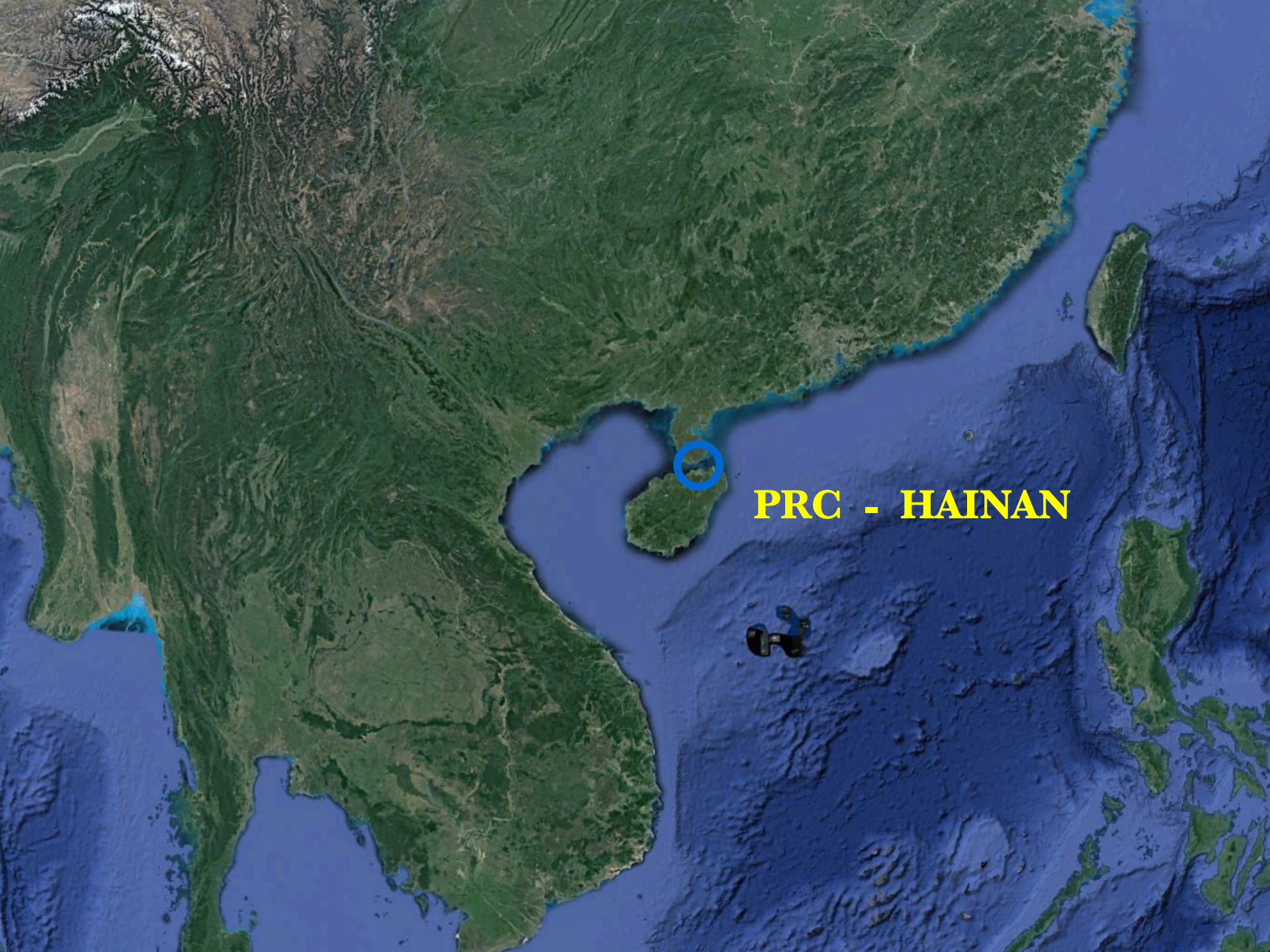

PRC - HAINAN


Image Landsat
Image © 2016 TerraMetrics

KUIPER COMPAGNONS

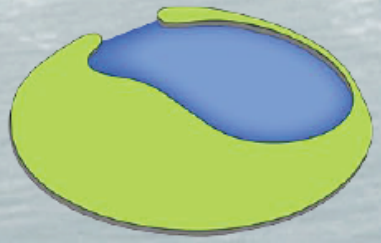


阴阳

是对平衡的追寻

Yin-Yang

Yin-Yang is about balance.



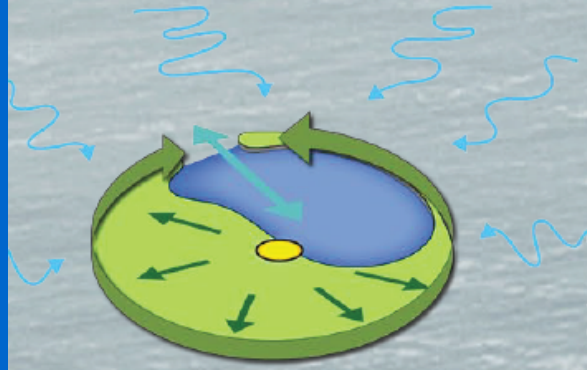
启发

岛屿形状为中国传统文化中阴阳的形象。

强调对平衡的坚持。

Inspired by Yin-Yang

The shape of the island is in line with the ancient Chinese symbol of yin-yang. It is emphasizing the strive for balance.



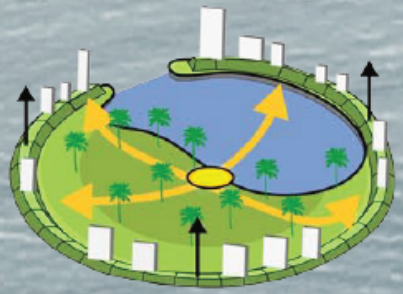
明珠

岛屿的心脏，是明珠所在的地方，也是陆海相接处。

船只停靠在这里，守护着明珠岛的秘密。

The Pearl

In its midst lies the Pearl, pivotal center of Pearl Island. The Pearl, in which sea and land come together and are connected. It holds the secret of Pearl Island.

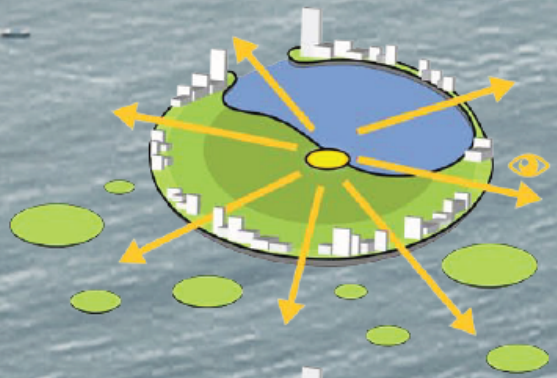


起伏的边缘

起伏的岛屿边缘是建设区的边界，由流线型的酒店环绕，形状如同绵延的山脉。

Undulating edge circle

This embracing gesture of welcome, formed by the defined, undulating edge of the circle.

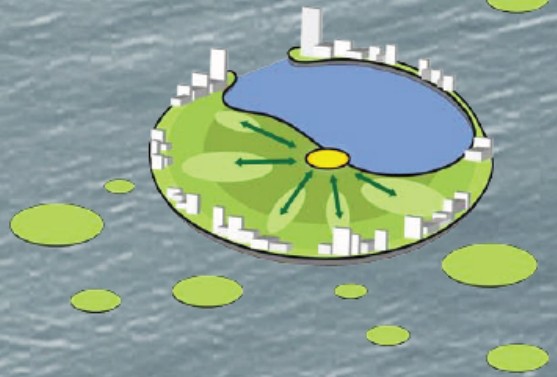


变幻的视野

当游轮从海上驶向这片宁静的港湾,郁郁葱葱的绿谷和海洋也随之映入眼帘。这是一座充满花园与绿地、新鲜与奇妙体验的城市。

View open to the sea

As ships arrive from the sea entering a calm bay. Their passenger's view opens to a lush, jungle valley, and sea.



绿蓝交错的室外桃源

置身于明珠岛，恍如进入蓝绿交错的世外桃源.

Paradise of green and blue

Hidden inside the island is a paradise of green, blue for all to discover, savor and experience.



龙凤呈祥

龙凤之城遥相呼应。 环绕明珠起舞，展示了律动与宁静的变幻.

Dragon and Phoenix

Phoenix joined with the Dragon in a whirling dance around the Pearl, she embodies lightness and calmness.

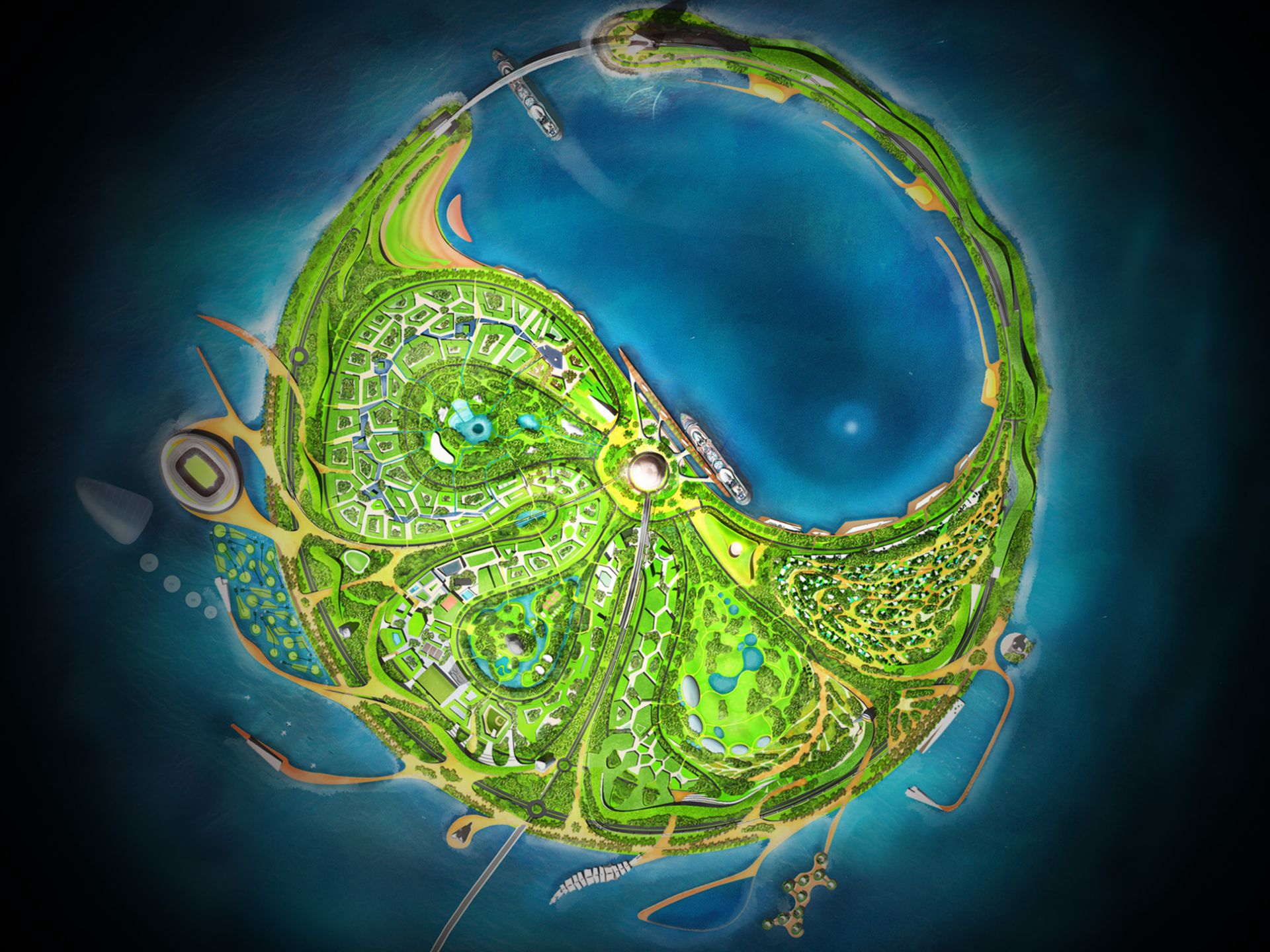


明珠岛迎接世界

明珠岛迎接世界，引领世界。城市生态化为城市发展带来全新理念，也为人们带来更舒适的体验。

Pearl Island welcomes the world

It will be a place that leads the world and guiding principles in natural urbanism.





Yin Yang Island under construction



SUSTAINABLE COASTAL ZONE DEVELOPMENT



Dr. R. E. Waterman MSc





KOREA
THE NETHERLANDS

JUNE 2012



SOUTH KOREA		THE NETHERLANDS
	SURFACE AREA	
	100,210 km²	33,883 km²
	INHABITANTS	
	50.8 million	17 million
	COASTAL LENGTH	
	14,800 km	353 km
	MAIN RIVERS	
	Han Gang	Rhine
	Nak Dong Gang	Maas
	Geum Gang	Scheldt
	Yeong San Gang	Eems
	4 RIVERS RENAISSANCE	
	Han Gang, Nak Dong Gang, Geum Gang, Yeong San Gang	



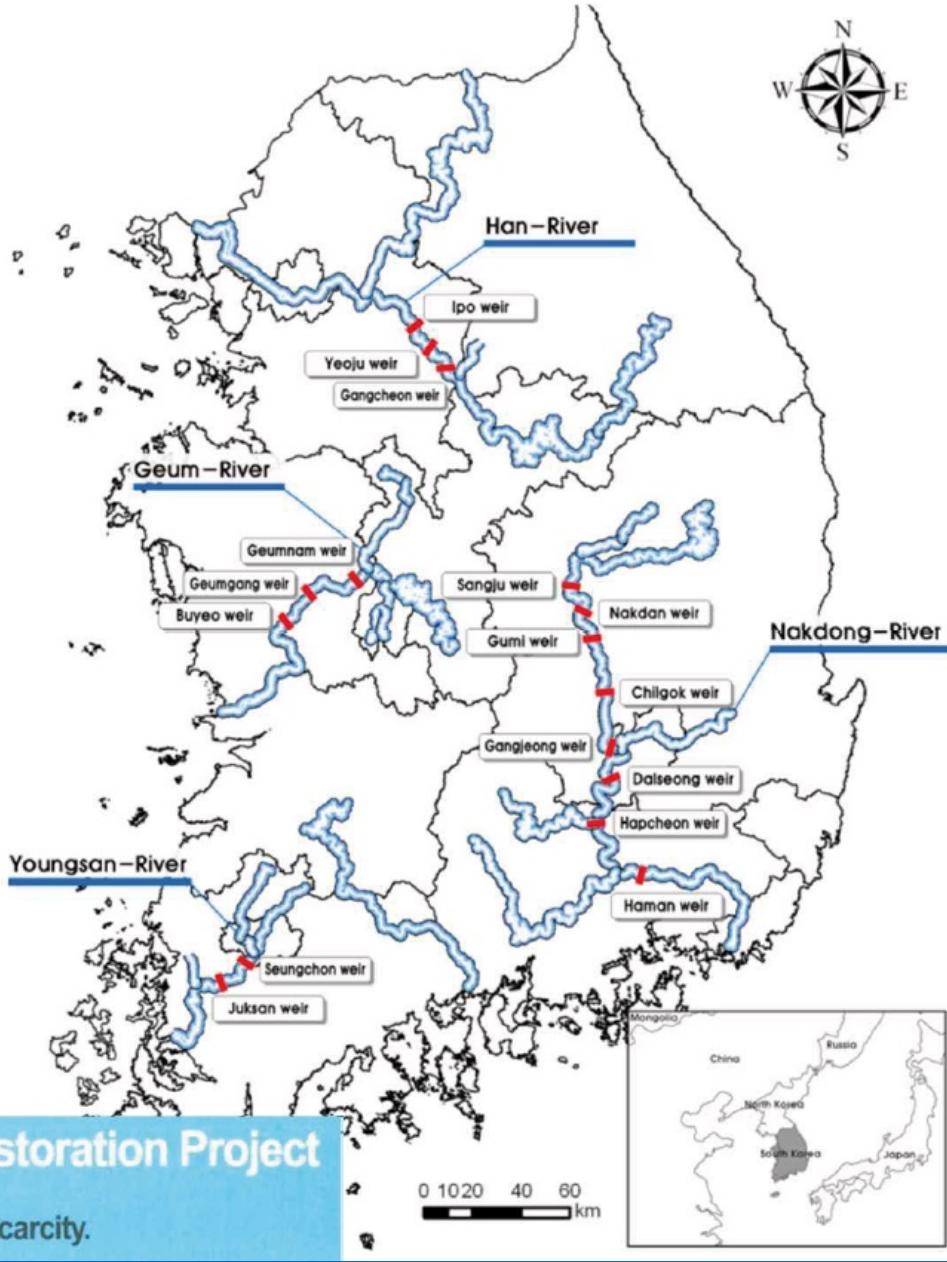


Background

As part of the Four Major Rivers Restoration Project:

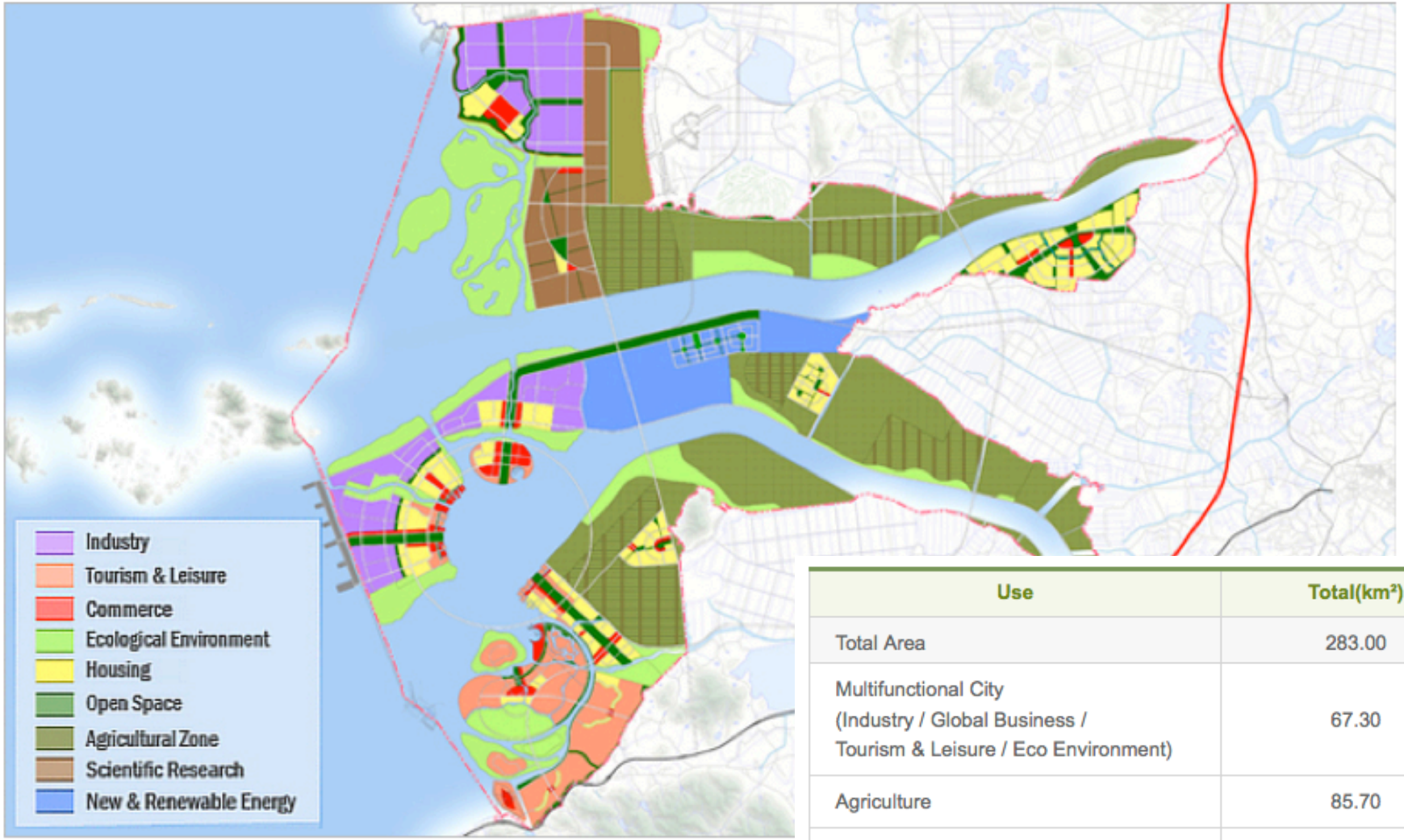
- **16 weirs**
- **4 river basins**





Five core challenges of the Four Major Rivers Restoration Project

- Securing abundant water resources to mitigate water scarcity.



Seamangeum Tideland Reclamation

Total Land Development 283 km²
Large Fresh Water Lake
Sea Dike Length 33.9 km

Use	Total(km²)
Total Area	283.00
Multifunctional City (Industry / Global Business / Tourism & Leisure / Eco Environment)	67.30
Agriculture	85.70
Industry	18.70
Scienctific & Research	23.00
New & Renewable Energy	20.30
City(Agriculture, Hinterland)	14.60
Eco & Environment	42.40
Waterproof Facilities, etc.	11.00








Gunsan, Seoul
Seoul
E-W road #1
Iksan
N-S road #3
Saemangem-Gunsan Railroad
Seohaean Expressway
N-S road #1
E-W road #2
Saemangeum-Jeonju Expressway
Jeonju, Pohang
N-S road #2
Internal Circulation Ring
Namwon, Sunchang
Gwangju
E-W road #3
Mokpo
N
0 1 3 5km

BUILDING WITH NATURE



Japan, Tokyo

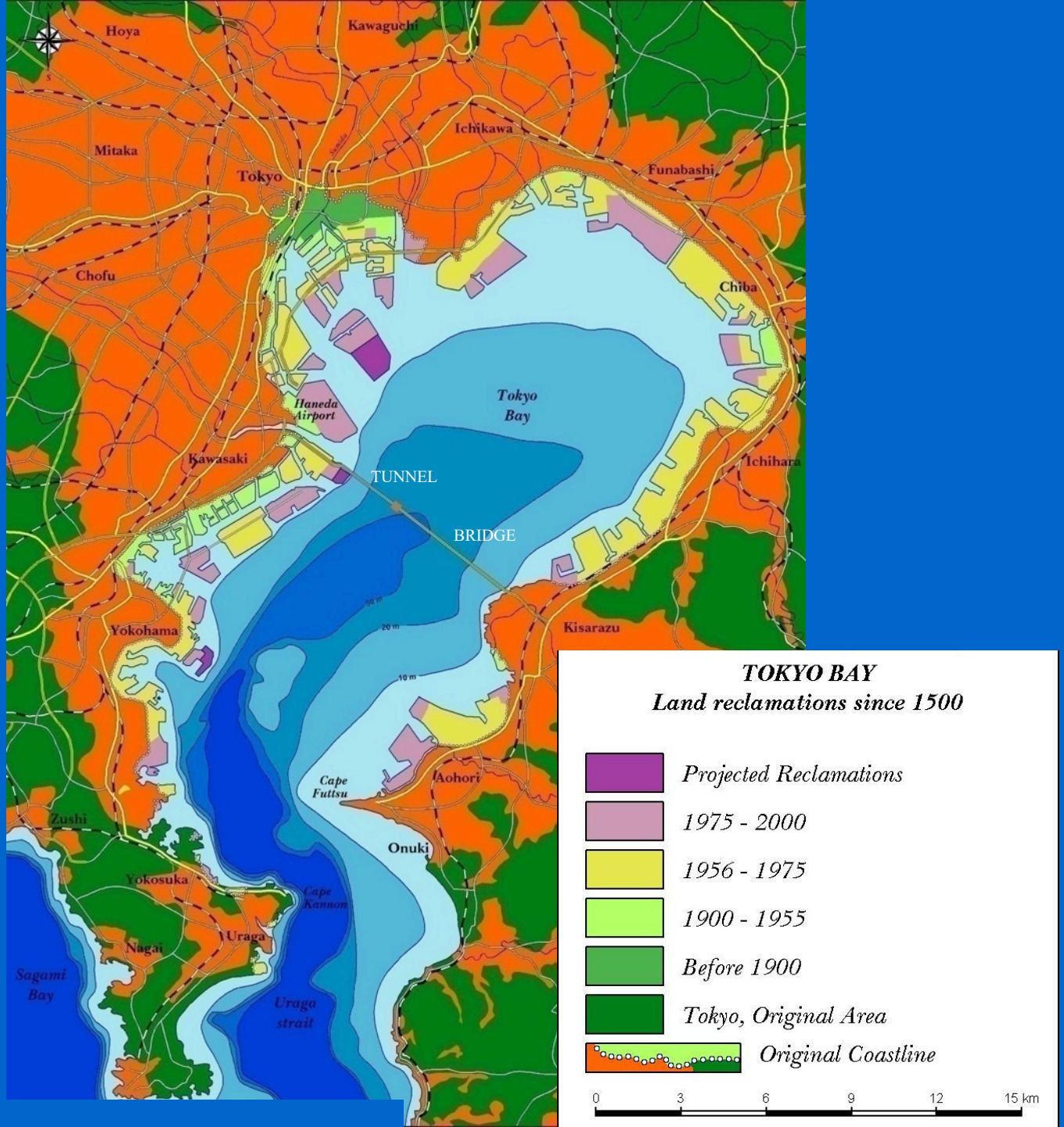


Tokyo



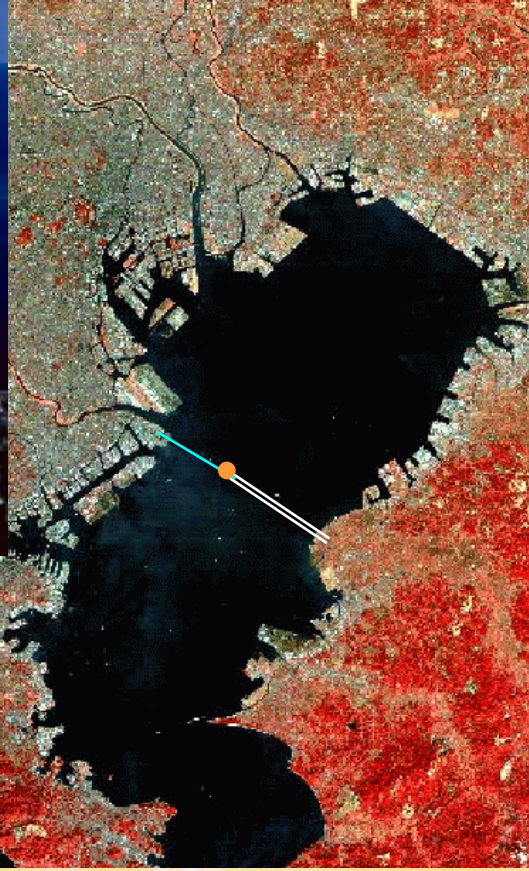
Tokyo

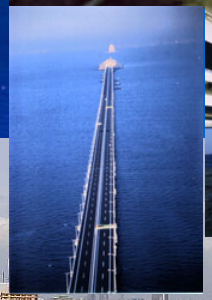
Tokyo

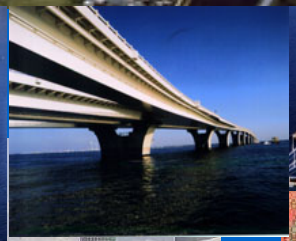

Hoya
Kawaguchi
Mitaka
Ichikawa
Tokyo
Funabashi
Chofu
Chiba
Tokyo Bay
Haneda Airport
Kawasaki
TUNNEL
Ichihara
BRIDGE
Yokohama
Kisarazu
20 m
10 m
Cape Futtsu
Aohori
Zushi
Onuki
Yokosuka
Cape Kannon
Uraga
Nagai
Sagami Bay
Uraga strait
TOKYO BAY
Land reclamations since 1500
Projected Reclamations
1975 - 2000
1956 - 1975
1900 - 1955
Before 1900
Tokyo, Original Area
Original Coastline
0
3
6
9
12
15 km


Outline of Tokyo Bay







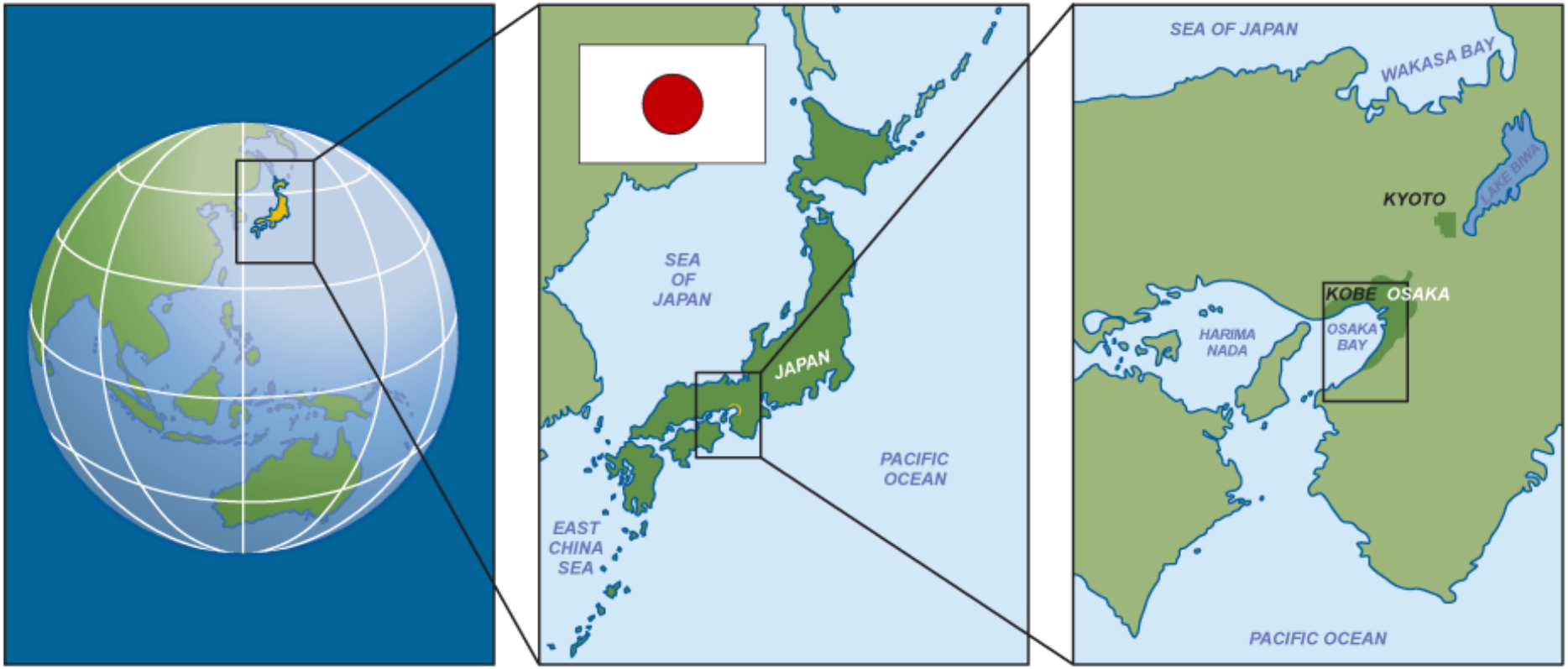


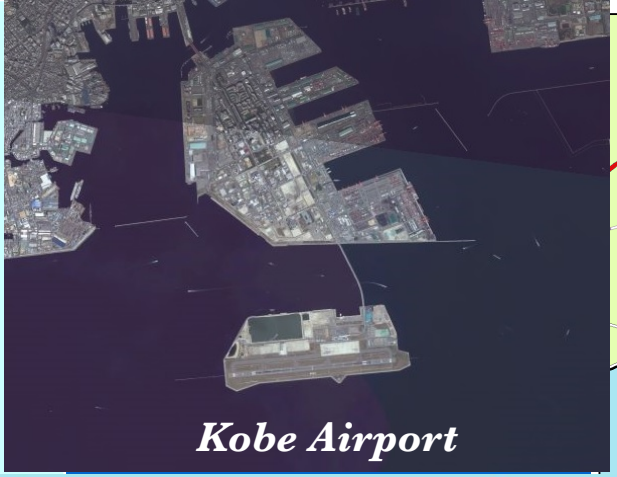




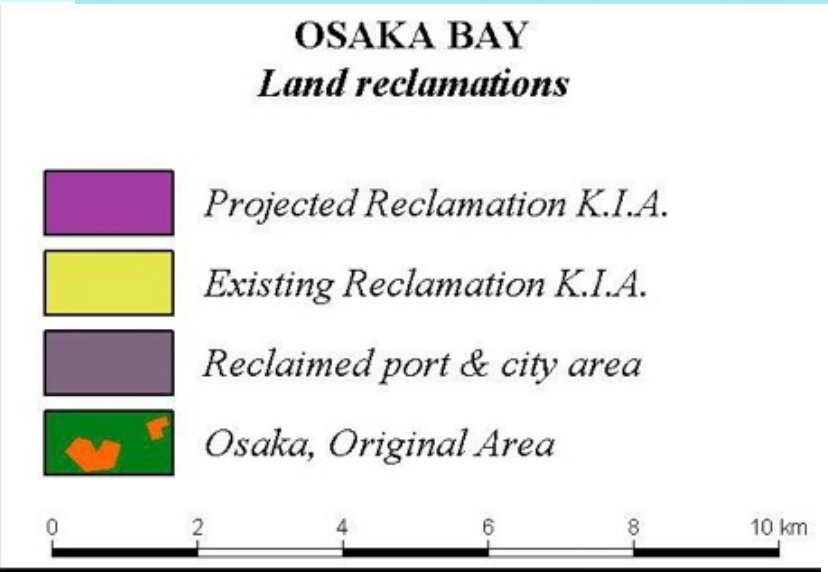


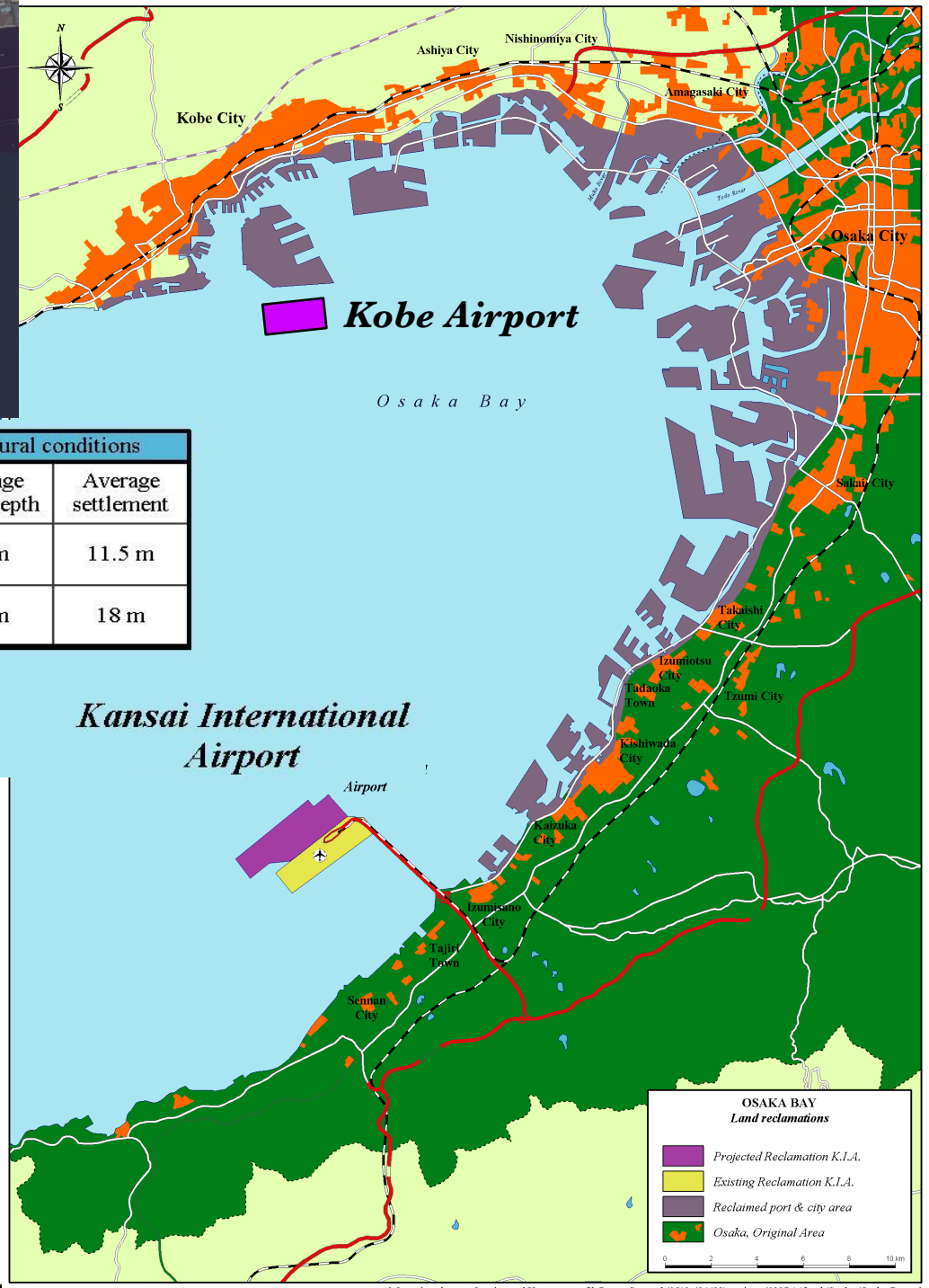
Osaka - Kobe


SEA OF JAPAN
JAPAN
PACIFIC OCEAN
EAST CHINA SEA
SEA OF JAPAN
WAKASA BAY
KYOTO
LAKE BIWA
KOBE
OSAKA
HARIMA NADA
OSAKA BAY
PACIFIC OCEAN



	Scale			Natural conditions	
	Landfill dimension	Seawall extension	Amount of landfill soil	Average water depth	Average settlement
Phase I of Island	510 ha	11.2 km	1.8 million m³	18 m	11.5 m
Phase II of Island	545 ha	13 km	2.5 million m³	20 m	18 m





Osaka – Kobe *Kansai Int. Airport 1*



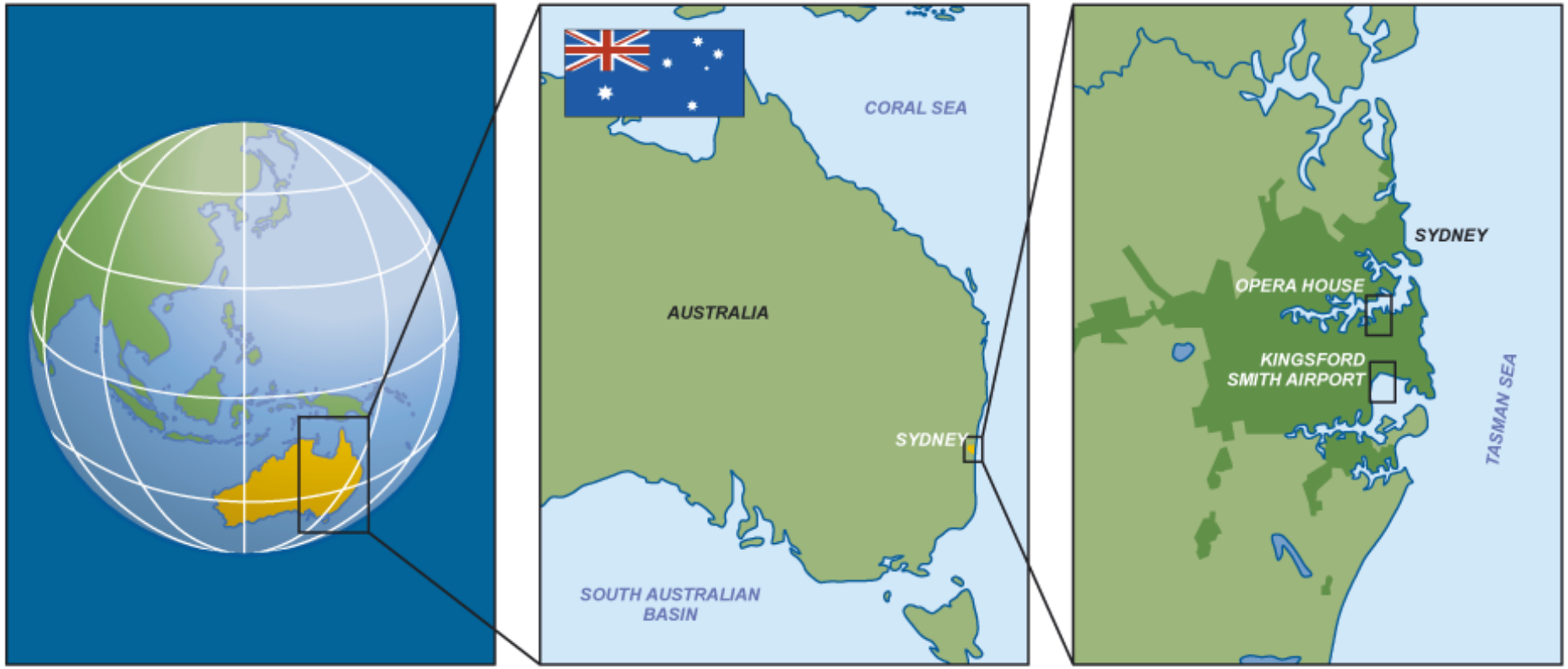
Osaka – Kobe *Kansai Int. Airport 2*



Osaka – Kobe *Kansai Int. Airport 2*



Australia - Sydney





SYDNEY
Land reclamations

Harbor area

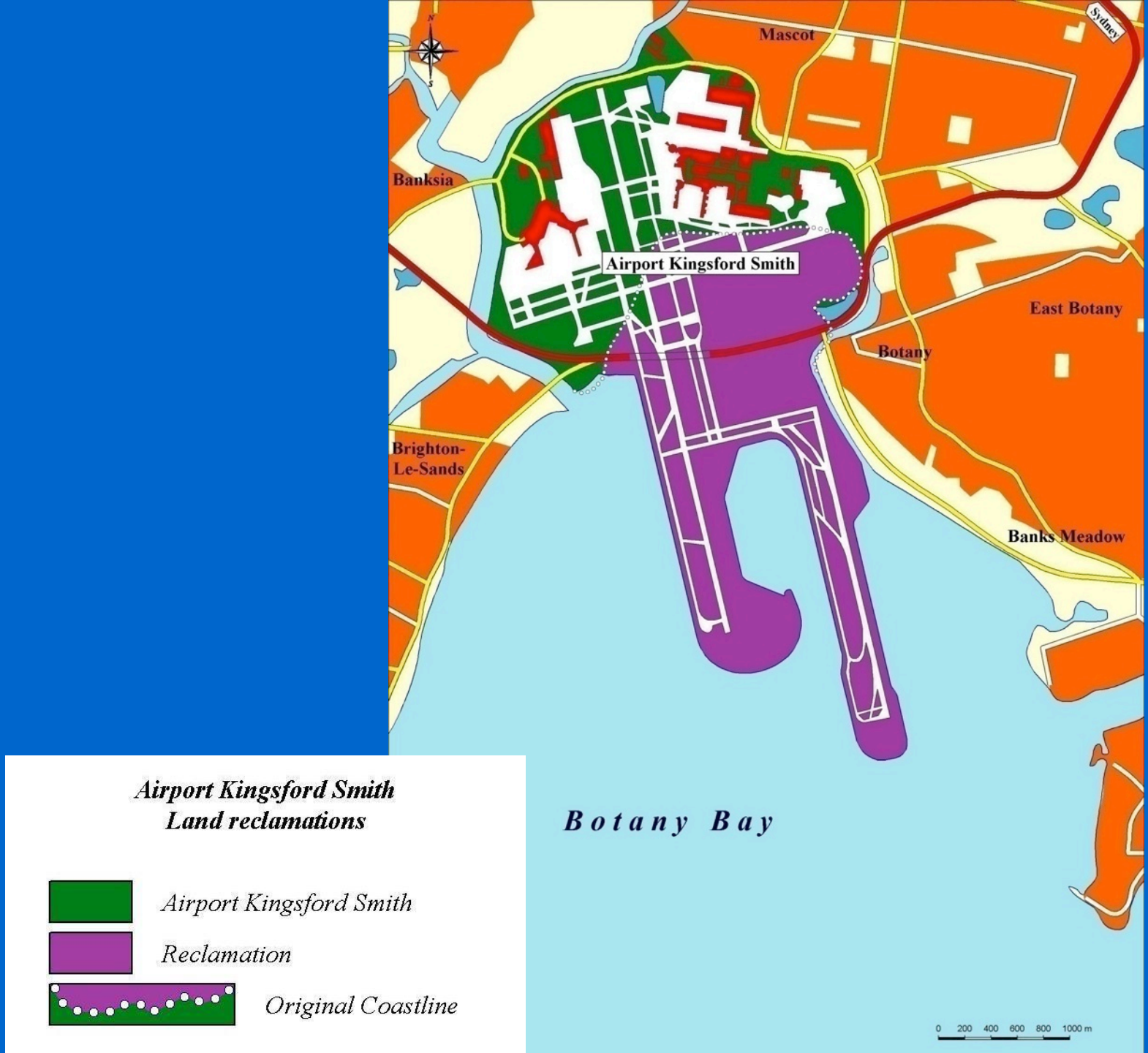
Original Coastline

Sydney *Opera House*



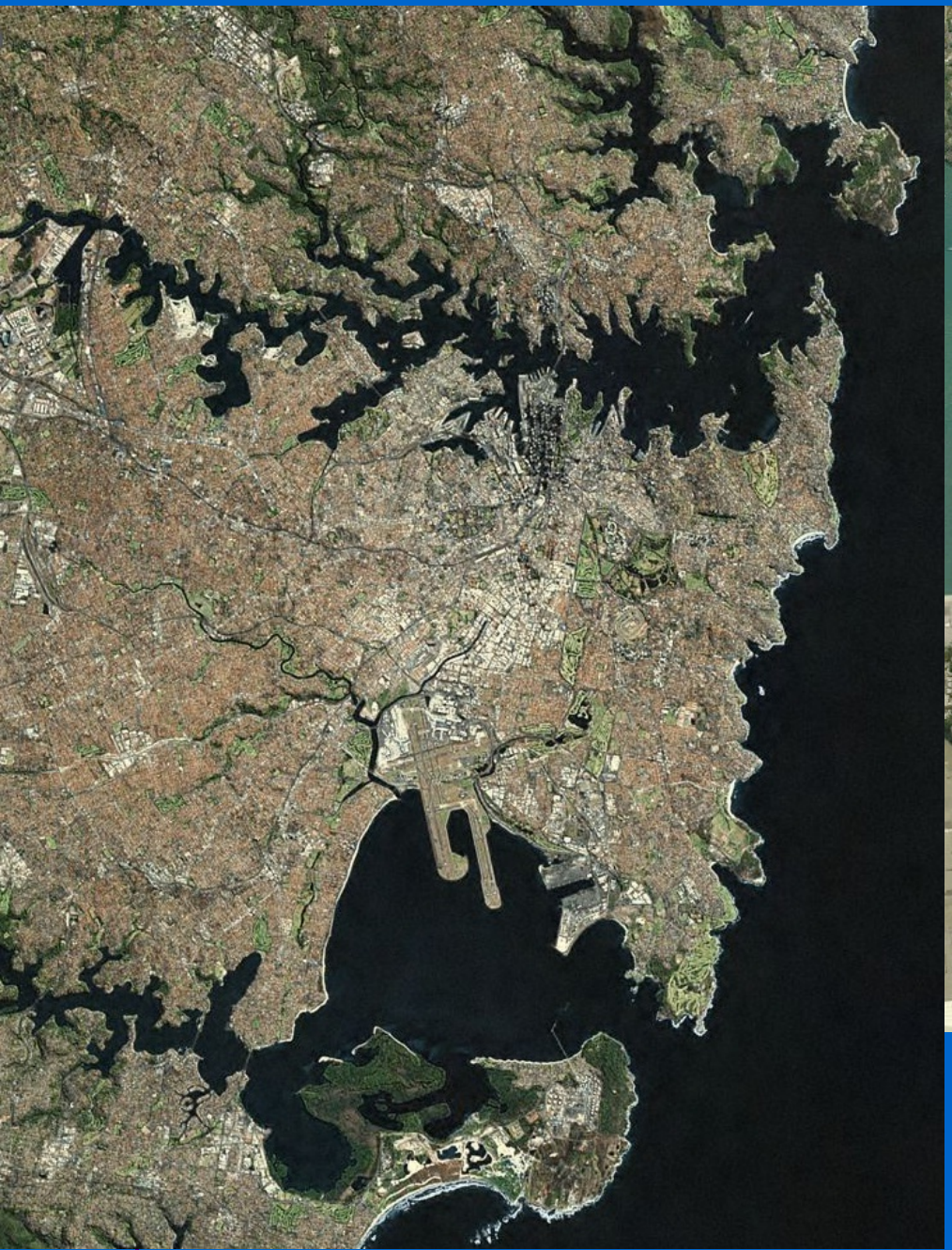





Mascot
Sydney
Banksia
Airport Kingsford Smith
East Botany
Botany
Brighton-
Le-Sands
Banks Meadow
Botany Bay
0 200 400 600 800 1000 m
Airport Kingsford Smith
Land reclamations
Airport Kingsford Smith
Reclamation
Original Coastline

Sydney *Kingsford Smith Airport*





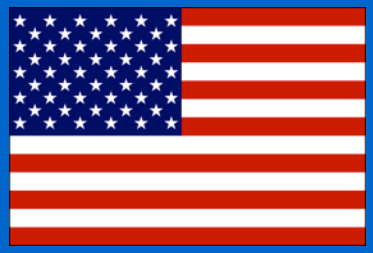


Sydney

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Prof. Dr. R.E. Waterman MSc



USA – THE NETHERLANDS

2013












ANNUIT
CŒPTIS
MDCCLXXVI
NOVUS ORDO SECLORUM


E PLURIBUS
UNUM


JE MAINTIENDRAI

HURRICANE SANDY









HURRICANE SANDY
impact on
New Jersey shore



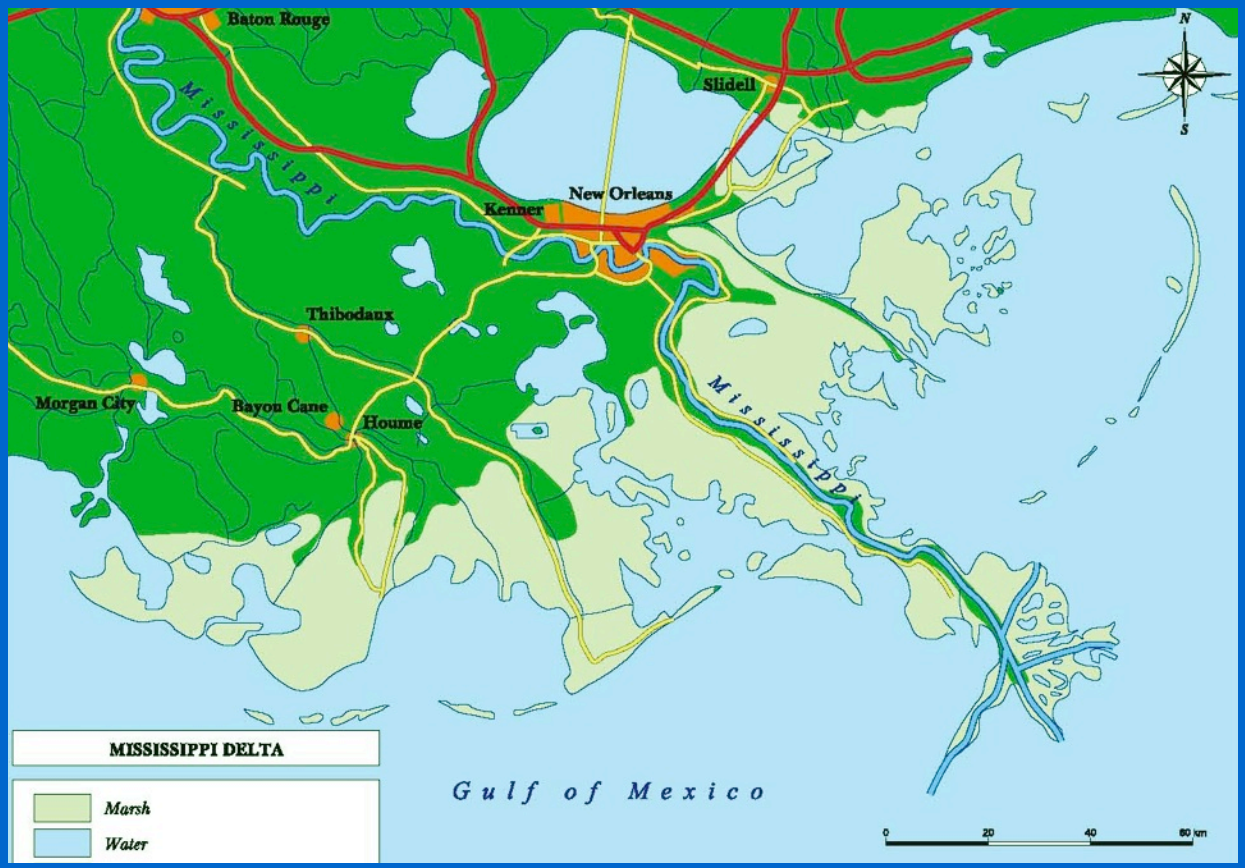


Remedy:

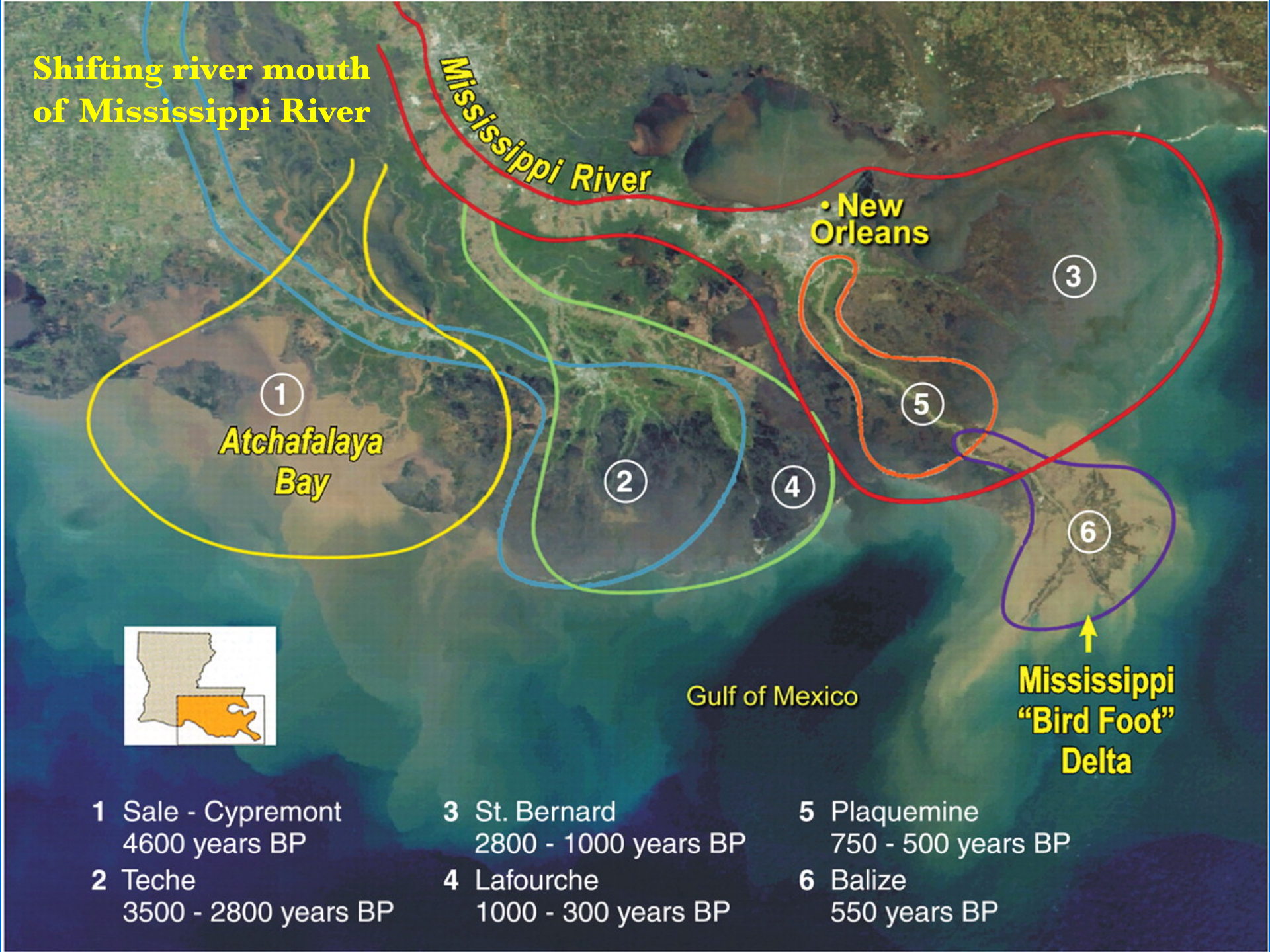
Dune - Beach Widening & Heightening

No constructions on the 1st range of protecting dunes

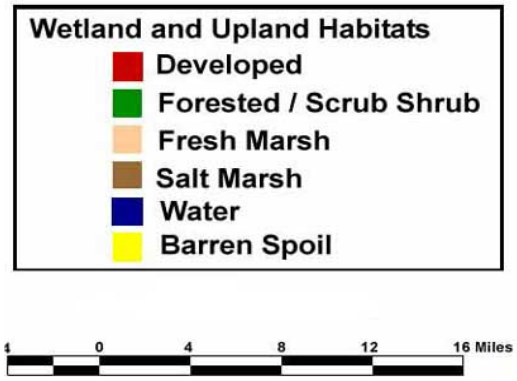
New Orleans in Mississippi Delta

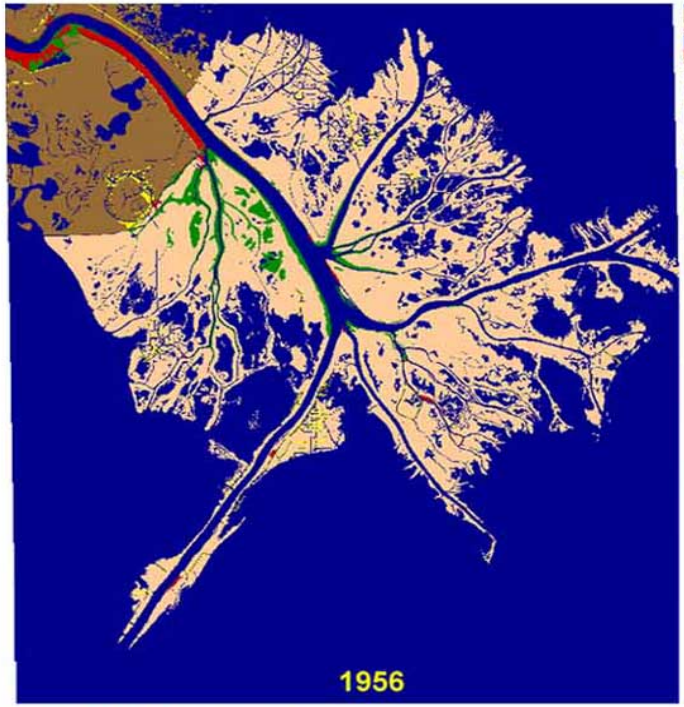


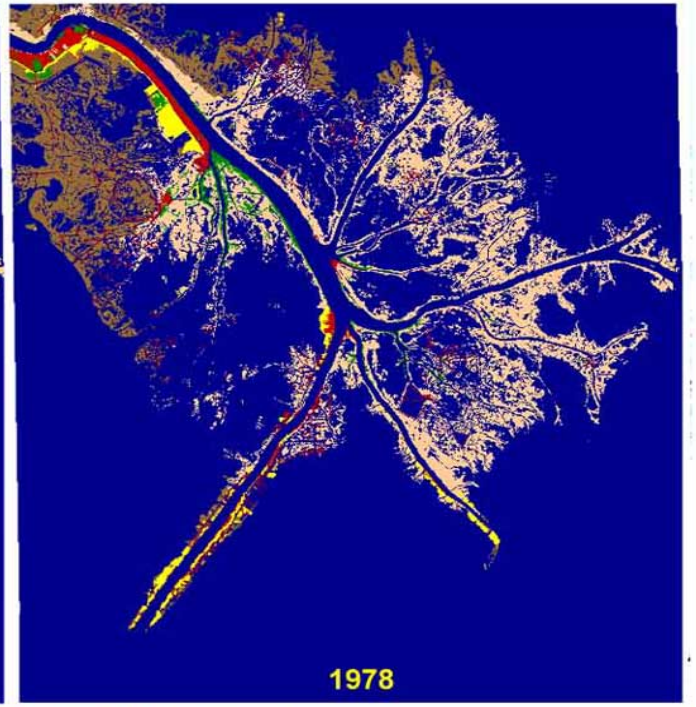
- Improving levees
- Improving drainage & pumping systems
- Introducing storm surge barriers
- Wetlands extension for safety & nature development
- Usage of upriver & seabed sediments

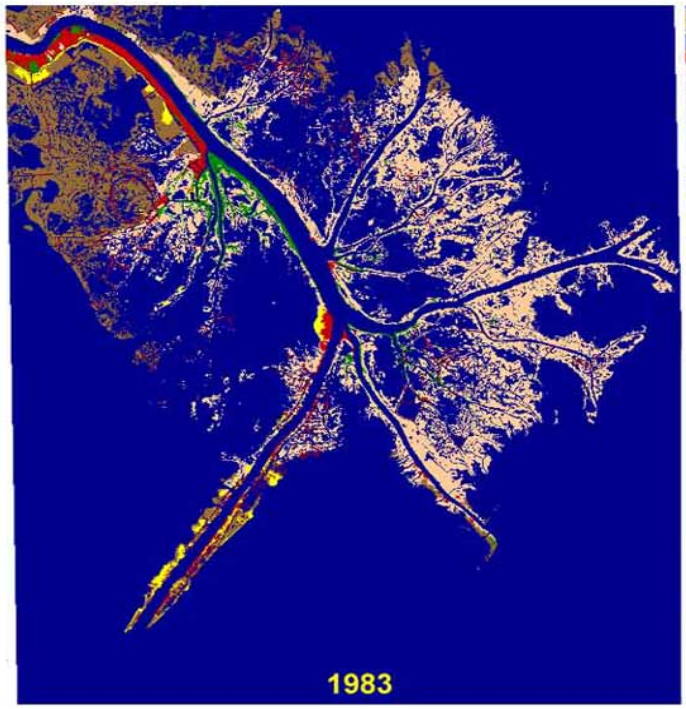

Shifting river mouth of Mississippi River
Mississippi River
• New Orleans
1
Atchafalaya Bay
2
3
4
5
6
Gulf of Mexico
Mississippi "Bird Foot" Delta
1 Sale - Cypremont 4600 years BP
2 Teche 3500 - 2800 years BP
3 St. Bernard 2800 - 1000 years BP
4 Lafourche 1000 - 300 years BP
5 Plaquemine 750 - 500 years BP
6 Balize 550 years BP

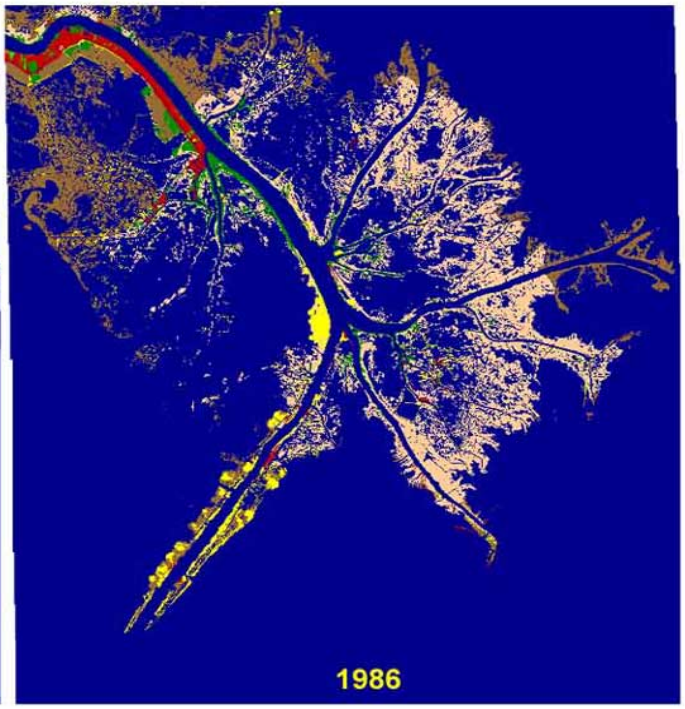
Lower Mississippi River Delta Habitat Change











SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



Dr. R. E. Waterman MSc



MEXICO
2015





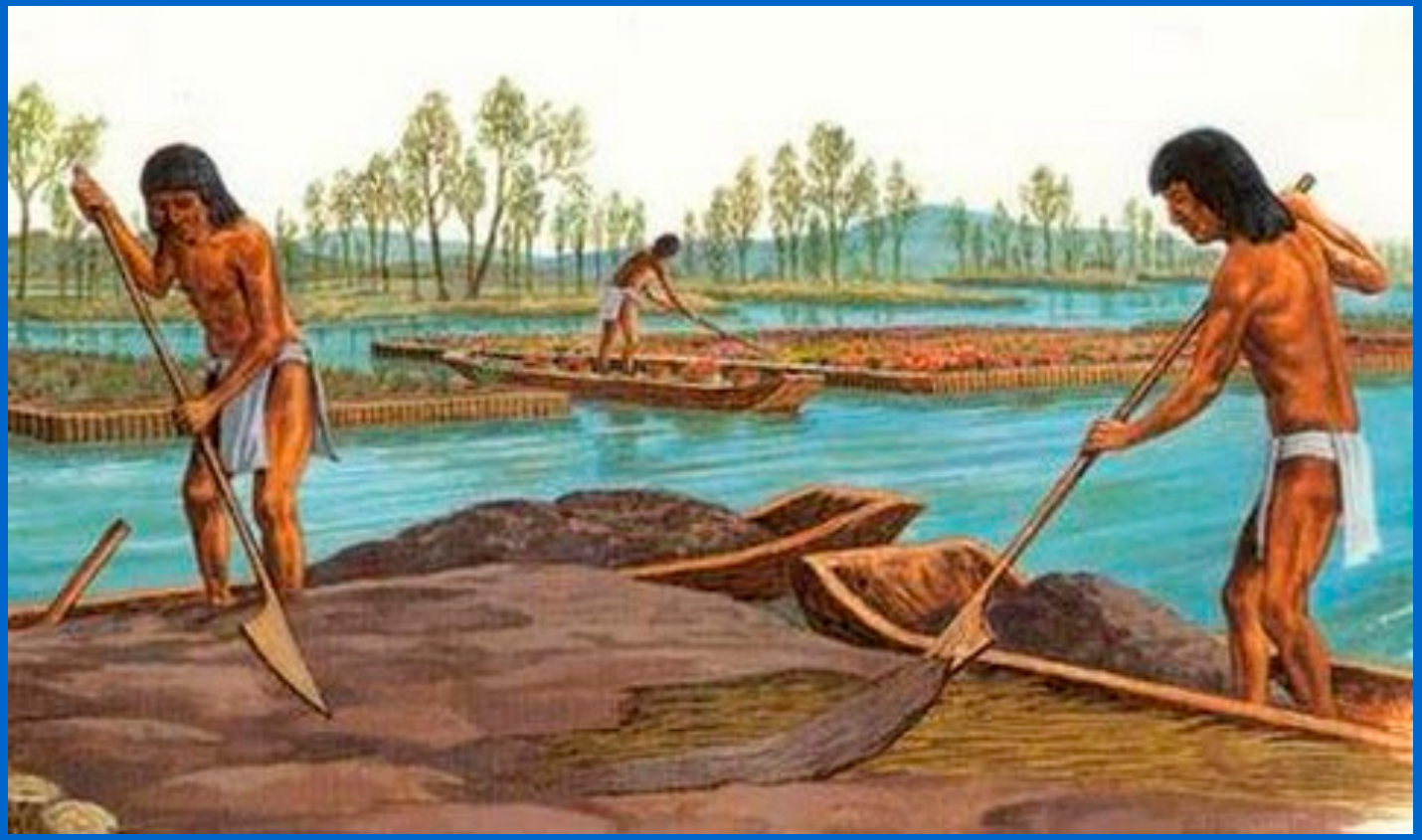





Mexico.



Xochimilco – Chinampas – World Heritage





MEXICO





SURFACE AREA

1,964,375 km² 33,883 km²

INHABITANTS

116.2 million 16.7 million

COASTAL LENGTH

2,805 km Gulf of Mexico
7,338 km Océano Pacifico
353 km North Sea

SEA PORTS

Veracruz
Altamira
Tampico
Dos Bocas

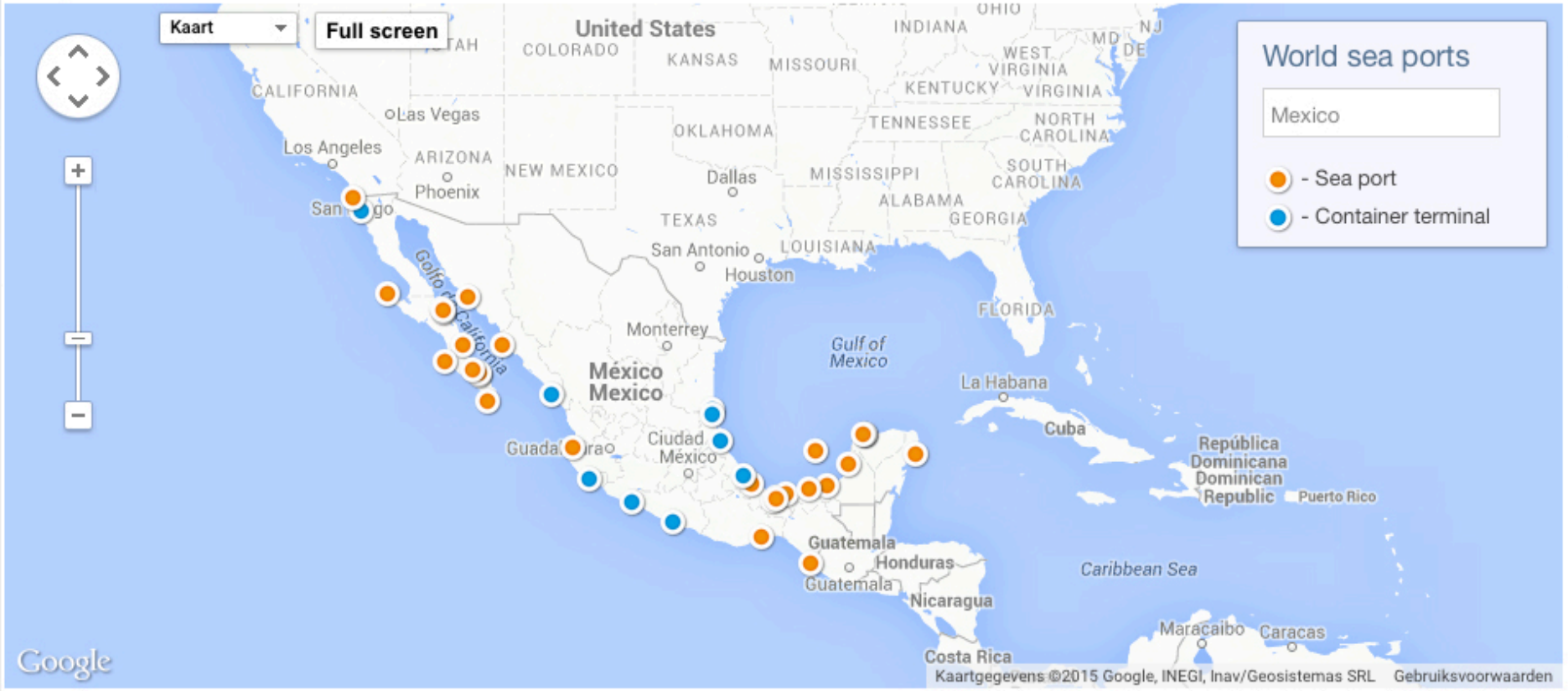
Acapulco

THE NETHERLANDS



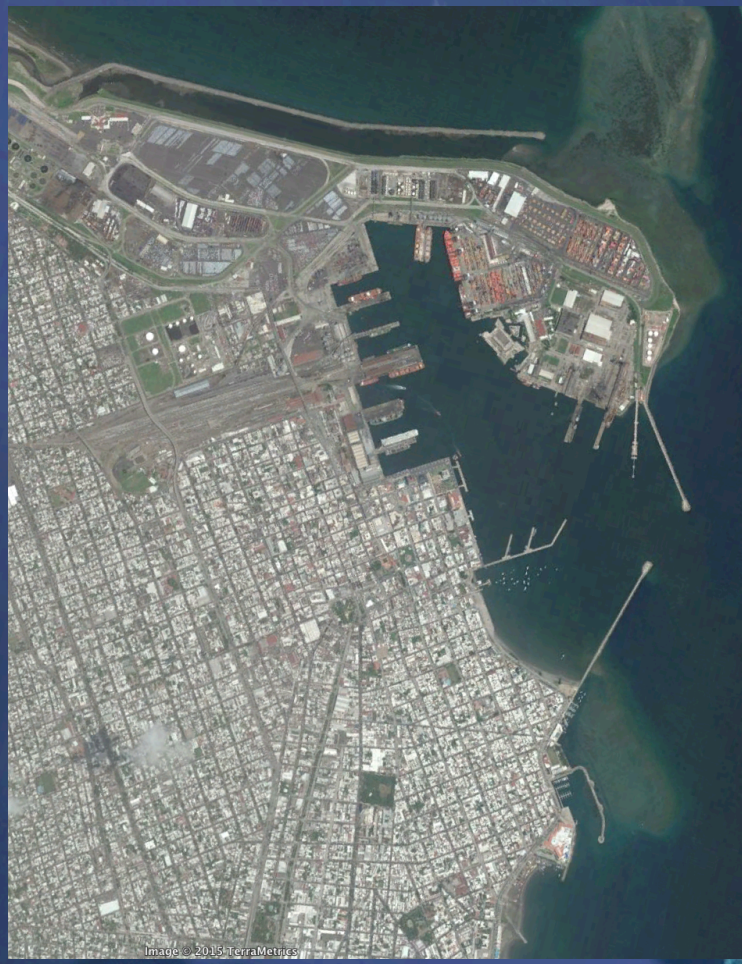


Sea ports of Mexico



Acapulco	Altamira	Alvarado	Cabo San Lucas	Campeche
Cayo Arcas	Ciudad del Carmen	Coatzacoalcos	Cozumel	Dos Bocas
Ensenada	Frontera	Guaymas	La Paz	Lazaro Cardenas
Manzanillo	Mazatlan	Minatitlan	Morro Redondo	Nanchital
Pichilingue	Progreso	Puerto Escondido	Puerto Madero	Puerto Progreso
Puerto Vallarta	Rosarito Terminal	Salina Cruz	San Carlos	San Juan de la Costa
San Marcos	Santa Maria	Santa Rosalia	Tampico	Topolobampo
Tuxpan	Veracruz	Yukalpeten		

VERA CRUZ



Heroica Veracruz, Veracruz

DOS BOCAS
TABASCO





Estado: TABASCO

Municipio: PARAISO

Altitud: 1msnm

Puerto de DOS BOCAS:
Depths 7-10 meter
Turning bassin 300 m diameter
Multipurpose & Specialised Terminals
Petroleum, fruit, meat, machinery, cruise passengers



Espigones que se han construido frente TMPDB
Breakwaters (groynes) in front of TMPDB




N



TUBERIAS DE SALIDA

TUBERIAS DE LLEGADA

DOS BOCAS, TABASCO

TERMINAL MARITIMA PEMEX


-9
-8
-7
-6
-5
-4
-3
-2
-1
2
3
4
5
6
10















25 DE NOVIEMBRE DEL 2013



AREA DE QUEMADORES, ESTRUCTURA DE PROTECCIÓN



AREA DE QUEMADORES, ESTRUCTURA DE PROTECION



AREA DE QUEMADORES, LADO OESTE



ALMACEN, CUBOS DE 3.7, 5.6 TON. Y BASE DEL MASTIL



CUBOS DE 3.7 TON.



CUBOS DE 3.7 TON Y PIEDRA EN GREÑA

25 DE NOVIEMBRE DEL 2013



BASE DEL MASTIL, CUBOS DE 5.6 Y 3.7 TON



CAMINO AL MORRO



CAMINO AL MORRO



CENTRO DE ESTRUCTURA DE PROTECCION



ESTRUCTURA DE PROTECCION, LADO OESTE



ESTRUCTURA DE PROTECCION, LADO ESTE

25 DE NOVIEMBRE DEL 2013



ESTRUCTURA DE PROTECCION, LADO ESTE



ESTRUCTURA DE PROTECCION, LADO



CENRO DE LA ESTRUCTURA DE



ESTRUCTURA DE PROTECCION LADO ESTE



CENTRO DE LA ESTRUCTURA DE PROTECCION



ESTRUCTURA DE PROTECCION, LADO OESTE

25 DE NOVIEMBRE DEL 2013



ALMACEN DE MATERIALES EN AREA DE QUEMADORES



BARDA PERIMETRAL TDN.



BARDA PERIMETRAL TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL TDN, 1er, TRAMO

25 DE NOVIEMBRE DEL 2013



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



TERRAPLEN, TRAMO 7



TERRAPLEN, TRAMO 6



TERRAPLEN, TRAMO 7

25 DE NOVIEMBRE DEL 2013



TERRAPLEN, TRAMO 5



TERRAPLEN, TRAMO 4



TERRAPLEN, TRAMO 4



TERRAPLEN, TRAMO 3



TERRAPLEN, TRAMO 3



TERRAPLEN, TRAMO 2

25 DE NOVIEMBRE DEL 2013



TERRAPLEN, TRAMO 1



Recuperacion y proteccion de la linea de costa de las instalaciones PEMEX Dos Bocas, Tabasco, Mexico

Dr. Ronald Waterman

Equipo

- Ronald Waterman
- Paul Geerders
- David Ortega Grillasca
- Alejandro Gomez Ponce

Antecedentes

- Historia de la problematica
  - Proteccion tuberia marina
  - Proteccion y reduccion de la vulnerabilidad de las instalaciones (incl. quemadores, bateria de separacion y conversion)
  - Recuperacion zona de playa
- Salida de campo
- Sobrevuelo helicoptero

Conclusiones, observaciones

- Hasta ahora: acciones puntuales
- Acciones no han tenido efecto deseado
- Acciones han tenido efectos adversos (ej. eliminacion de las dunas)
- Oportunidad para PEMEX promover su conciencia ambiental
- Potencial de beneficios sociales, economicos para la region

Objetivos

- Plan Maestro: solucion holistica, integral, multifuncional, sostenible
- Recuperacion dunas (incl. vegetacion) y playas
- Implementacion en fases y segmentos

Concepto: Construir con la Naturaleza

- Usar mas que antes los materiales, las fuerzas e interacciones de la Naturaleza
- Creacion de una nueva linea de costa dinamica y flexible, consistiendo de dunas (con vegetacion) y playas
- Equilibrio entre erosion y acrecion
- Minimo de elementos duros
- Arena requerida a traves de dragado amigable al ambiente y en profundidad mas de 20 m
- Minimo de mantenimiento (alimentacion)
- Monitoreo: antes (linea de base), durante y despues (seguimiento)

Prioridad

- Base de datos e informacion: actualizados, completos, confiables
- Todos aspectos relevantes

Actividades

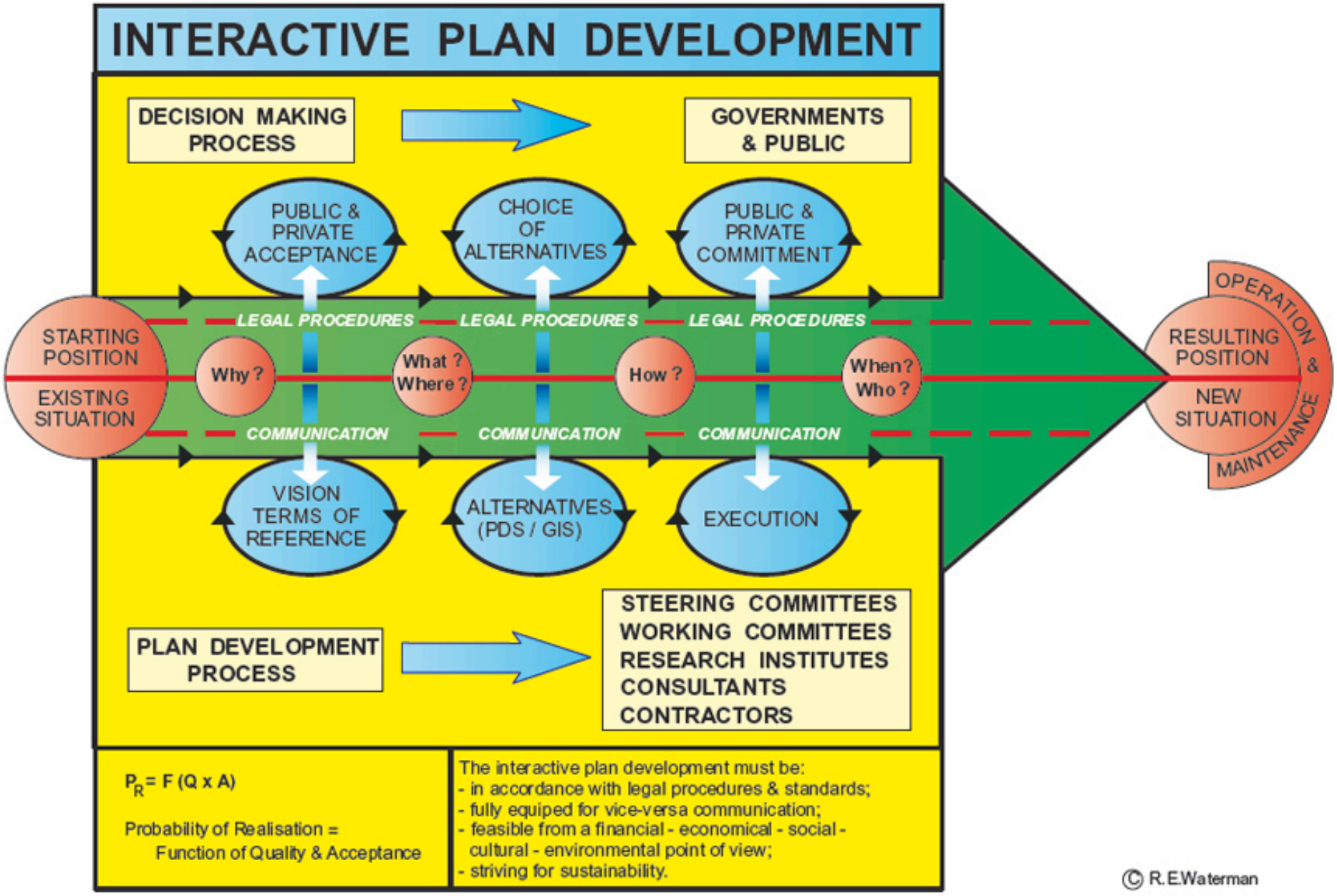
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- Identificacion de obras prioritarias
- Desarrollo del proyecto definitivo apuntando a una solucion holistica, integral, multifuncional y sostenible

Cronograma

- Hasta finales del 2015
  - Propuesta proyecto datos e informacion
  - Establecimiento base de datos e informacion
  - Desarrollo e implementacion en fases
  - Propuesta proyecto Plan Maestro definitivo (Octubre 2015)
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MesX	1	2	3	4	5	6
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DECISION MAKING PROCESS
GOVERNMENTS & PUBLIC
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LEGAL PROCEDURES
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Why ?
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- striving for sustainability.
© R.E.Waterman

SUSTAINABLE COASTAL ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Atasta, Campeche





SUSTAINABLE FUTURE OF INLAND WATERWAYS

Stimulating the Blue Green Economy

for

Regional, Socio-Economic &
Spatial Development,

while safeguarding

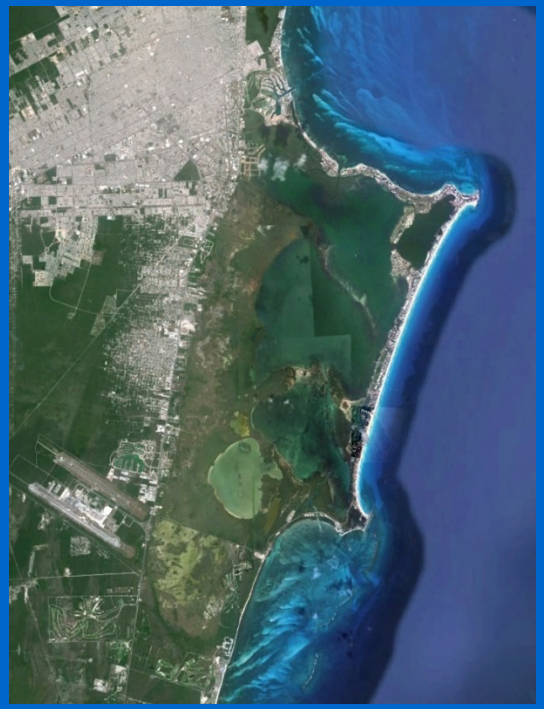
Environmental Values & Nature

as well as Safety

MEXICO



CANCUN



THE NETHERLANDS

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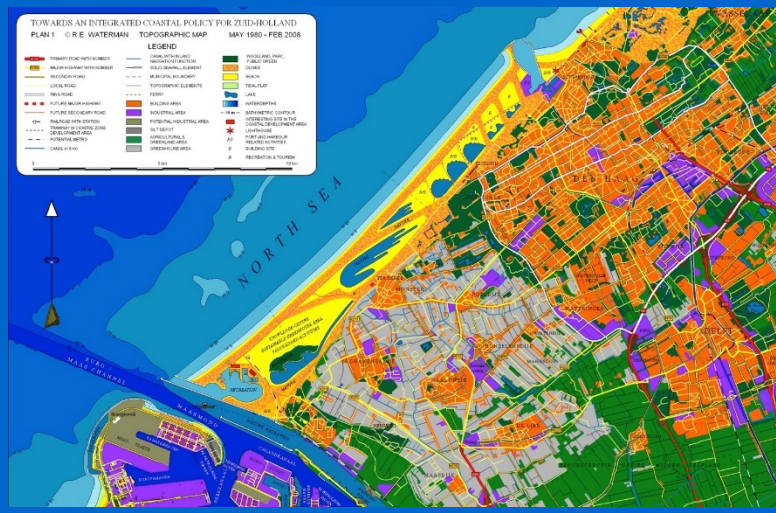
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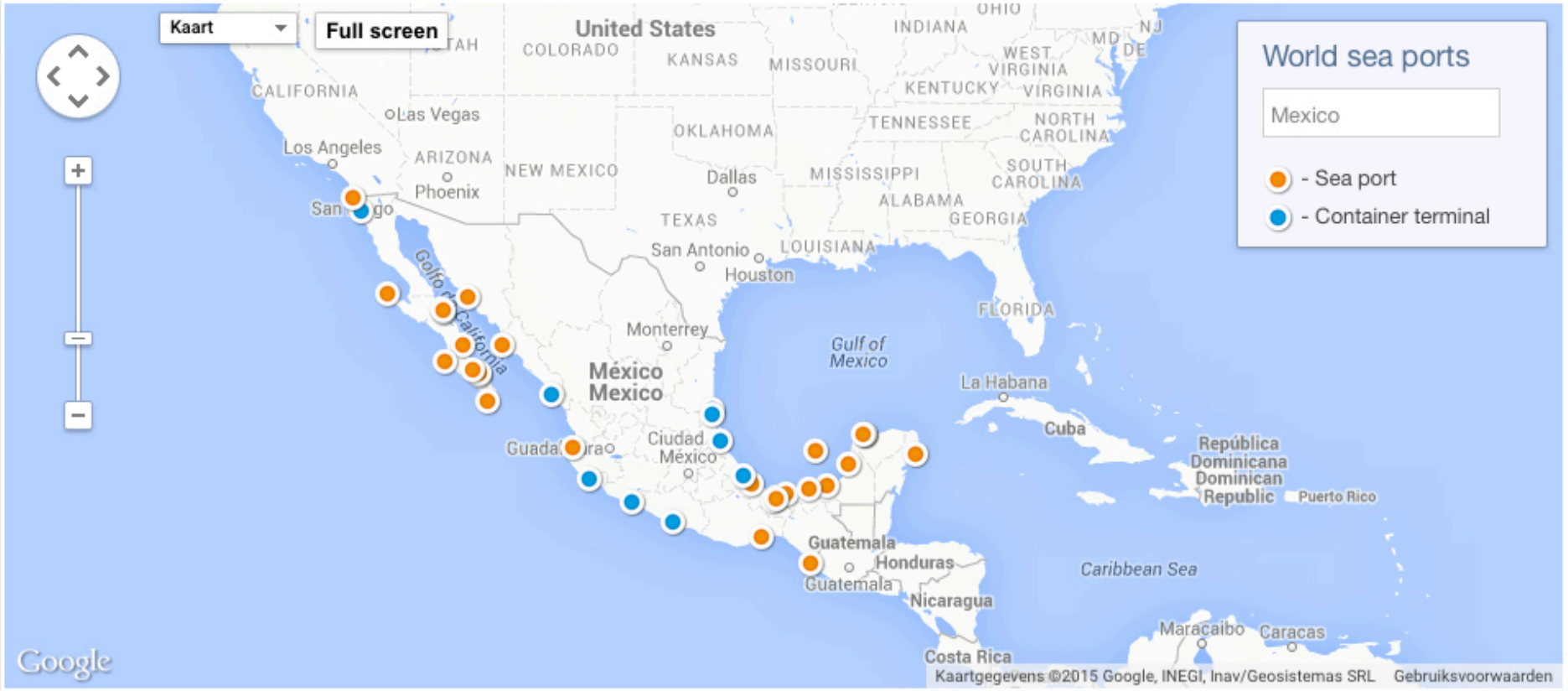
Acapulco

Rotterdam
Amsterdam





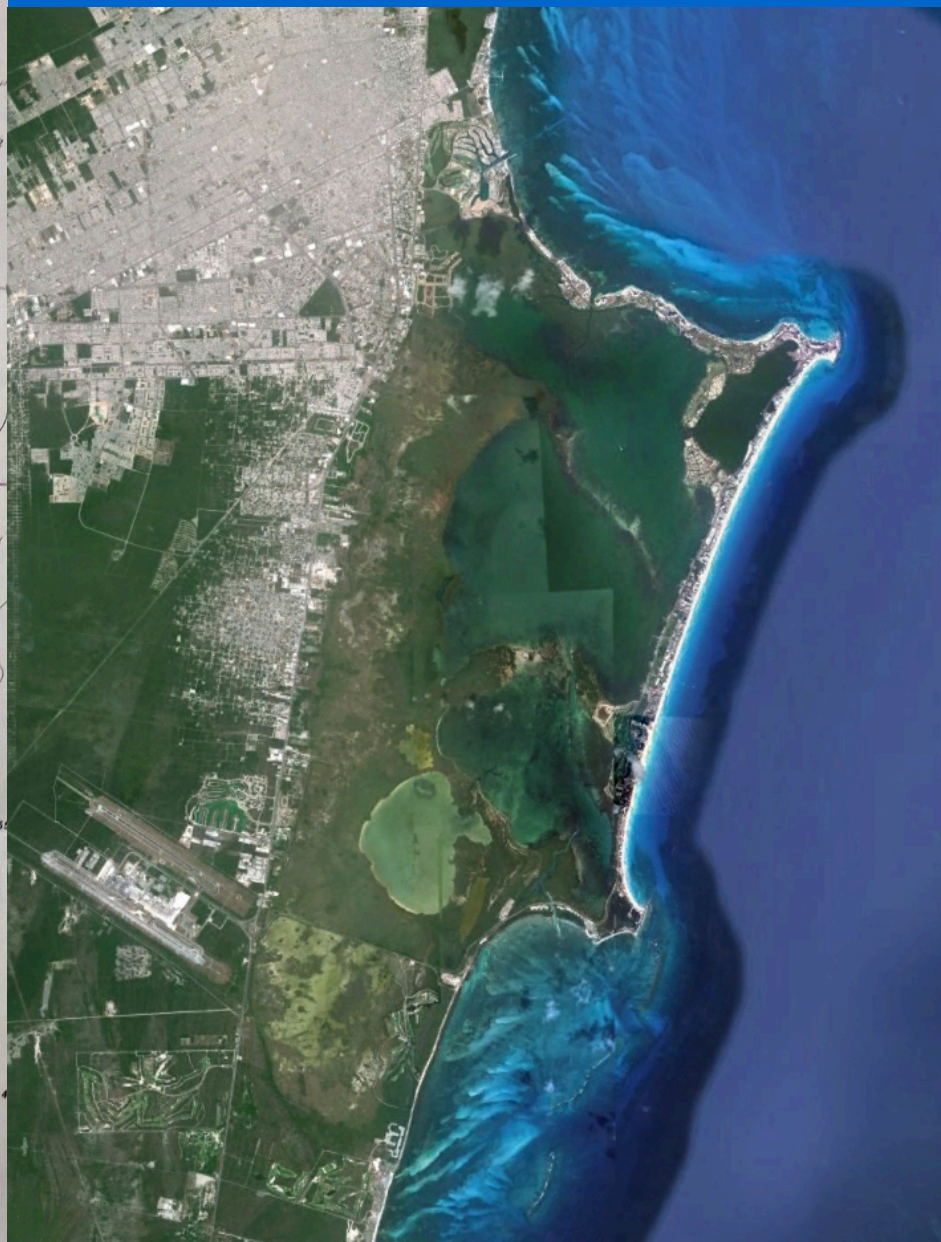
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Cancun

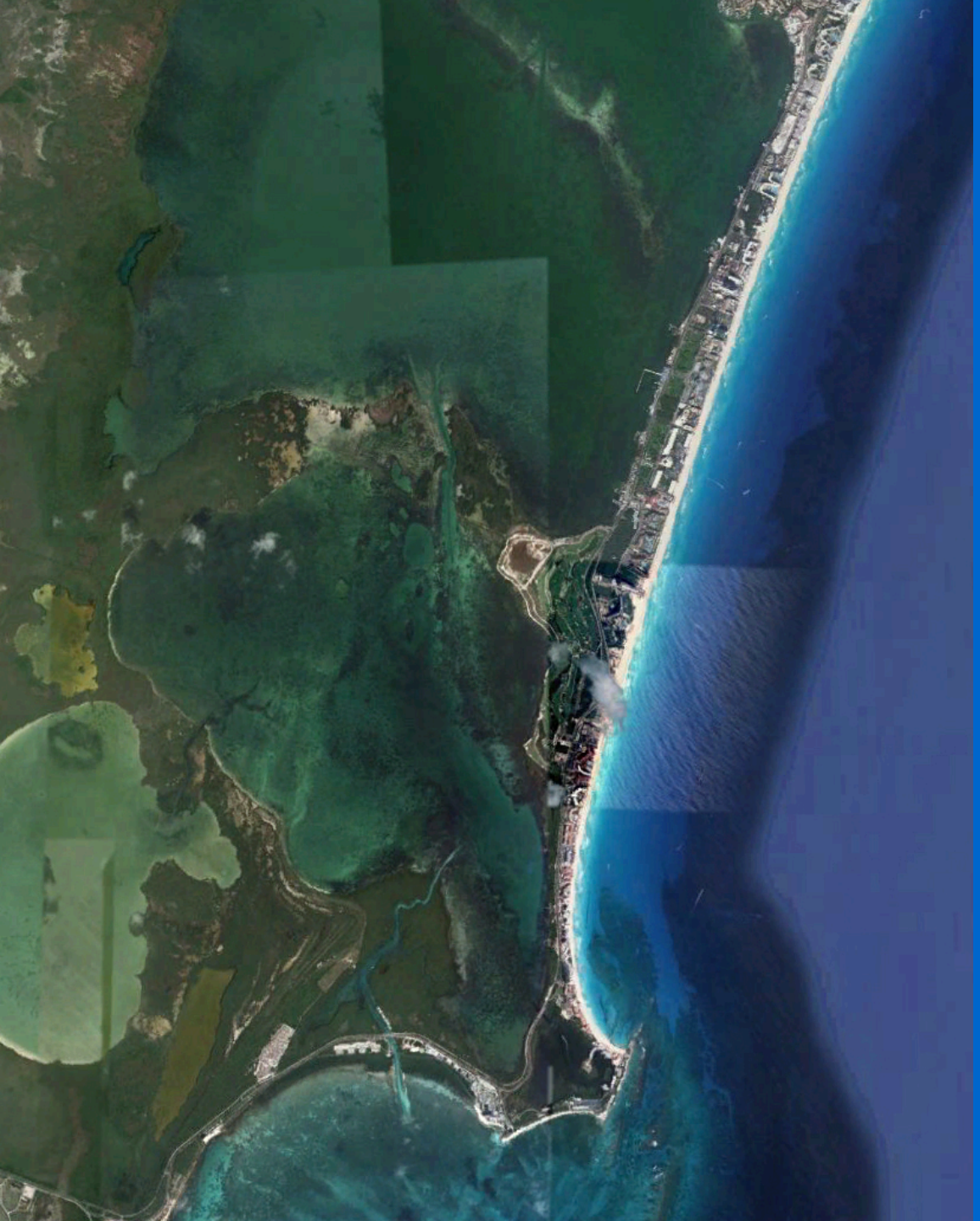

MEXICO
CANCÚN
Isla Mujeres
Isla Contoy
Isla Cancun
Punta Nizuc
ARROWSMITH BANK
ISLA COZUMEL
Cozumel
Punta Molas
Punta Maroma
Puerto Morelos
Punta Brava
Playa del Carmen
Punta Tul
Punta Solimán
Bahía de la Ascensión
Punta Pájaros
Bahía del Espíritu Santo
Punta Herrero
Puerto Chico
CABO CATOCHE
Laguna de Yalahau
Punta Mosquito
Bacheil
Tencah
Tulum
Palma
El Zarzal
Vigía Chico
Punta Allen
88°
87°W
86°
21°N
20°





Puerto Cancun


Cancun



Cancun

Cancun



Cancun



Equipo

- Ronald Waterman
- Paul Geerders
- David Ortega Grillasca

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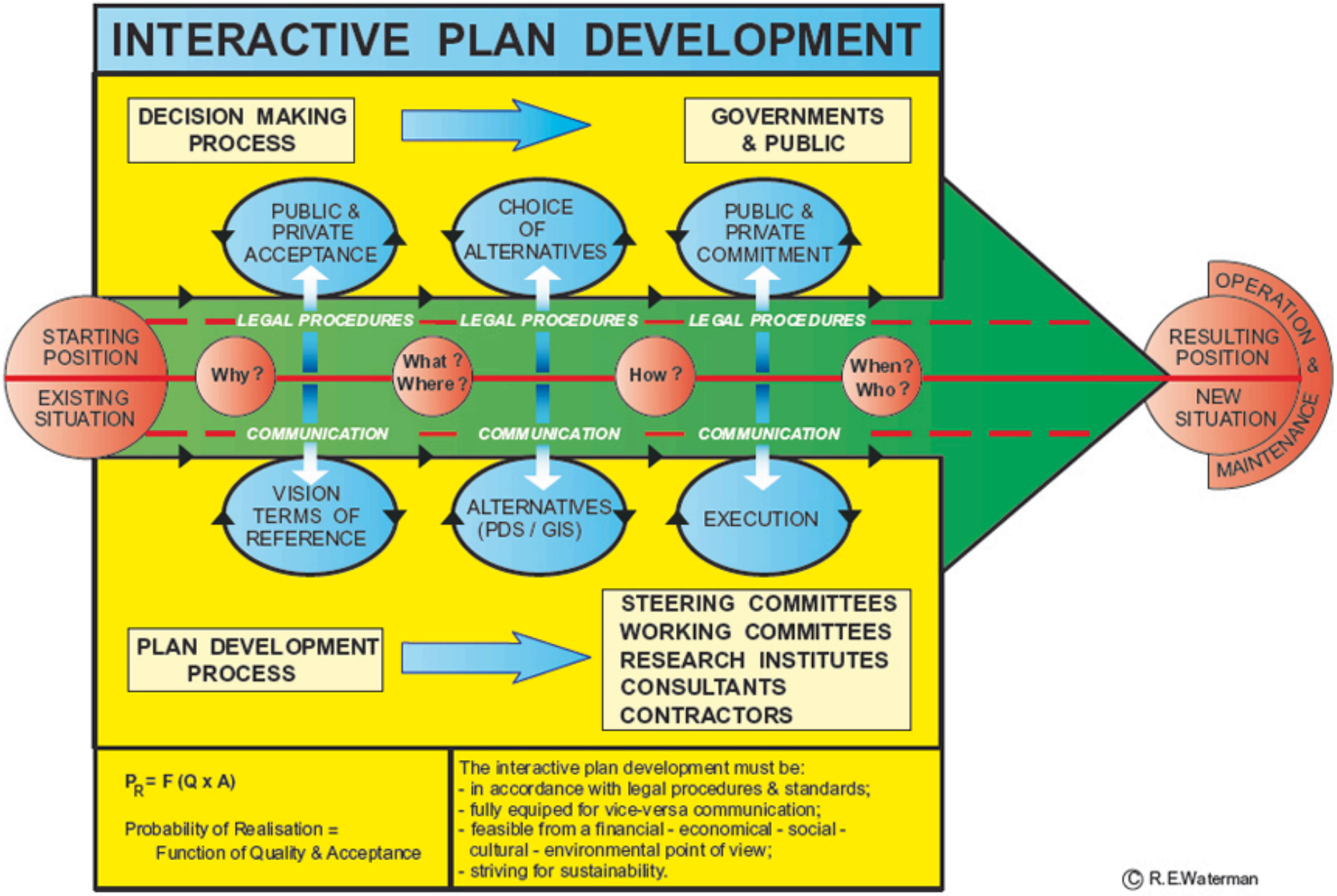
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© R.E.Waterman

AQUAPUNCTURE©

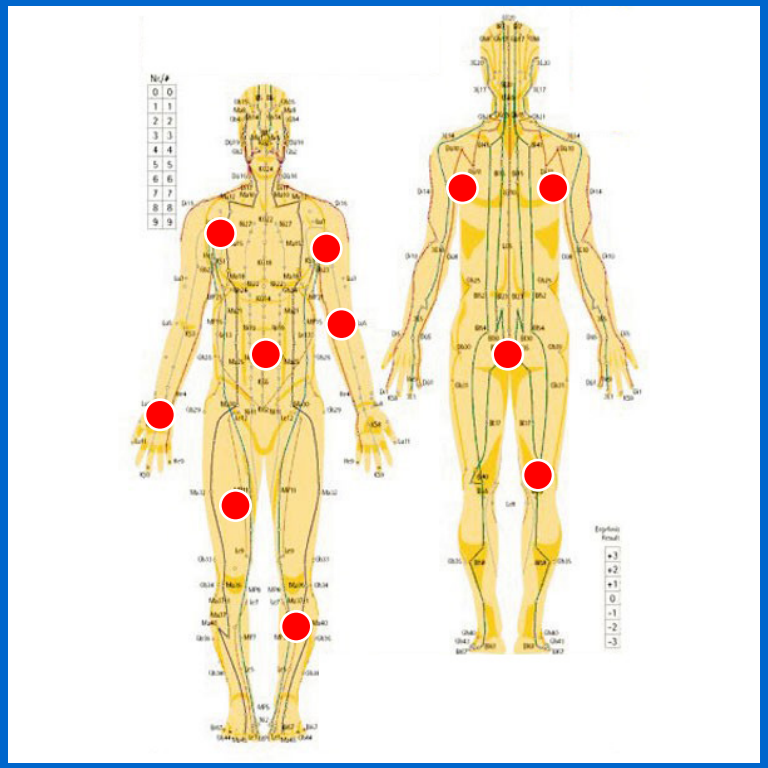
Introduction of AQUAPUNCTURE©

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



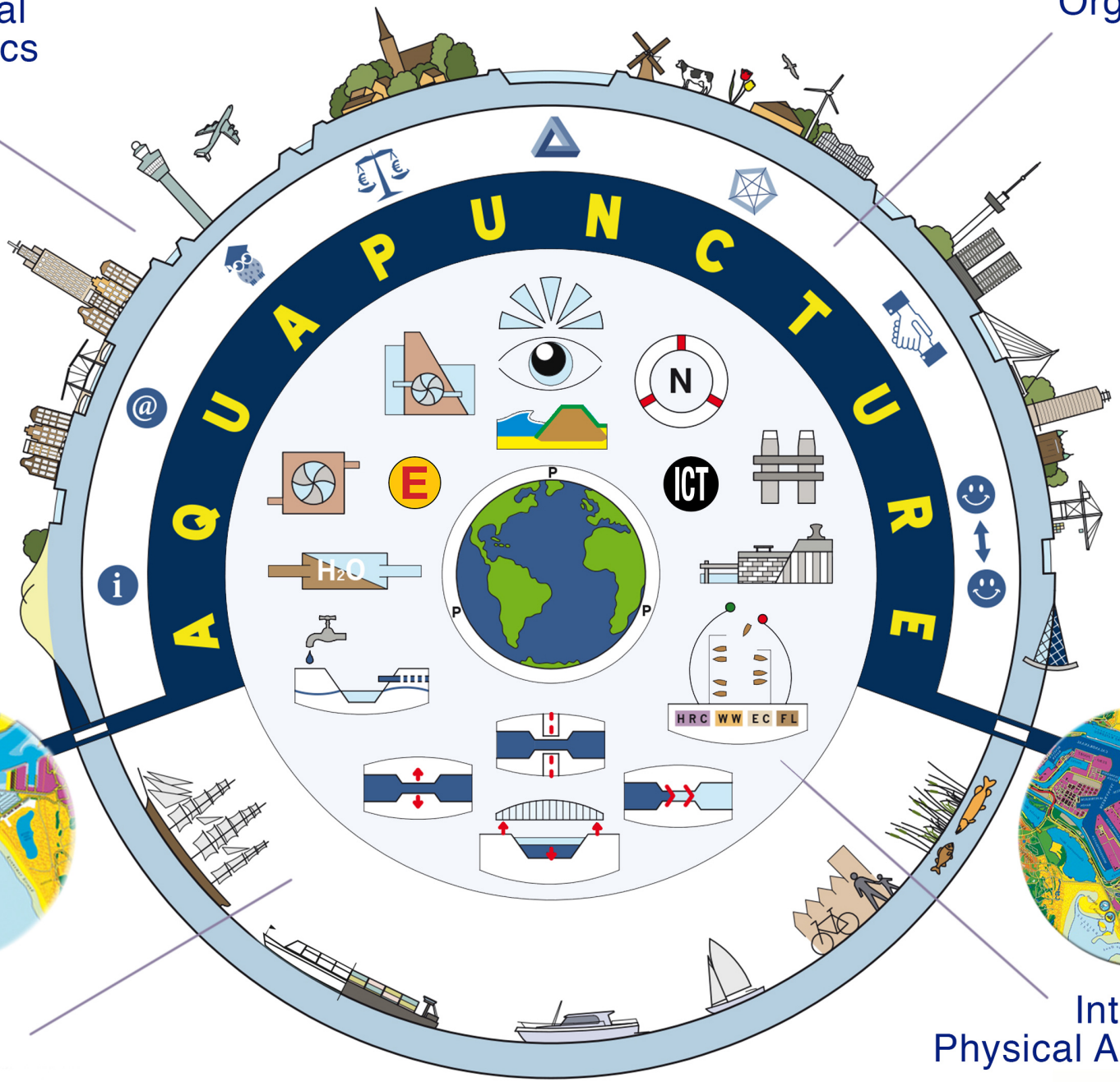
AQUAPUNCTURE

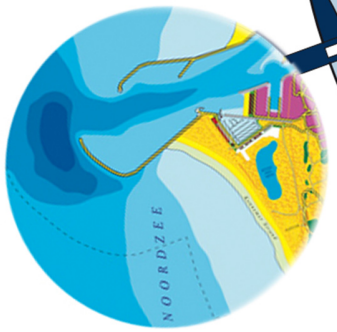
to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

Organisation







User Groups

Interventions Physical Adaptations

© J.A.Brouwer / R.E.Waterman (2020)

The GROASIS® TREE TECHNOLOGY is an integrated solution to solve food, soil erosion and climate problems by introducing the WATERBOXX



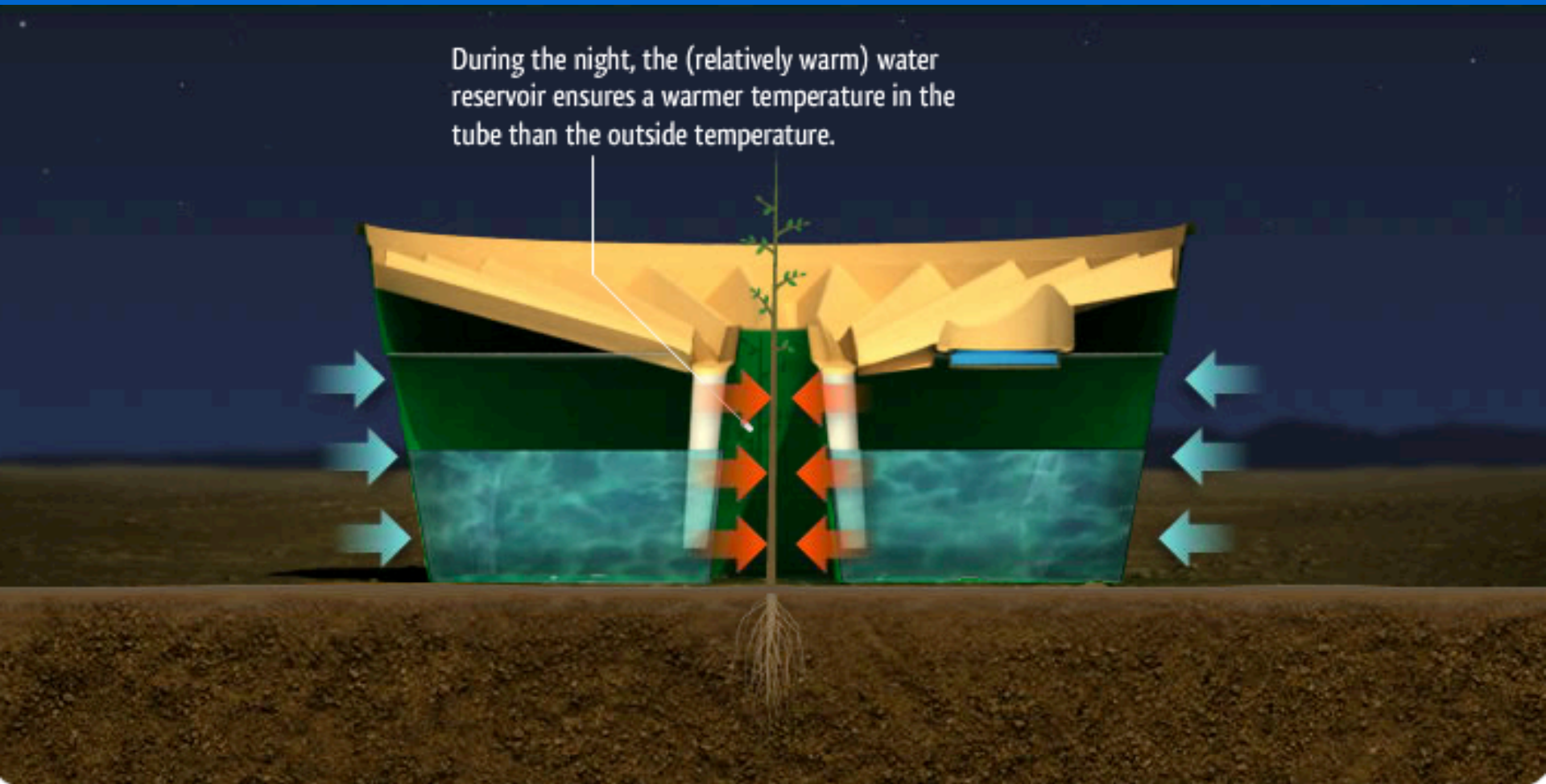


Groasis Greenboxx

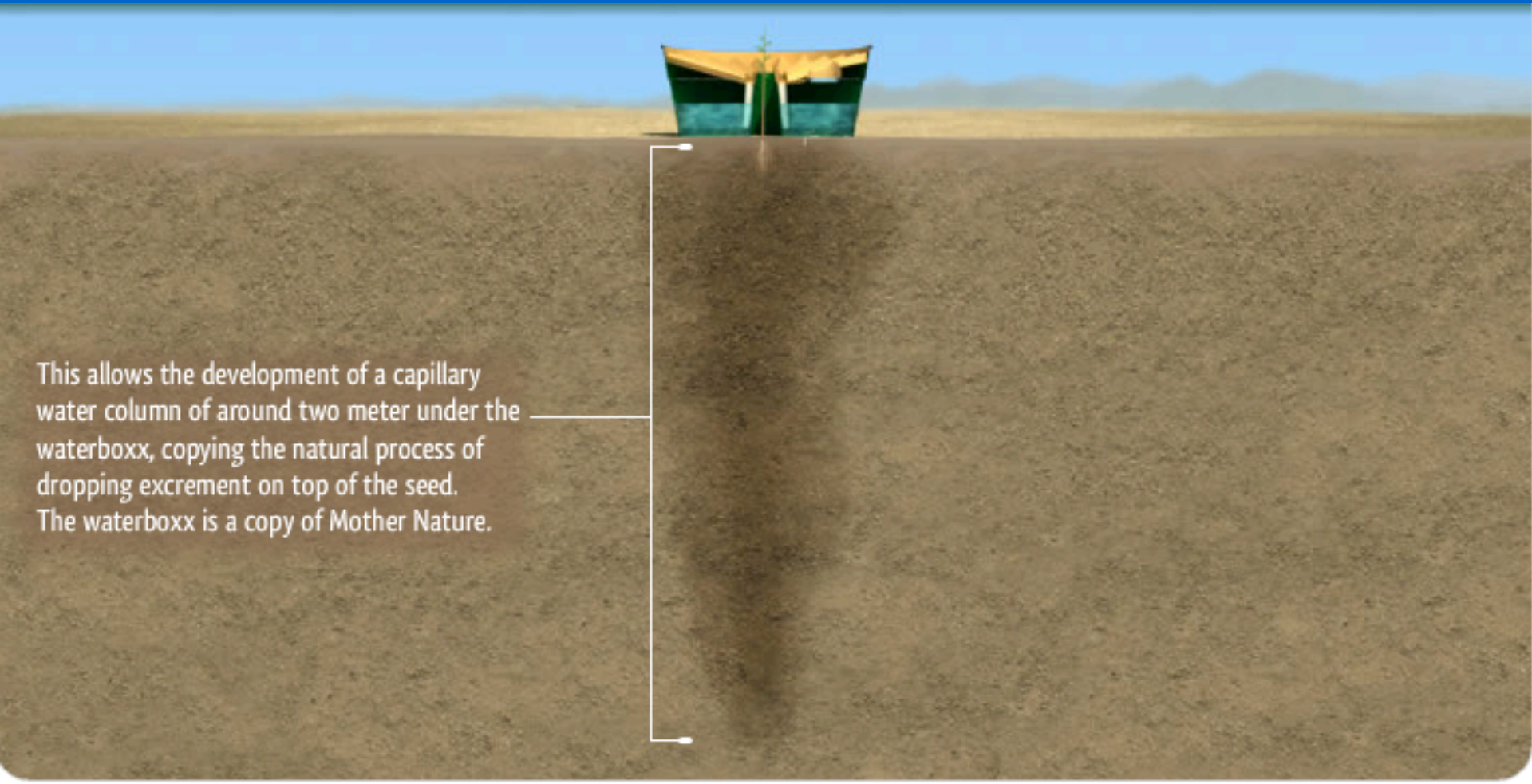


Successful planting in Los Monegros Desert – Zaragosa – Spain

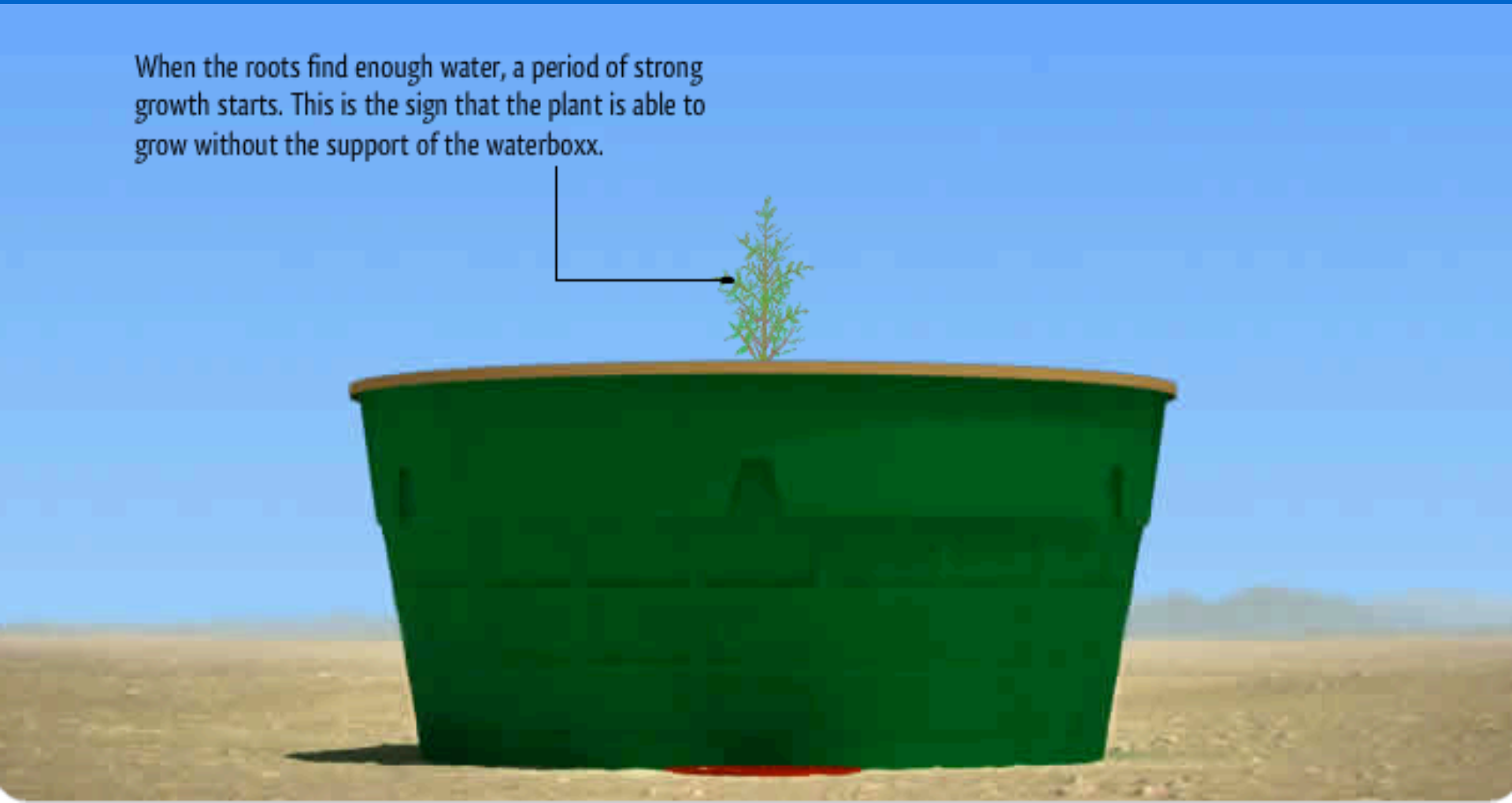
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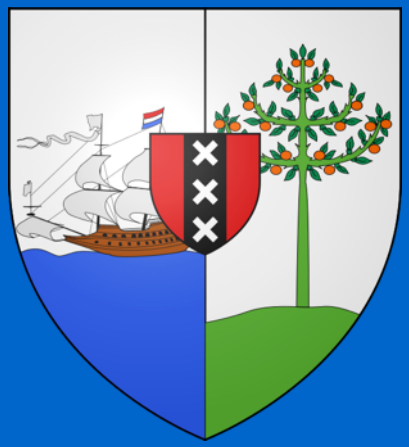
SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



Dr. R. E. Waterman MSc

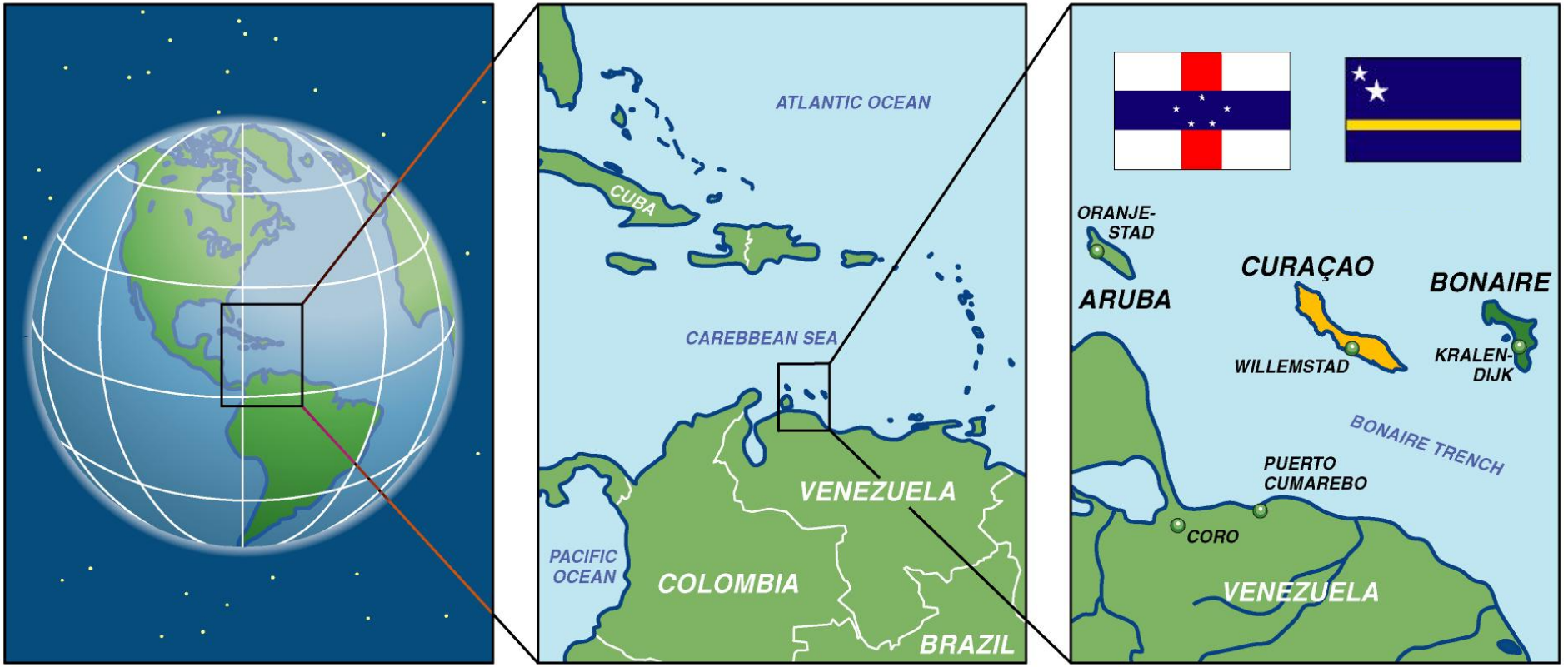




CURAÇAO
2013



Curaçao


ATLANTIC OCEAN
CUBA
CAREBBEAN SEA
VENEZUELA
PACIFIC OCEAN
COLOMBIA
BRAZIL
ORANJE-STAD
ARUBA
CURAÇAO
WILLEMSTAD
BONAIRE
KRALEN-DIJK
BONAIRE TRENCH
PUERTO CUMAREBO
CORO
VENEZUELA



Inhabitants
150,000

Surface Area
444 km²

Length
61 km

Width
5 – 14 km

Coastal Length
364 km

Highest Point
Christoffel Berg
375 m


KONTIKI BEACH
parking for 1200 cars
Site for future hotels and apartments
approximatelty 300 rooms
parking
parking
parking
20 m
65 m
MAMBO BEACH
profile
CARIBBEAN SEA
Willemstad
Westpunt
Bullenbaai
Harbour marina
Lagoon
Lagoon
Sea lion lagoon
Therapy dolphin lagoon
Animal encounter lagoon
Dolphin "swim" lagoon
Royal resort
Animal Encounter Dive shop
Aquariums and educational area
profile
12 - 15 m
4 m
profile of rock boulder, all distances are average, drawing is not at scale
CURAÇAO DOLPHIN ACADEMY
Land Reclamation Project since 1990
Green area
Artificial - man made beaches
Rock boulder - defense
Dune area - selective plants for seaside vegetation areas
Path ways, roadways
Building area
Origianal coastline
Wave direction
Ocean current
0 10 20 30 40 50 100 m







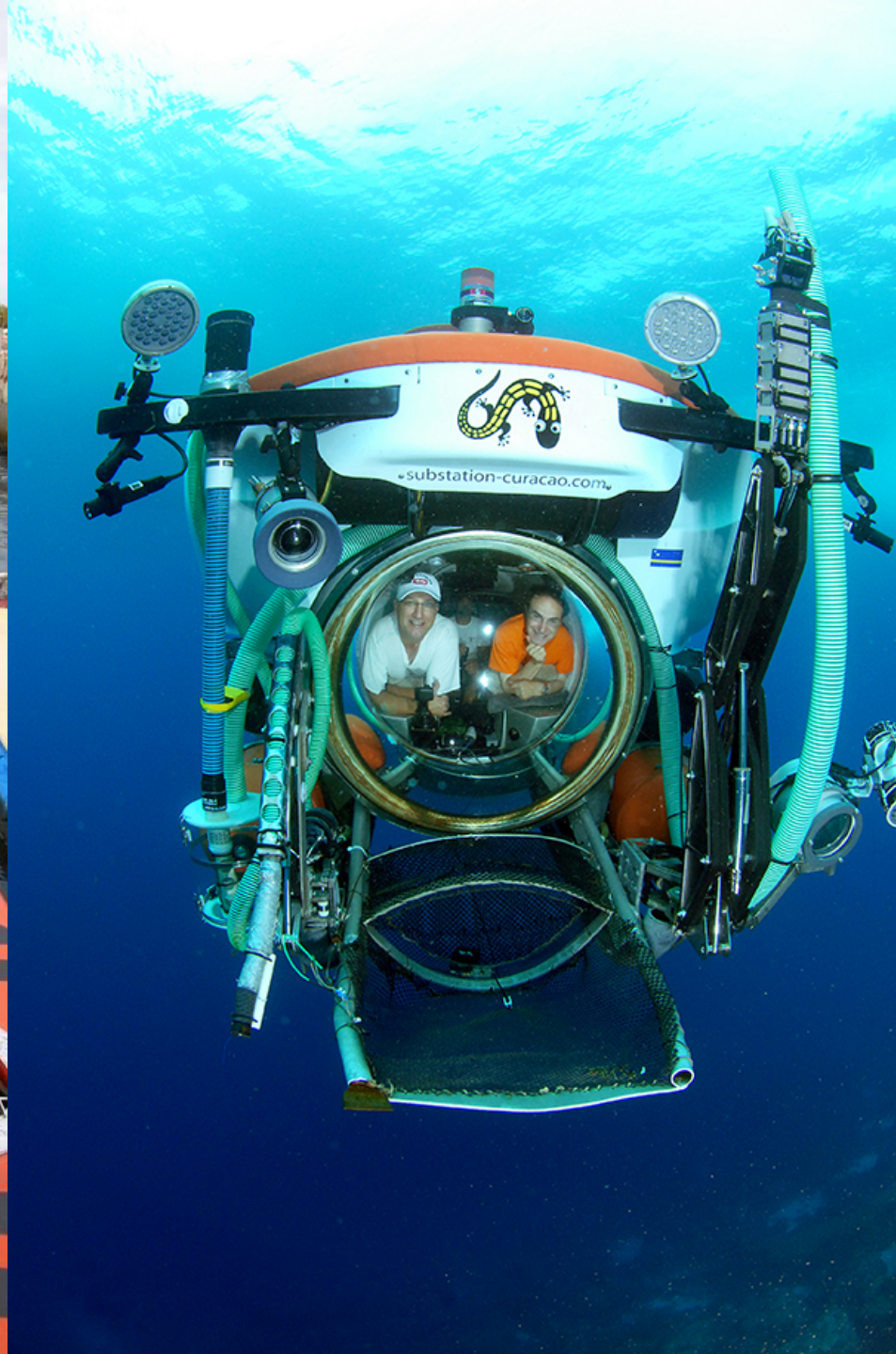







SUBSTATION CURAÇAO


SUBSTATION


substation-curacao.com











SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Delta Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



COLOMBIA – THE NETHERLANDS



2015










LIBERTAD Y ORDEN
JE MAINTIENDRAI

COLOMBIA







SURFACE AREA

1,141,748 km² 33,883 km²

INHABITANTS

48.8 million 17 million

COASTAL LENGTH

1760 km Mar Caribe
1448 km Océano Pacifico
353 km North Sea

MAIN RIVER BASINS

Magdalena-Cauca
Orinoquia
Amazonia
Caribe
Pacifico
Rhine - Maas - Scheldt

SEA PORTS

Cartagena de Indias
Barranquilla
Santa Marta
Buenaventura
Tumaco
Rotterdam - Amsterdam

THE NETHERLANDS









PACIFIC COAST

Mostly rocky with steep rocky slope

Tidal difference up to 7 m

Currents more random and coastline is prone to tsunamis

Bogotá 7,9 million

Medellín 2,4 million

Cali 2,4 million

Barranquilla 1,2 mill.

Cartagena 0,9 million





ATLANTIC COAST

Includes sandy beaches and a more gradual sandy slope

Tidal magnitude around 40 cm

Along Caribbean coast almost continuous current flows from NE to SW

Large reserves of fresh water

11% national parks

High biodiversity

4 Climatic Zones
- **Tierra Caliente**
- **Tierra Templada**
- **Tierra Fria**
- **Tierra Heleda**

Turbo



GOLFO DE URABÁ

BAHÍA COLOMBIA

Río Turbo

Mangroves

Coastline and Depths (see Note)

76° 45′ Punta Yarumal

44′

43′

El Uno

TANK

TURBO

Terminal

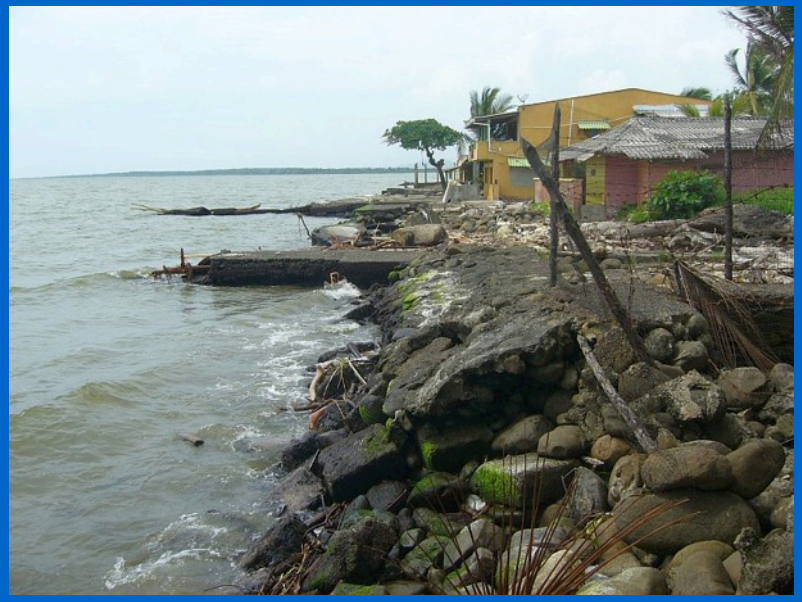
BAHÍA TURBO

Canal Casanova

Airfield

Punta Las Vacas

Fresco Lirio





Golfo de Urabá & Turbo









Golfo de Urabá & Turbo





Punta Arboletes





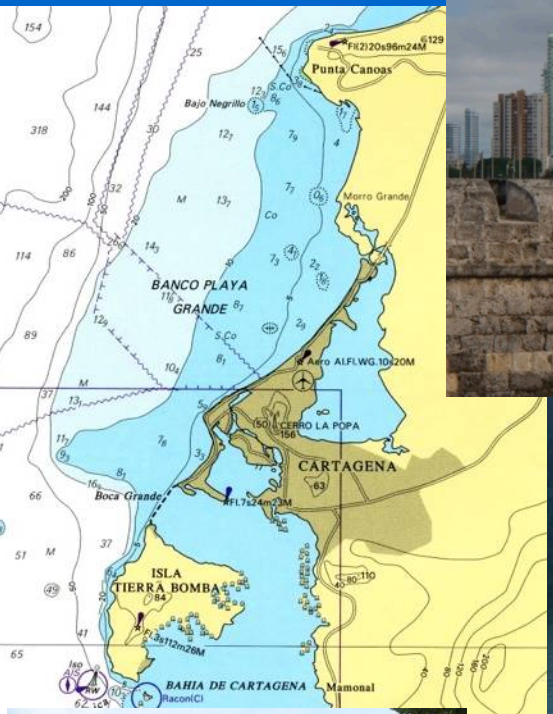


Cartagena de Indias



Cartagena de Indias











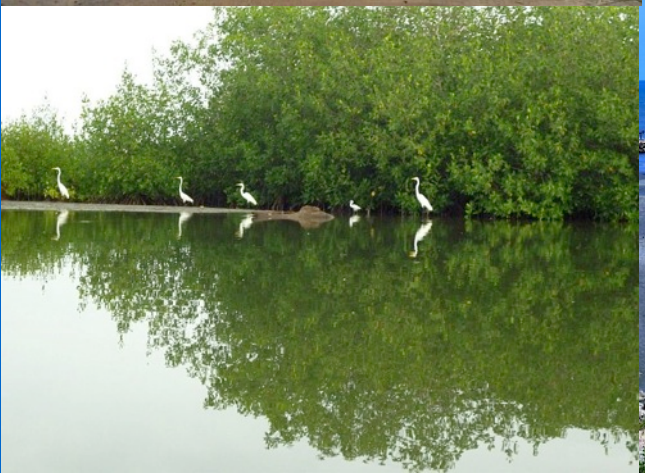
Cartagena de Indias







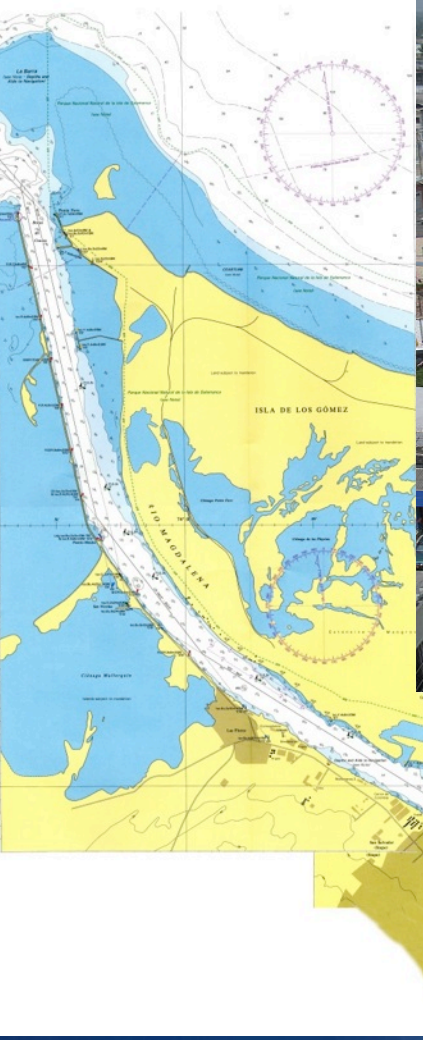






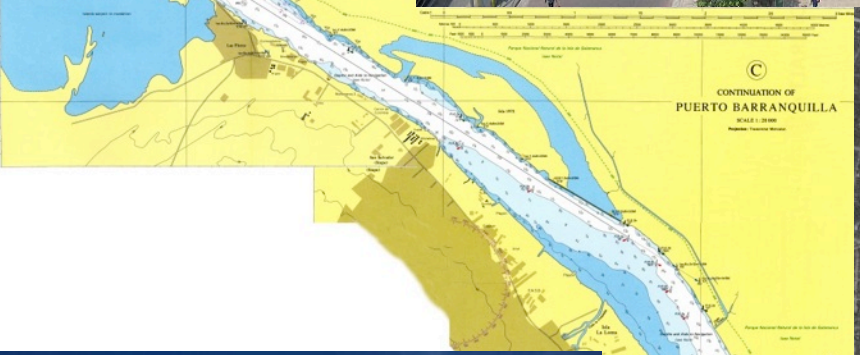
Cartagena de Indias

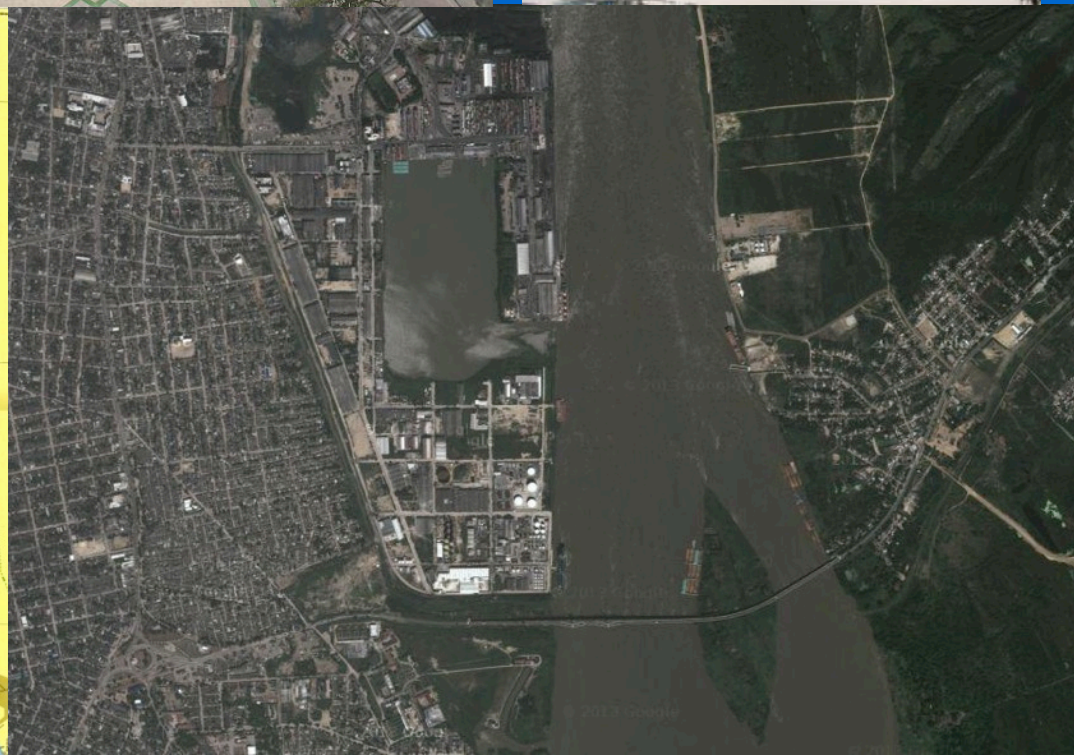
Barranquilla & Rio Magdalena



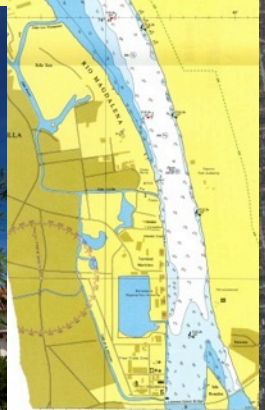












GEODESY

In planning & design Geodesy plays an essential role.

Historical and actual data with regard to land & sea surfaces and sub surfaces are needed for planning & map making.

Measurements are required through land- and sea survey, including Remote Sensing.

SUSTAINABLE MULTI-FUNCTIONAL COASTAL ZONE DEVELOPMENT

General approach

A. ***Integrated Coastal Policy*** to give an answer to the question: How can we solve many existing and future problems in relation to each other, in relation to the existing hinterland on the one hand and in relation to the bordering sea on the other, while creating added value

B. Application of the method ***Building with Nature®*** using more than before the materials and forces/interactions present in nature, creating a new flexible dynamic equilibrium coast in which accretion and erosion are more or less balancing each other with a minimum of solid seawall elements. Taking into account the bio-geomorphology & geohydroloy of coast & seabed.

SUSTAINABLE MULTI-FUNCTIONAL COASTAL ZONE DEVELOPMENT

Local Measures

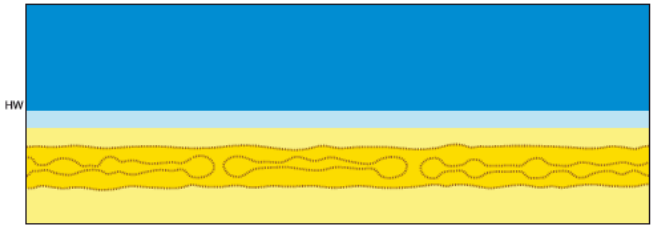
1. Dune & Beach & Foreshore nourishment
2. Restoration of natural sediment transport
3. Sand Engine for long term maintenance
4. Making work with work: reuse of dredged material
5. Mangrove rehabilitation
6. Application of sand packed geotextiles, poles & sticks
7. Reshaping cliffs with adequate slope combined with vegetation
8. Preservation & restoration of Coral Reefs; artificial reefs
9. Use of existing Barrier Islands
10. Introduction of a minimum of Coast Parallel Breakwaters
11. Spatial Planning

PRINCIPALES MEDIDAS PARA MITIGAR LA EROSION

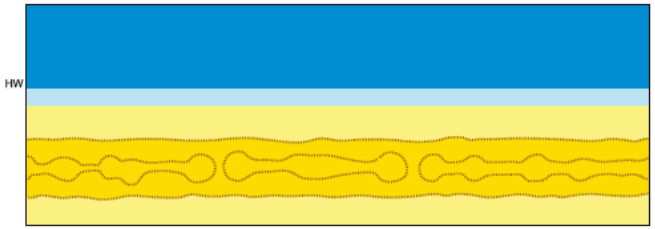
1. La restauración del transporte natural de sedimentos
2. La reutilización de material dragado
3. La regeneración de arena
4. La rehabilitación de manglares
5. La remodelación de acantilados
6. El desarrollo de arrecifes de coral
7. El uso inteligente de estructuras duras
8. Medidas de protección a pequeña escala
9. La planificación espacial

SOLUTIONS IN FULL HARMONY WITH NATURE: NATURAL BEACHES AND DUNES

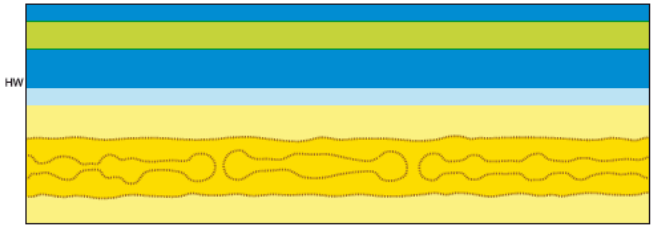
I.A.1
Existing Coastline
with Beach and Dunes



I.A.2
Dune and Beach
Nourishment

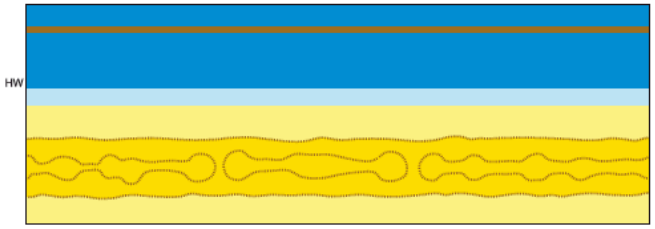


I.A.3
Foreshore Nourishment

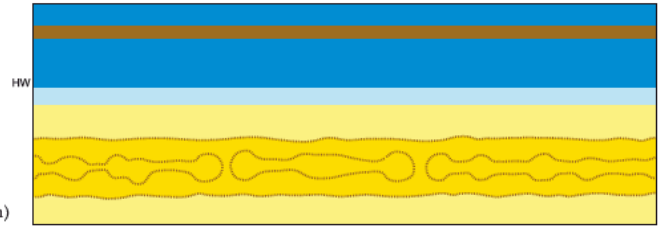


SOLUTIONS USING ARTIFICIAL STRUCTURES IN HARMONY WITH NATURE

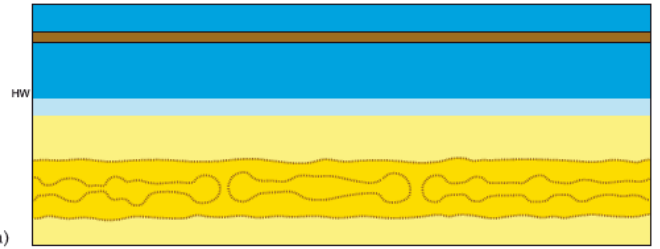
I.B.1
Submerged
Parallel Berm /
Perched Beach
(Sand Retaining Dam)



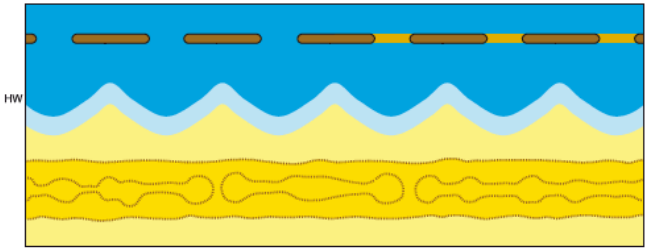
I.B.2
Submerged Offshore
Breakwater - Reef Type
(Sand Retaining Dam,
Wave Energy Reduction)



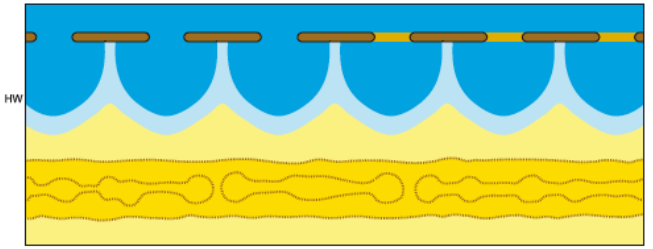
I.B.3
Offshore Breakwater
(Sand Retaining Dam,
Wave Energy Reduction)



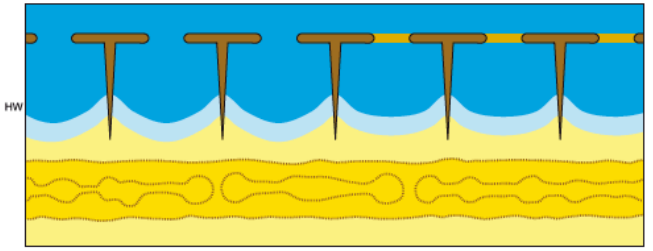
I.B.4
Multiple Offshore
Breakwaters without or
with sills
(Salient Beaches)



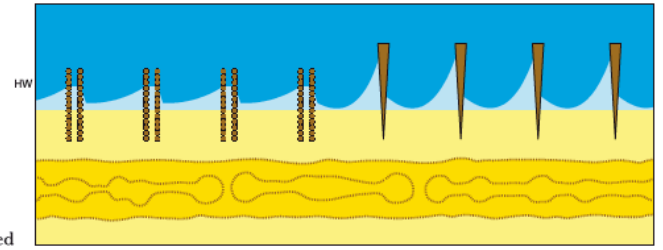
I.B.5
Multiple Offshore
Breakwaters without or
with sills
(Tombolo Beaches)



I.B.6
T-shaped Breakwaters
without or with sills
(Pocket Beaches)

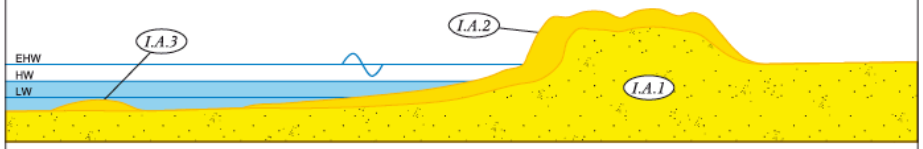


I.B.7
Groynes, Open or Closed



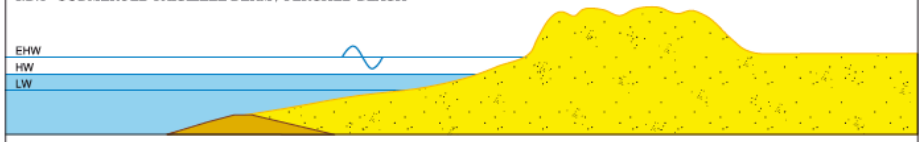
NATURAL BEACHES AND DUNES

I.A.1,2,3 WITH OR WITHOUT FORESHORE AND ONSHORE NOURISHMENT

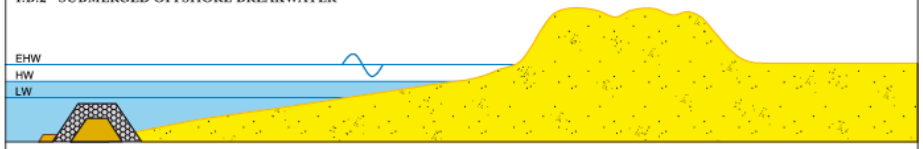


SEMI-NATURAL BEACHES AND DUNES

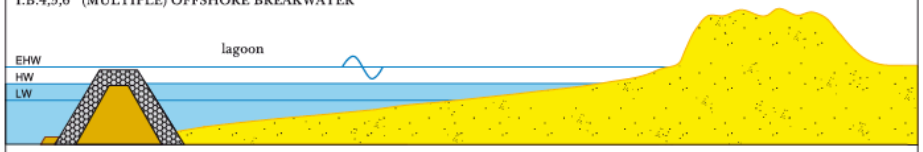
I.B.1 SUBMERGED PARALLEL BERM / PERCHED BEACH



I.B.2 SUBMERGED OFFSHORE BREAKWATER

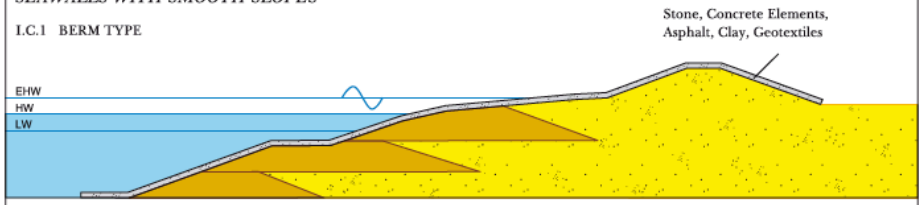


I.B.4,5,6 (MULTIPLE) OFFSHORE BREAKWATER

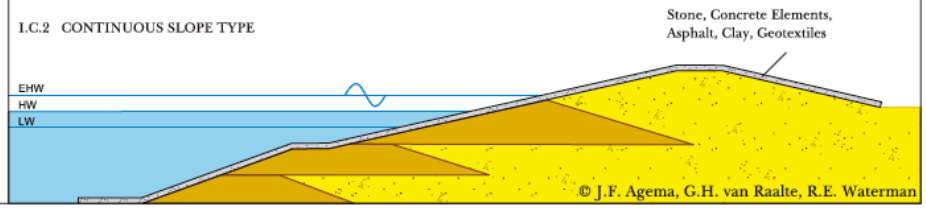


SEAWALLS WITH SMOOTH SLOPES

I.C.1 BERM TYPE



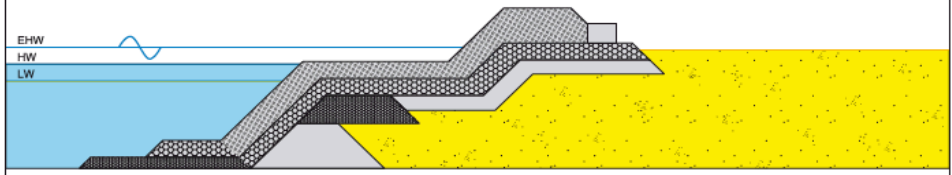
I.C.2 CONTINUOUS SLOPE TYPE



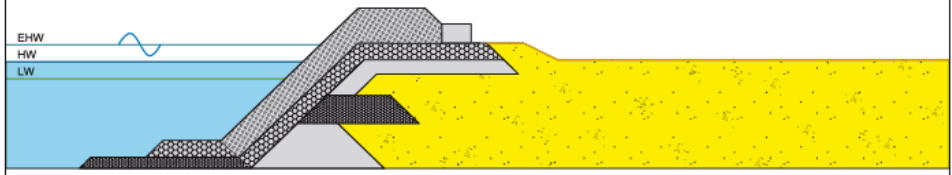
© J.F. Agema, G.H. van Raalte, R.E. Waterman

SEAWALLS WITH STEEP SLOPES

I.D.1 BERM TYPE

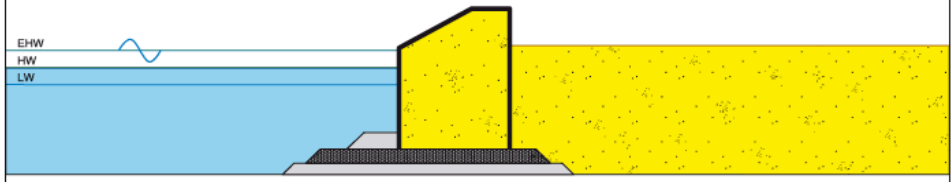


I.D.2 CONTINUOUS SLOPE TYPE

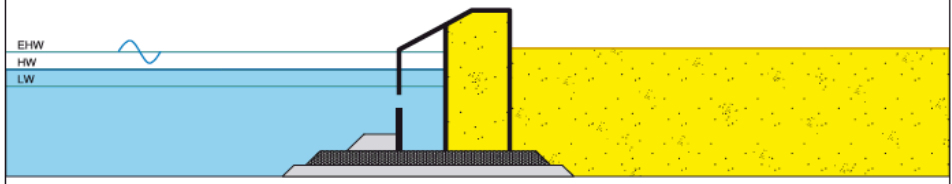


SEAWALLS WITH CAISSONS

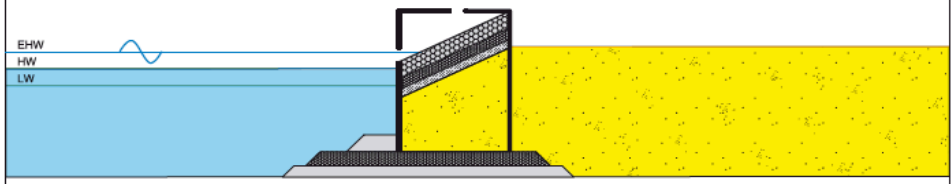
I.E.1 HANTSHOLM TYPE



I.E.2 HANTSHOLM TYPE PERFORATED



I.E.3 HANTSHOLM TYPE PERFORATED WITH INTERNAL ROCK SLOPE



© J.F. Agema, G.H. van Raalte, R.E. Waterman

PACIFIC COAST

Mostly rocky with steep rocky slope

Tidal difference up to 7 m

Currents more random and coastline is prone to tsunamis

Bogotá 7,9 million

Medellín 2,4 million

Cali 2,4 million

Barranquilla 1,2 mill.

Cartagena 0,9 million





ATLANTIC COAST

Includes sandy beaches and a more gradual sandy slope

Tidal magnitude around 40 cm

Along Caribbean coast almost continuous current flows from NE to SW

MAIN RIVER BASINS

Magdalena-Cauca

Orinoquia

Amazonia

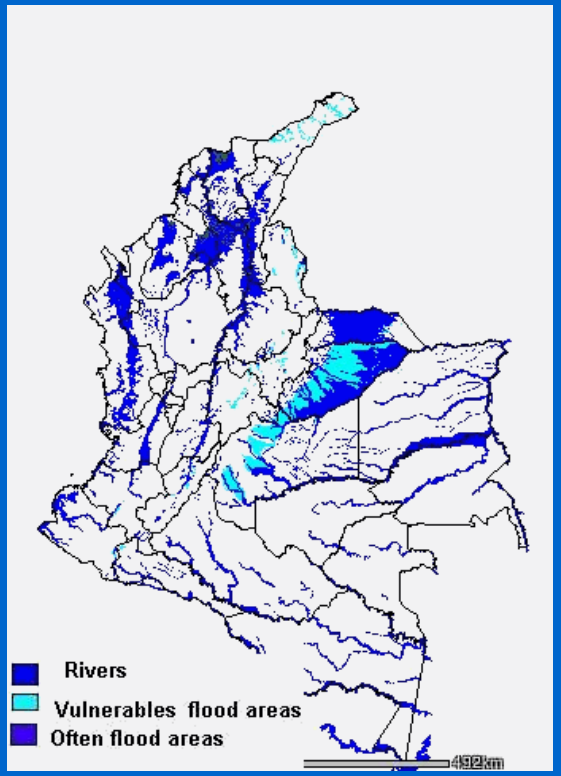
Caribe

Pacifico

MAIN RIVER BASINS

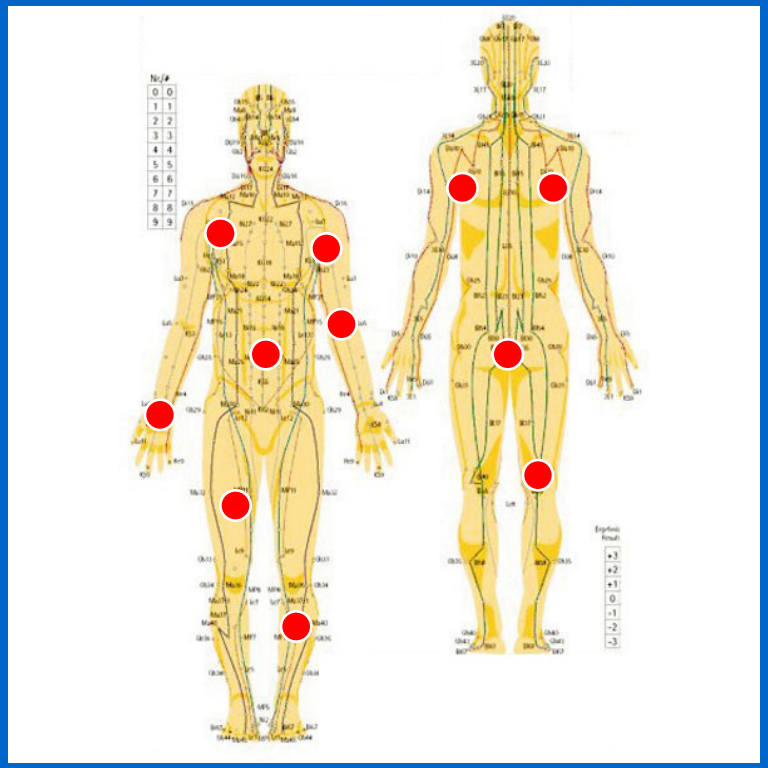
Magdalena-Cauca
Orinoquia
Amazonia
Caribe
Pacifico

Flood Areas



ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



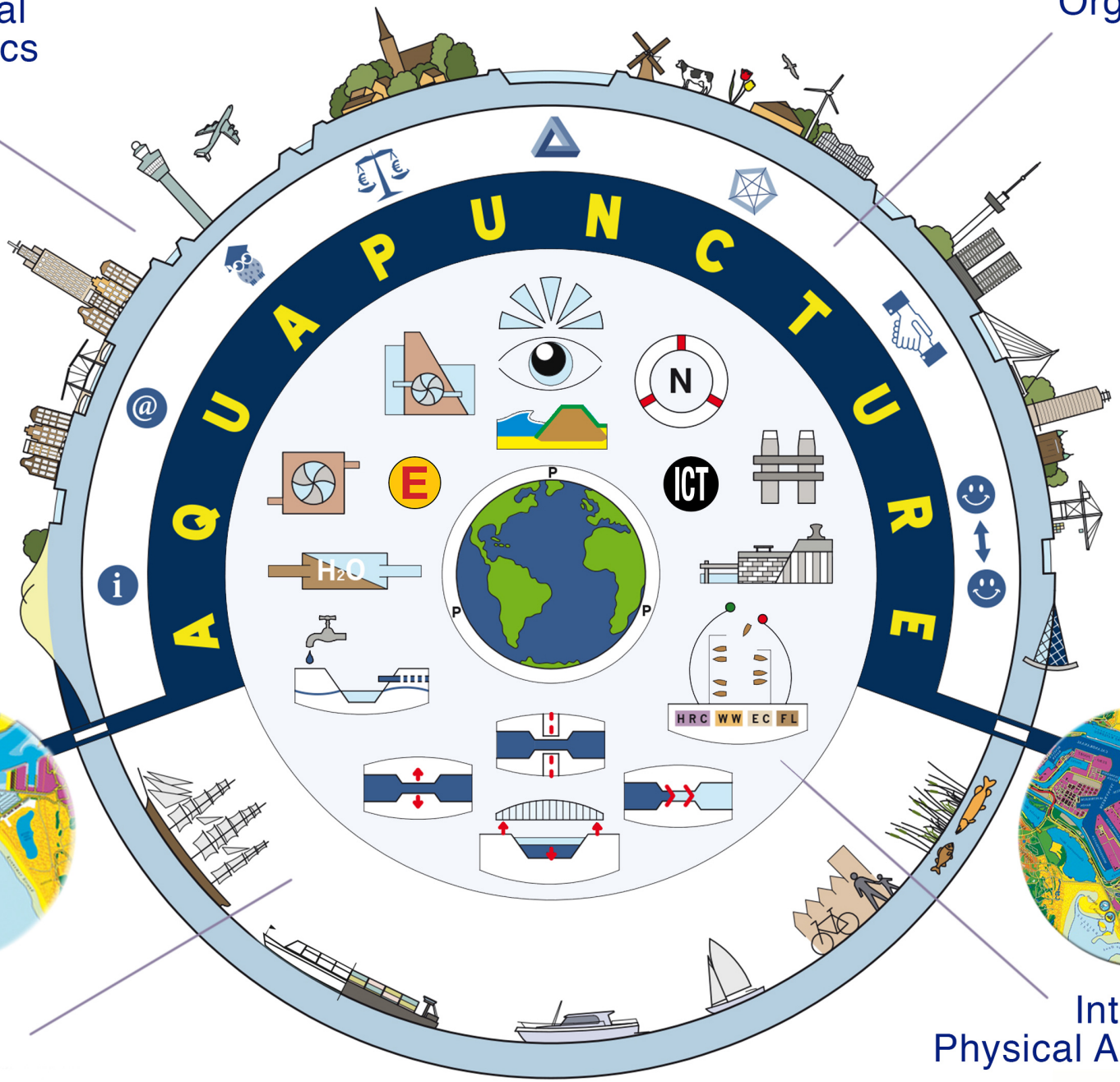
AQUAPUNCTURE

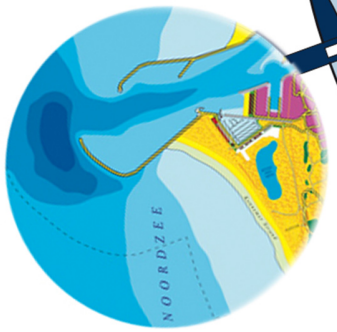
to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

Organisation







User Groups

Interventions Physical Adaptations

© J.A.Brouwer / R.E.Waterman (2020)

Recuperación del Canal del Dique



Length 120 km, from Catagena to Rio 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









Rio Magdalena





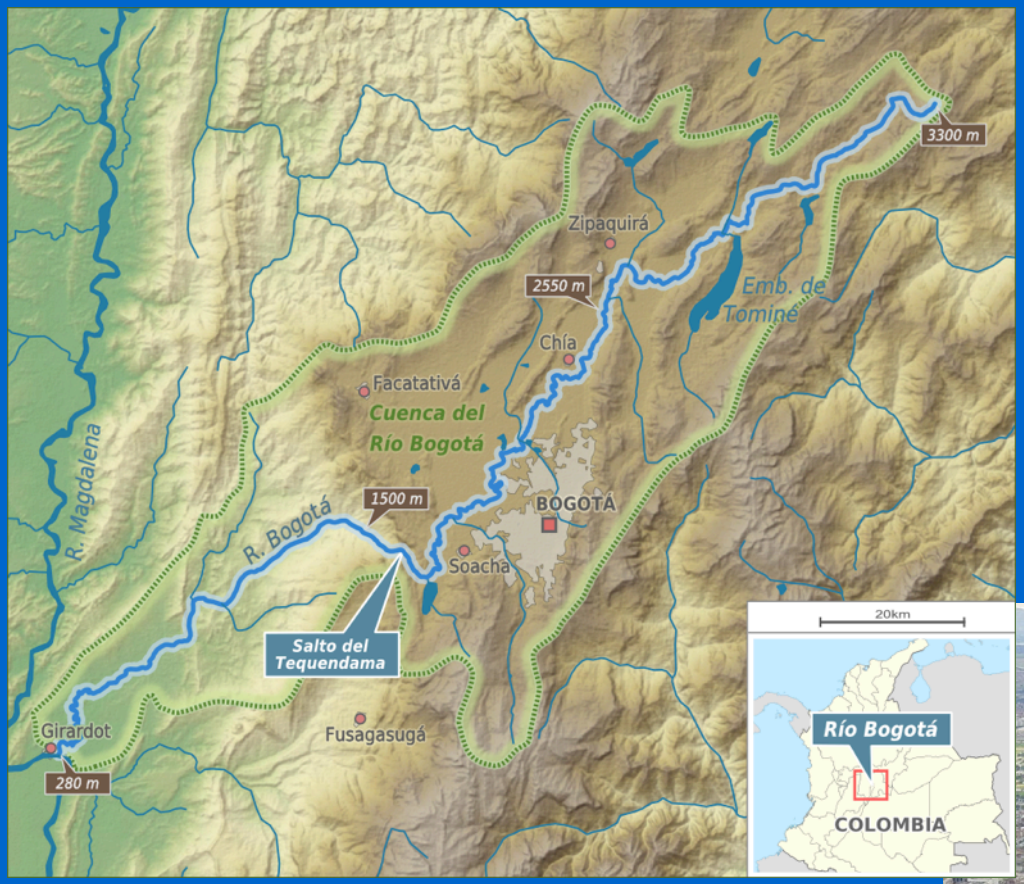




Rio Magdalena –
Length 1540 km

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 Rio Bogotá should be improved through AGUAPUNTURA©

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

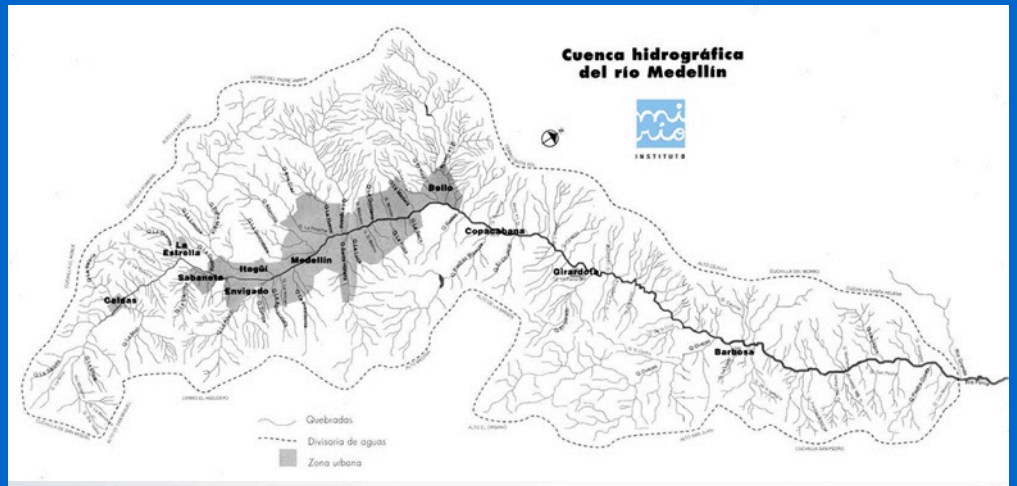


Bogotá

7.9 million inhabitants



Rio Medellin





Medellin - 2.4 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



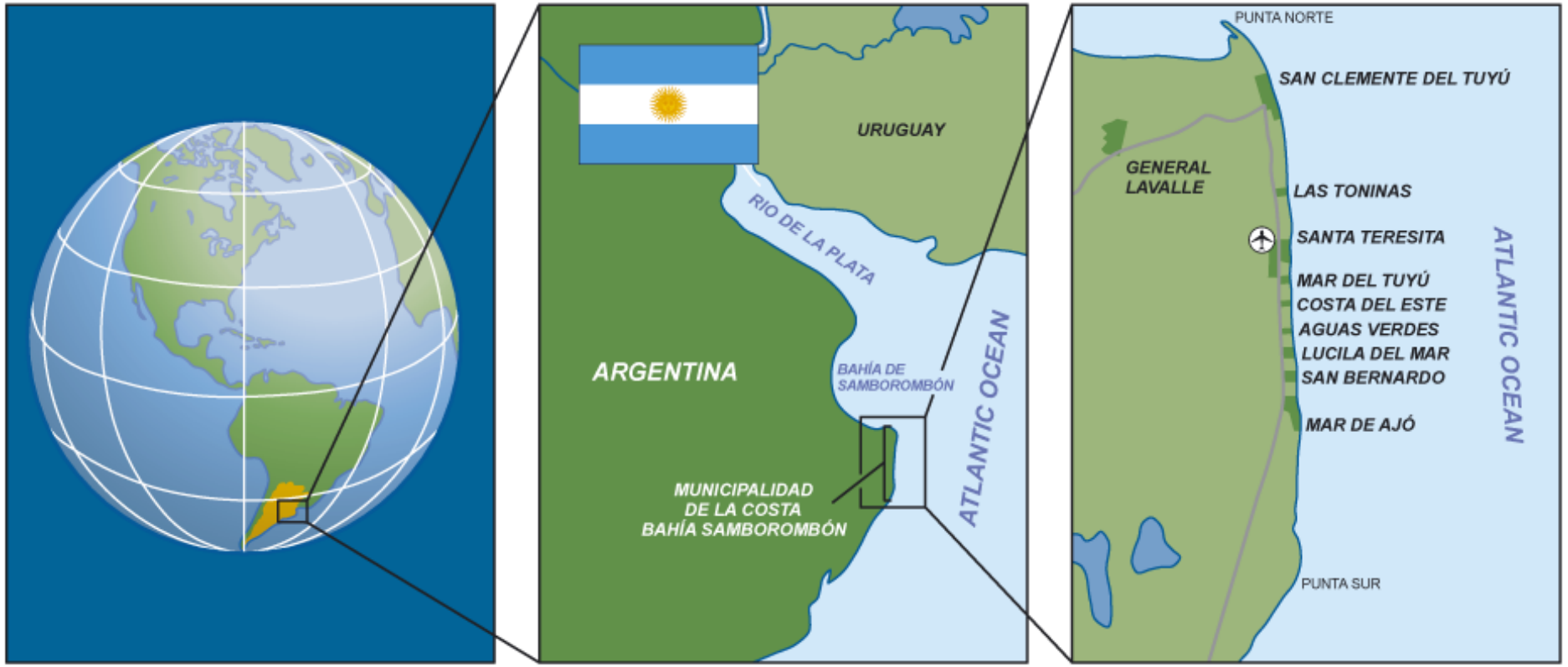
Santiago de Cali –
2.4 million inhabitants

Rio Cali

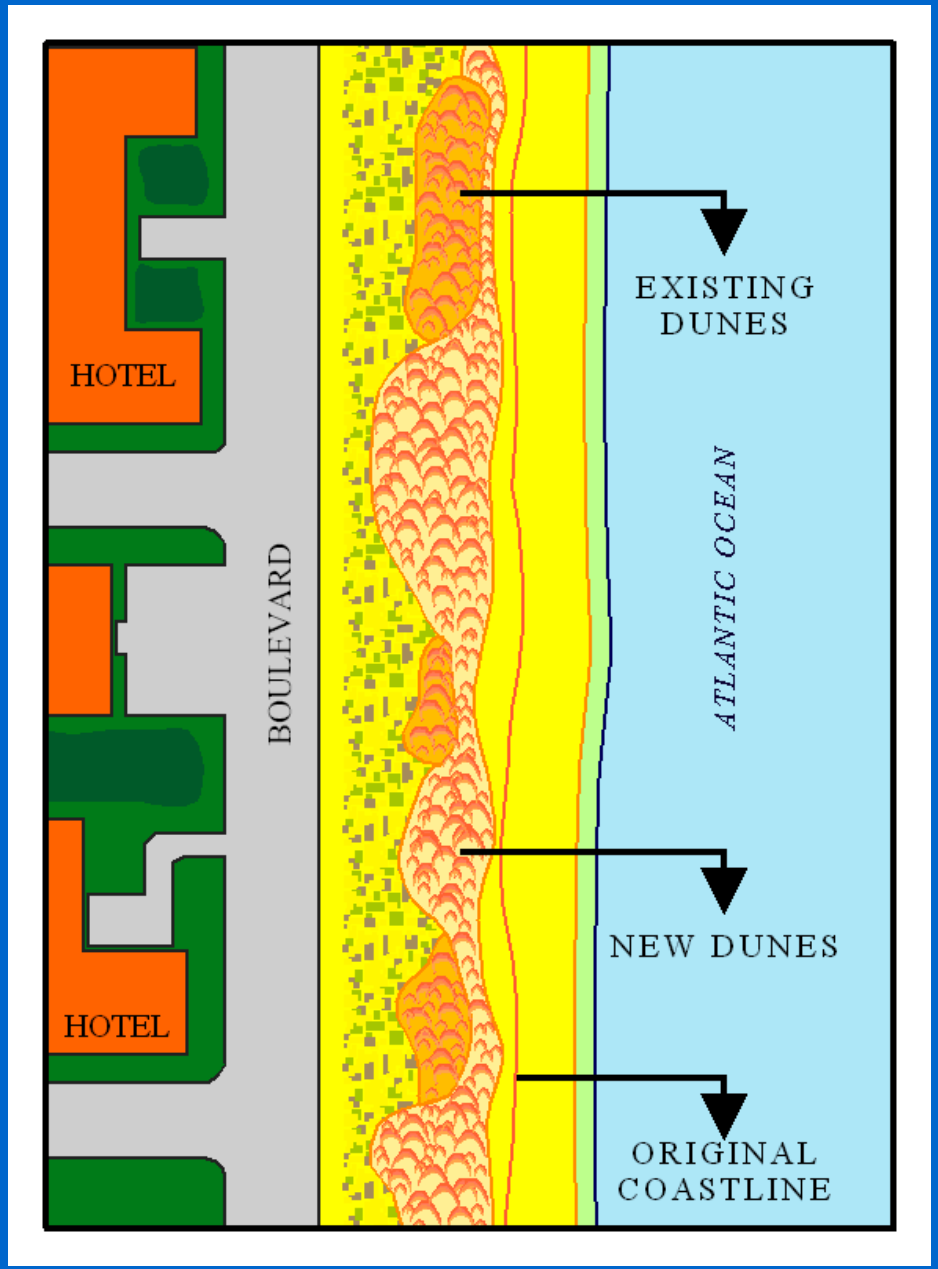
AGUAPUNTURA©
for the optimal use & adaptation of the waterway and their waterfronts for economy, employment, environment, nature & landscape



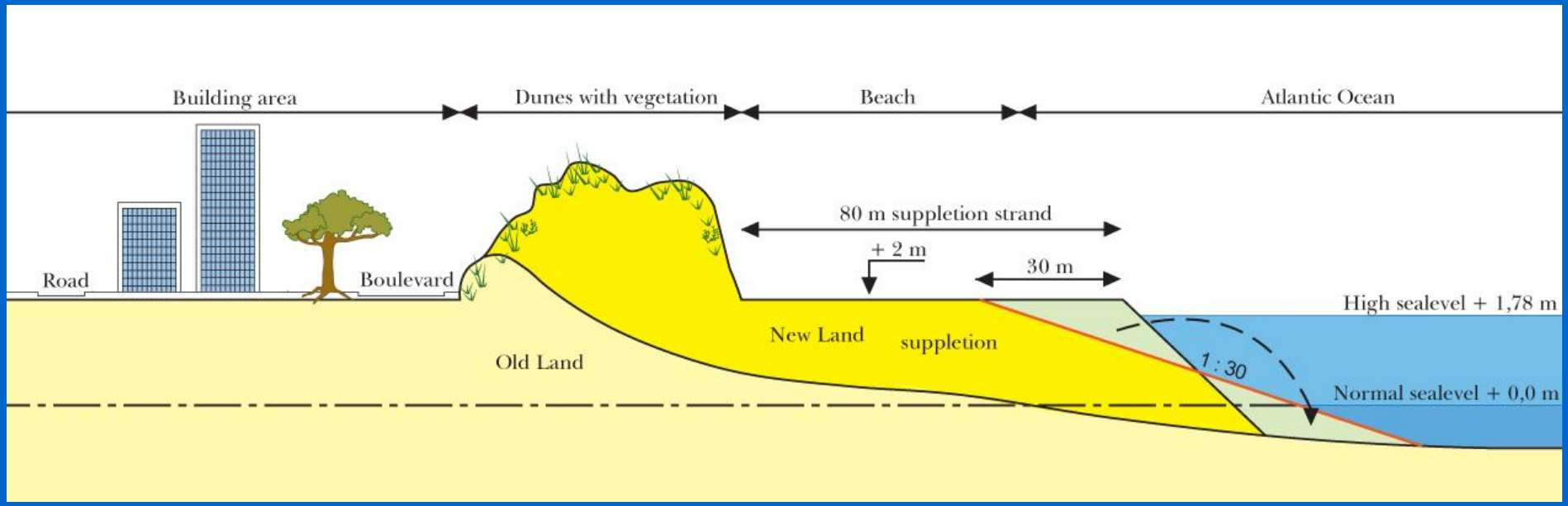
Argentina – *Municipalidad de la Costa*




Punta Norte
San Clemente
General Lavalle
Las Toninas
Santa Teresita
Mar del Tuyú
Costa del Este
Aguas Verdes
Lucila del Mar
San Bernardo
Mar de Ajó
Punta Sur
Atlantic Ocean
N
S
10 m
20 m
0
5
10
15
20 km


HOTEL
HOTEL
BOULEVARD
EXISTING DUNES
NEW DUNES
ORIGINAL COASTLINE
ATLANTIC OCEAN

Argentina – *Municipalidad de la Costa*



Argentina

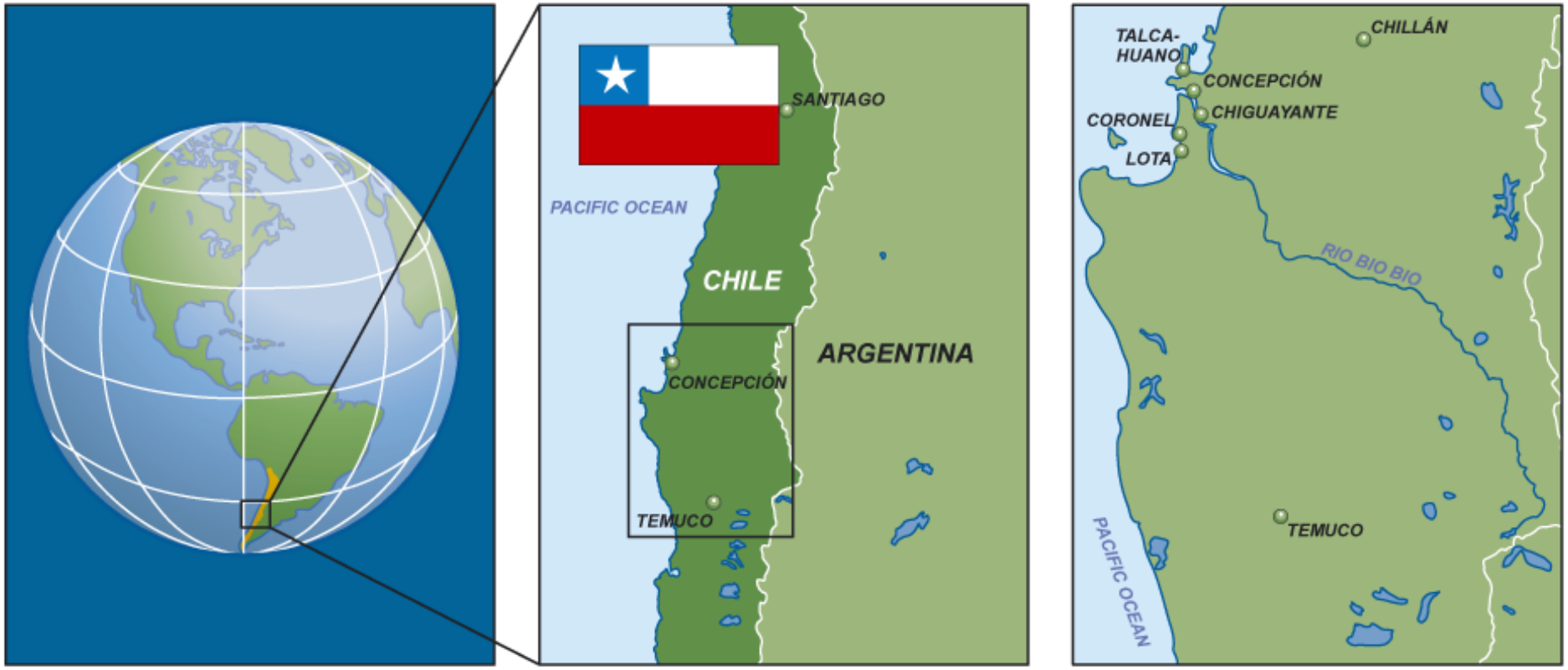


Mar del Tuyu



San Clemente del Tuyu

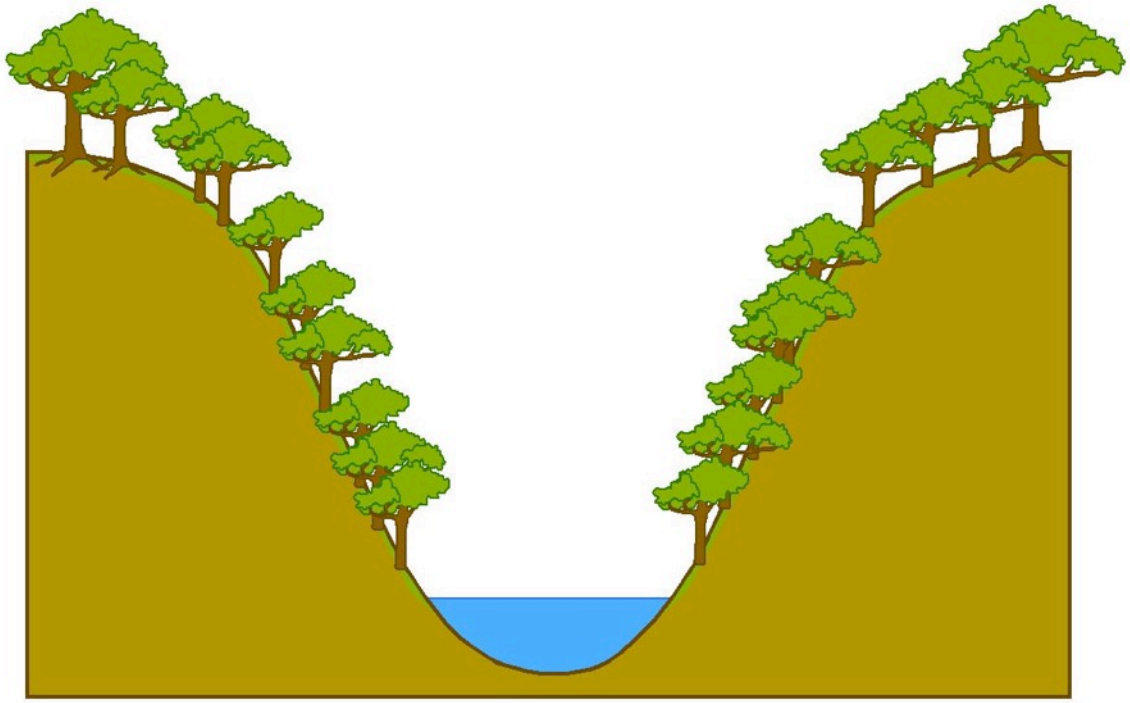
Chile


SANTIAGO
PACIFIC OCEAN
CHILE
ARGENTINA
CONCEPCIÓN
TEMUCO
TALCA-
HUANO
CHILLÁN
CONCEPCIÓN
CHIGUAYANTE
CORONEL
LOTA
RIO BIO BIO
TEMUCO
PACIFIC OCEAN

Chile *Rio Bio Bio*

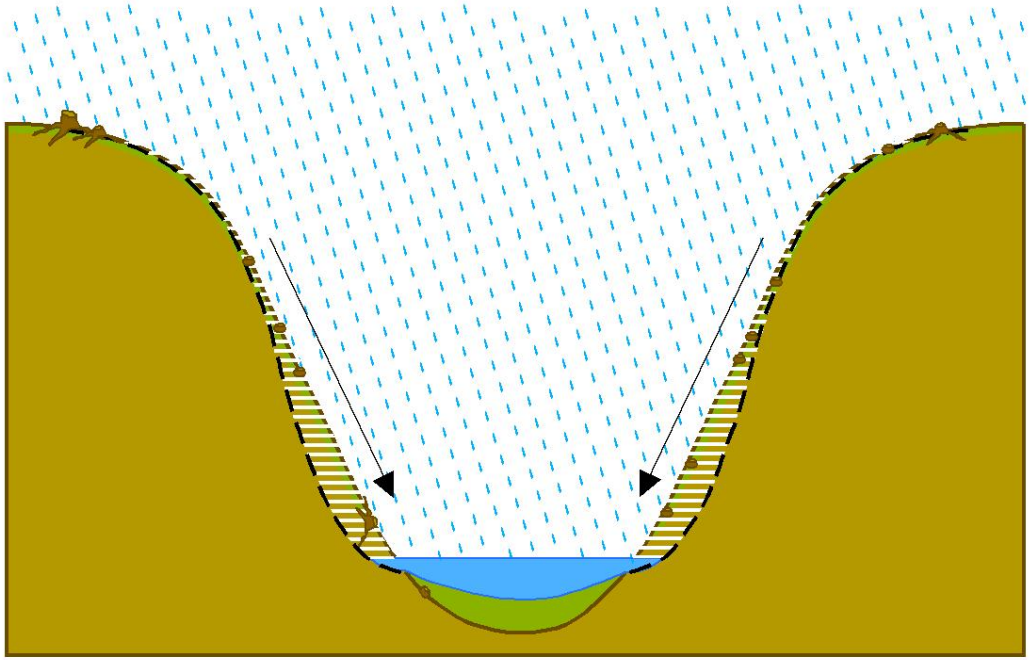
RIO BIO BIO IN CHILE

Cross section in original situation of riverbanks with trees, shrubs and a navigable river.



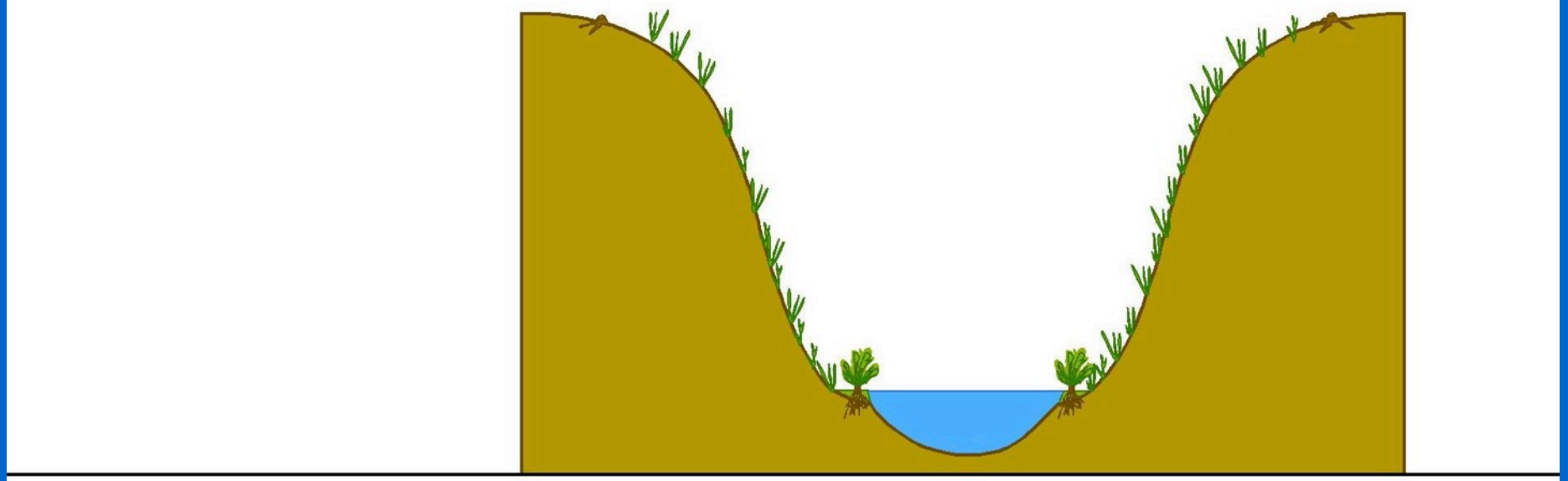
Chile *Rio Bio Bio*

Cross section with man-induced erosion by tree logging leading to a wider but less deep riverbed which in turn causes reduced navigatebility and reduction of fertile land.



Chile *Rio Bio Bio*

Cross section with river bank restoration by tree planting and planting of tree saplings in the river causing local sedimentation and land reclamation, which in turn forces the river in a narrower and deeper riverbed, thereby restoring the original river depth.





Chile *Rio Bio Bio*



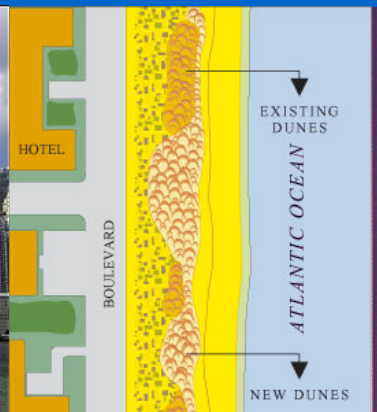
BUILDING WITH NATURE

Building with Nature®

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

Question Time









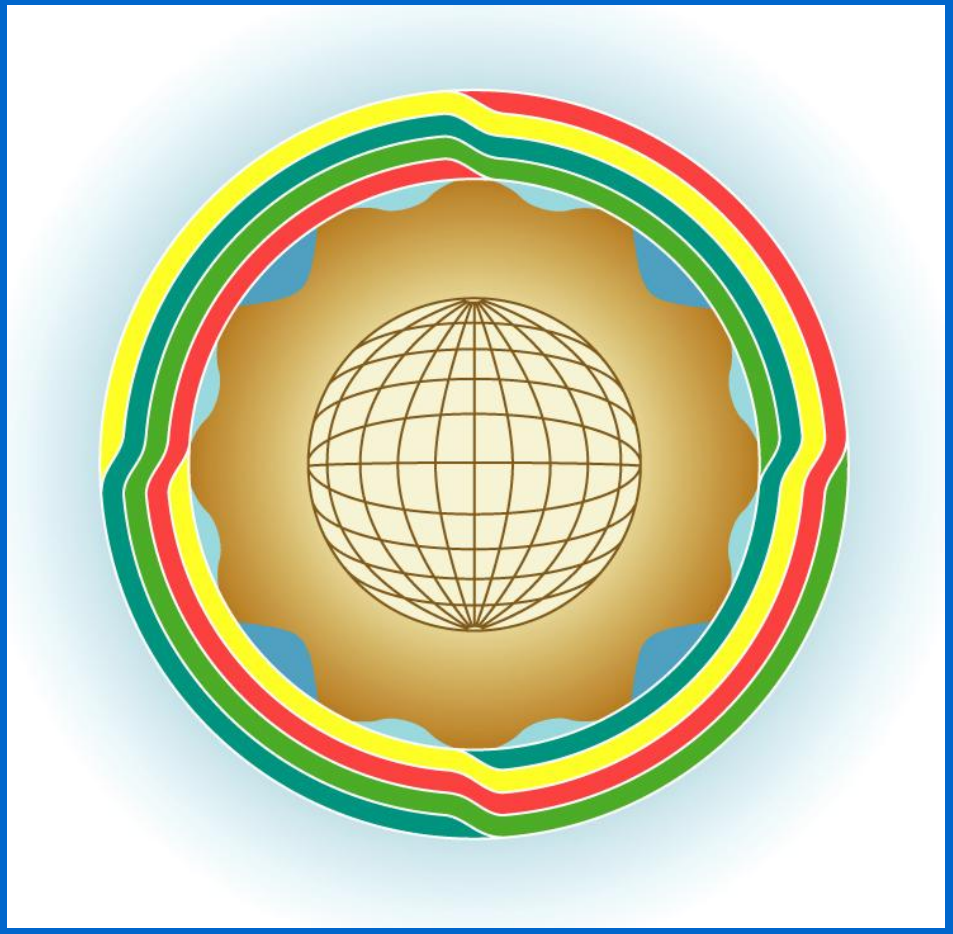
GEODESY

In planning & design Geodesy plays an essential role.

Historical and actual data with regard to land & sea surfaces and sub surfaces are needed for planning & map making.

Measurements are required through land- and sea survey, including Remote Sensing.

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

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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.

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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.

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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.

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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.

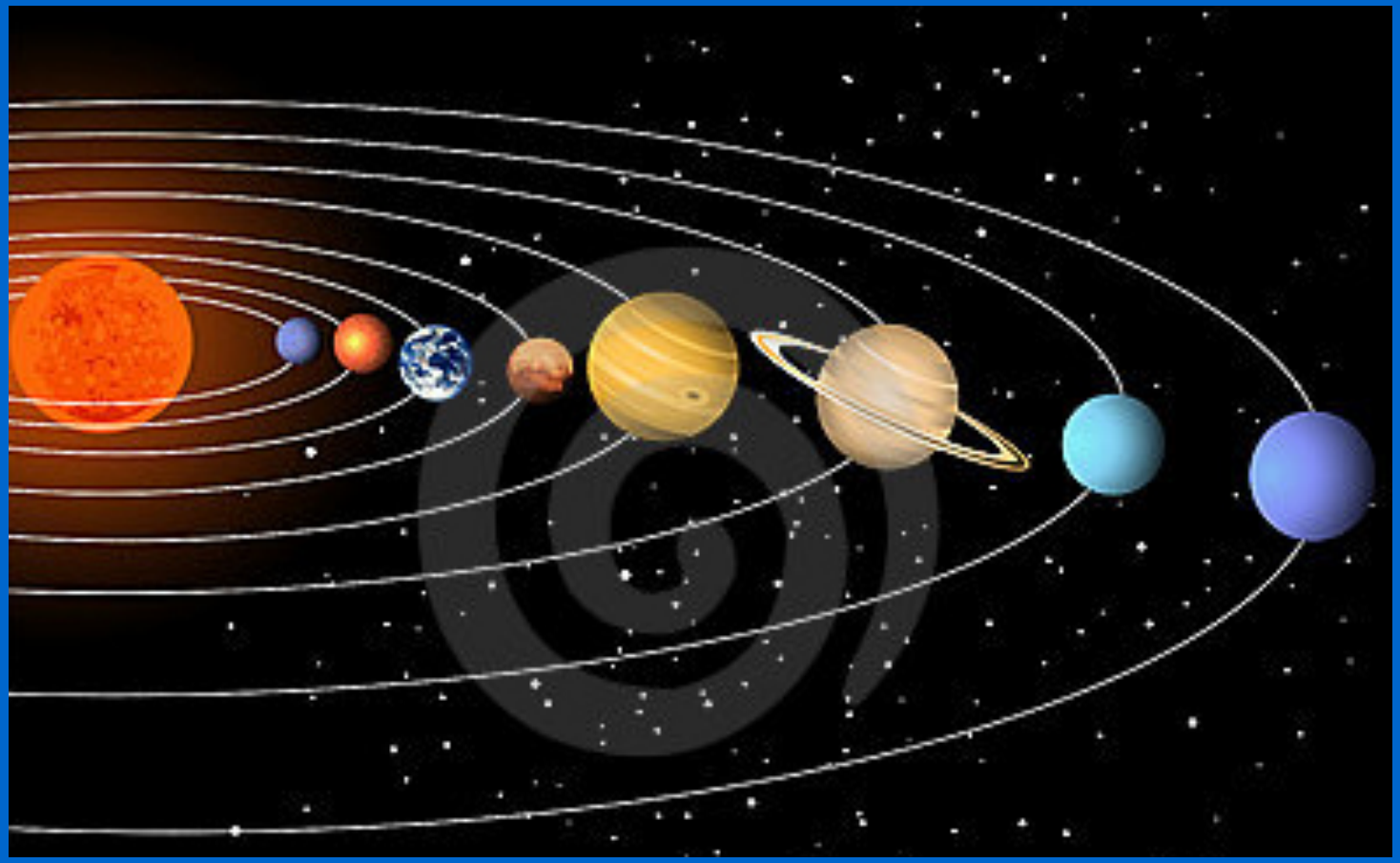
In the spatial planning process with regard to the separate and interrelated layers, special attention must be given to the composition of the underground layer and thereby in general to the third dimension.

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Relation

Environment – Economy – Space

SIGNIFICANCE OF THE ANTHROPOCENE



Dr. R.E. Waterman Msc

Estimated age of the universe: approx. 13.5 billion / year

Estimated age of the earth: approx. 4.5 billion / year

Geological periods:

Precambrium
Cambrium
Ordovicium
Silurian
Devonian
Carboniferous
Perm
Triassic
Jurassic
Cretaceous
Tertiair
Quartair: Pleistocene – Holocene – Anthropocene

ANTHROPOCENE

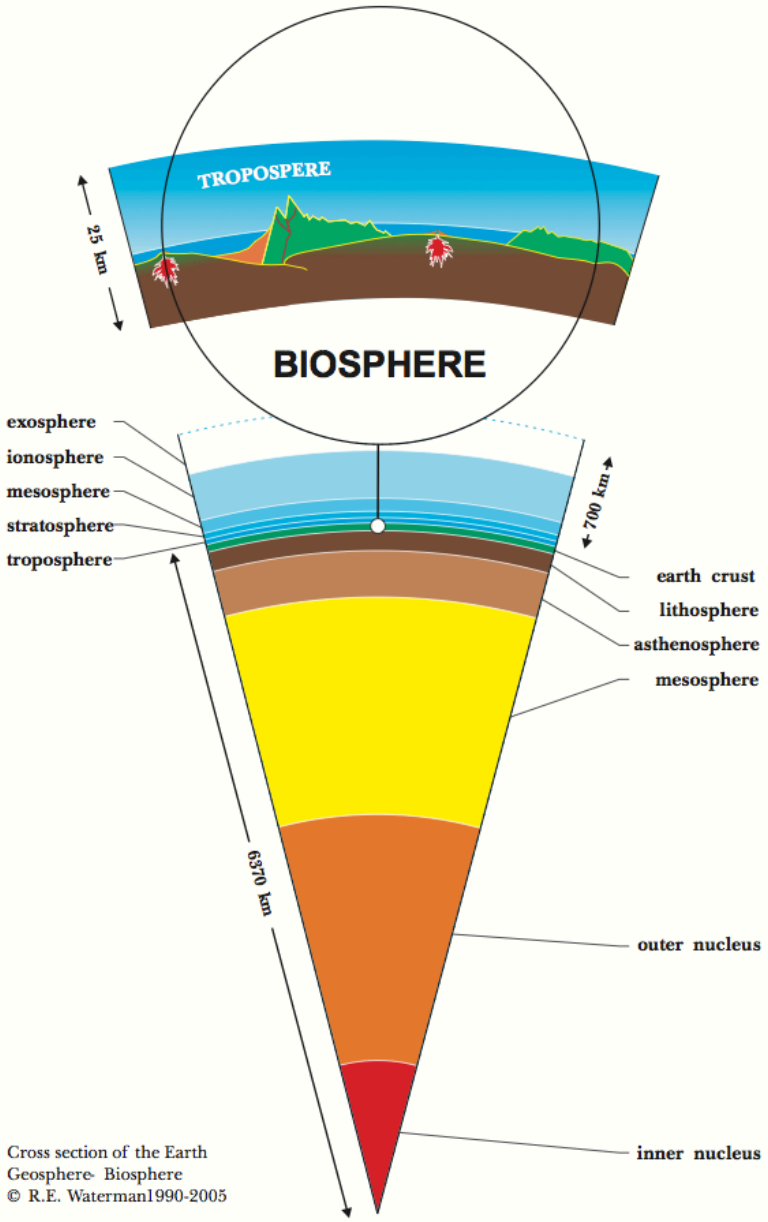
For the first time in the geological history MANKIND has become a geological factor by numbers and lifestyle



Global footprint =

F (size of population, lifestyle, technology)

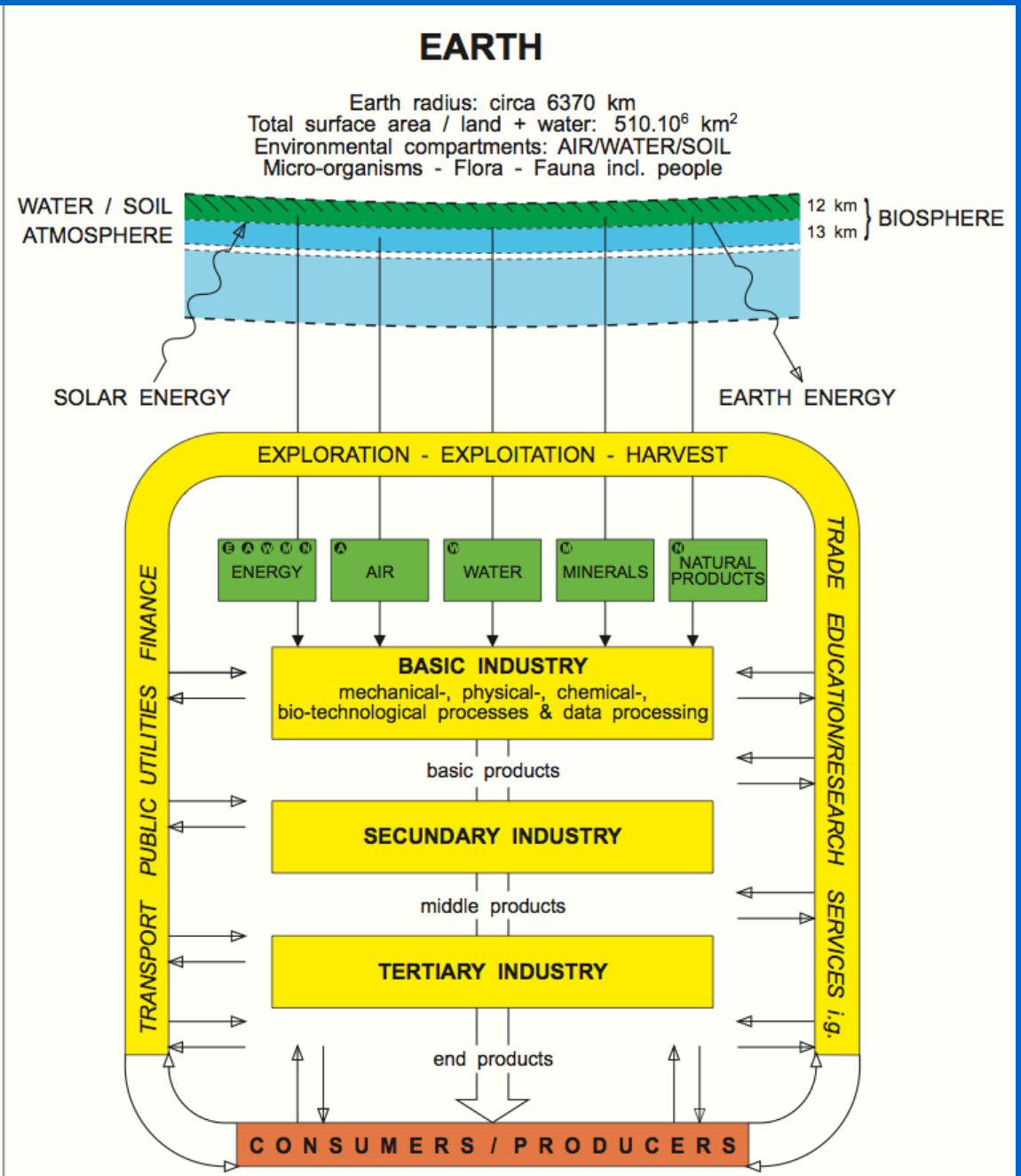
Necessity: stabilizing world population, lifestyle modification and introduction of technologies focused on sustainability



Cross section of the Earth
Geosphere- Biosphere
© R.E. Waterman1990-2005

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, flora, fauna, micro-organisms and people and all the material expressions of human activities



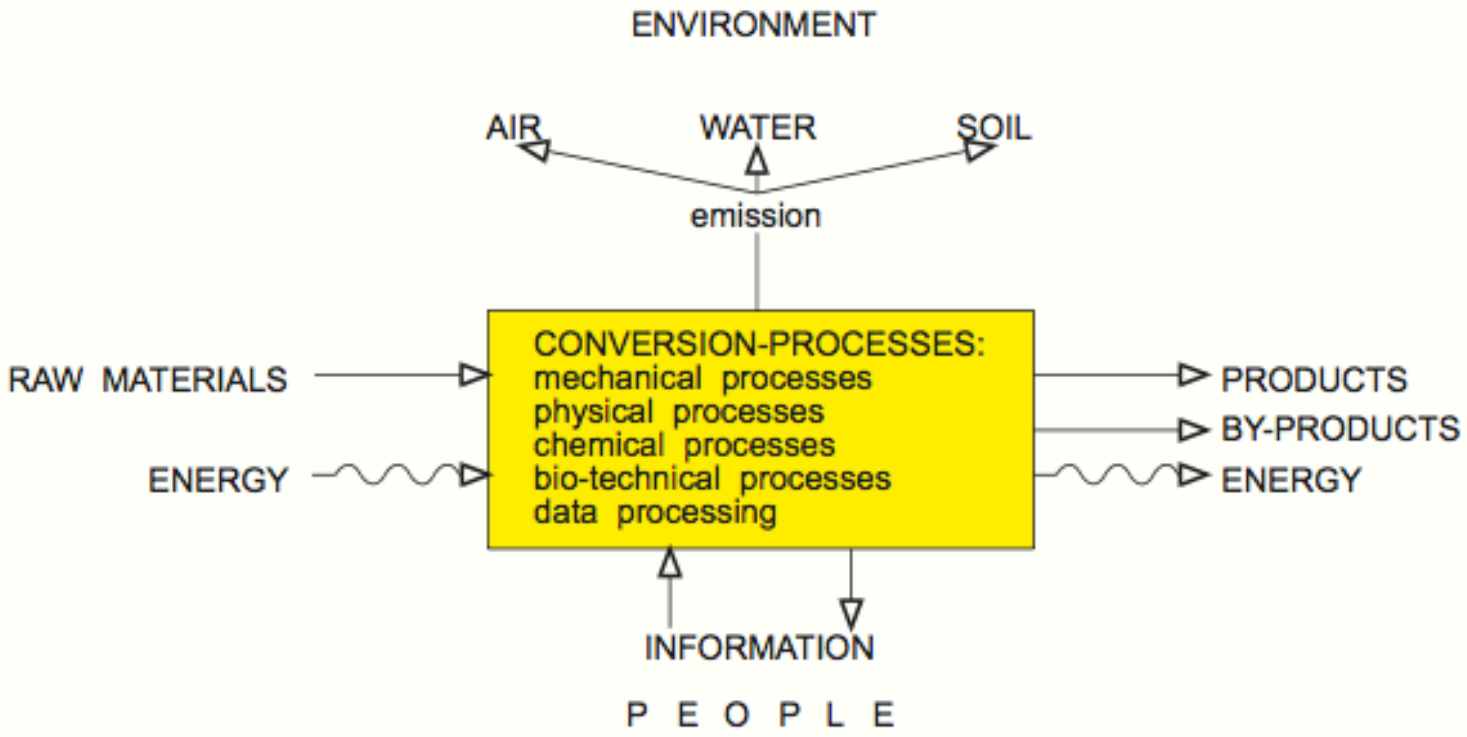
MANKIND extracts from / in the geosphere raw materials and energy

Every human being is at the same time

PRODUCER & CONSUMER

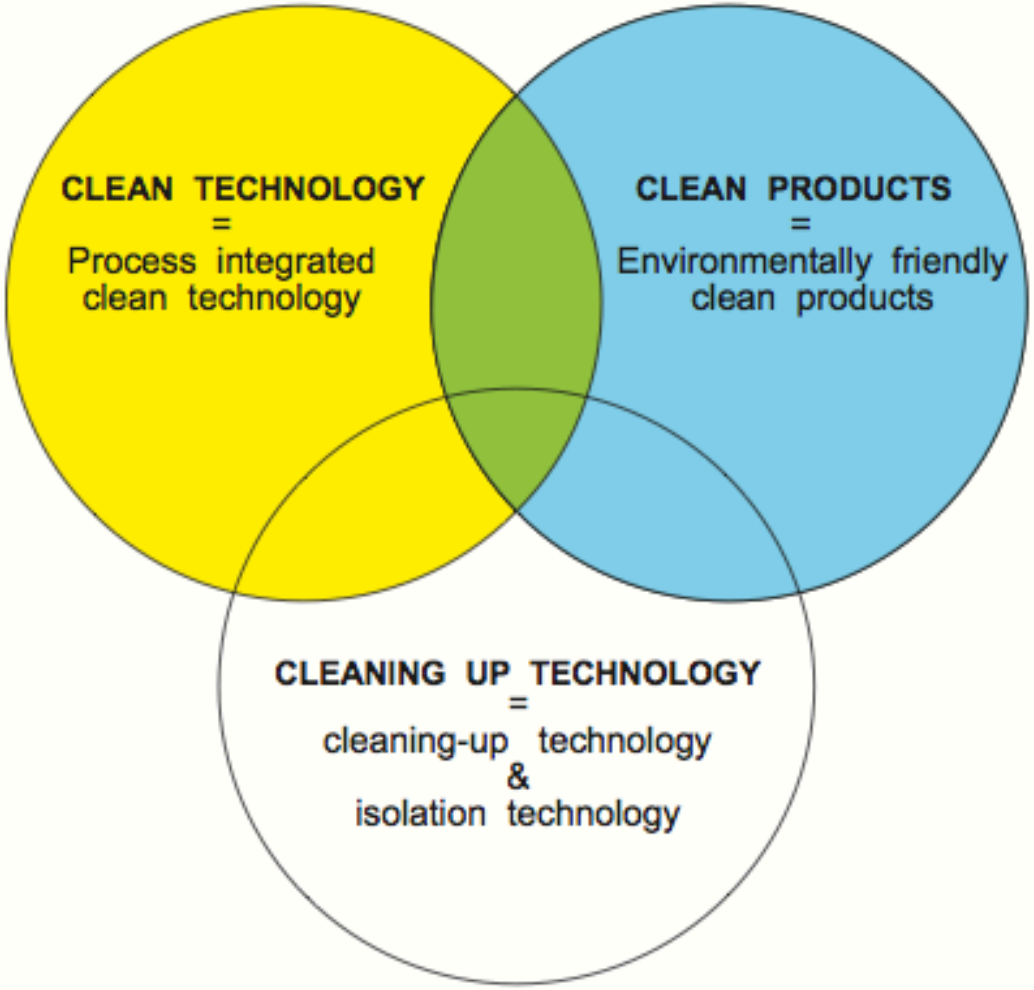
1804: 1 billion people
1927: 2 billion people
2000: 6 billion people
2012: 7 billion people
2040: 9 billion people
2090: 11 billion people

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

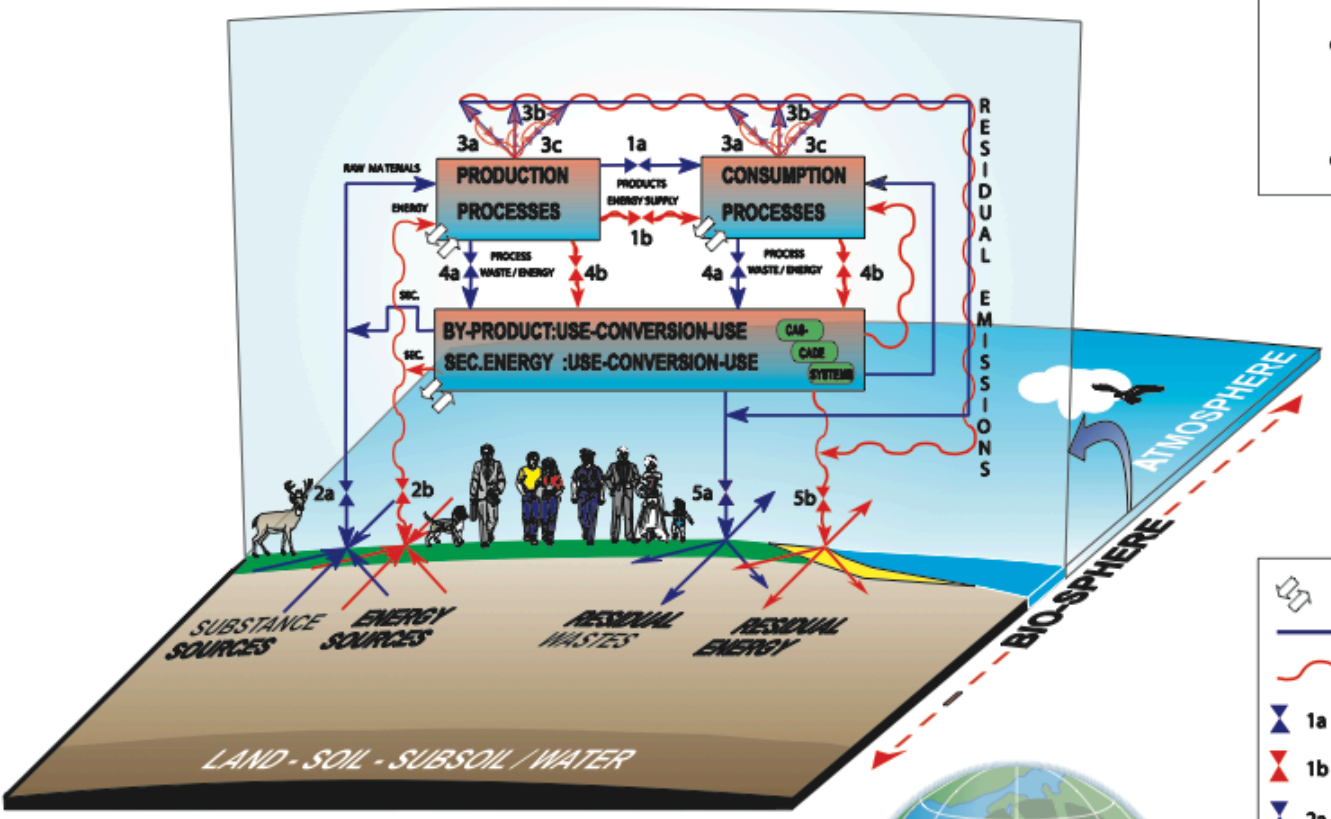
Environmental Technology



Triple - C approach

TOWARDS A (CLOSED) MASS / ENERGY - CYCLE IN A SUSTAINABLE SOCIETY

(in which up- and downgrading occurs)



ENVIRONMENTAL FOOT IMPRINT (IN HA)

=

FUNCTION (POPULATION, LIFESTYLE, TECHNOLOGY)



- 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
- ENERGY SOURCES

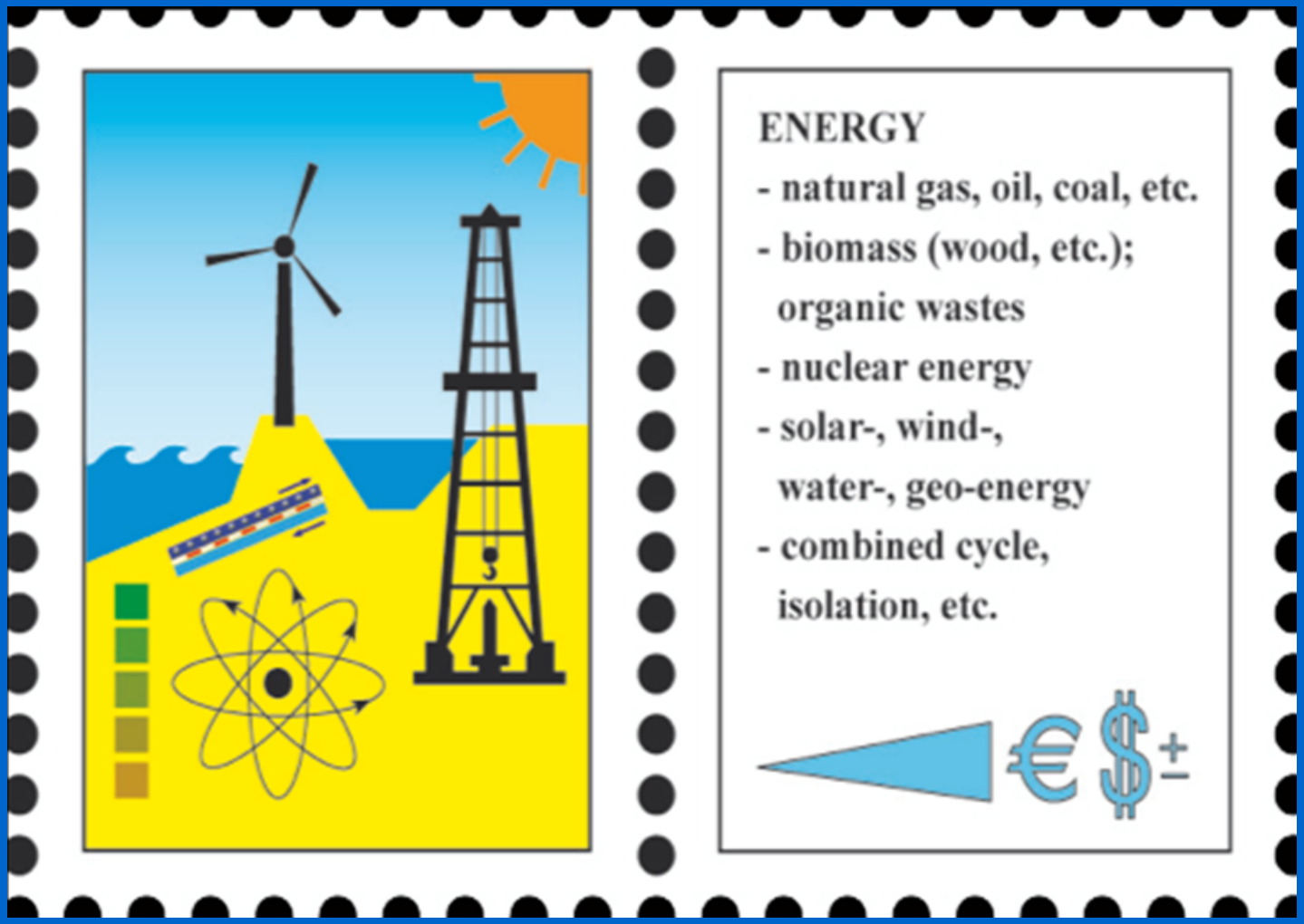
} VIA EXPLORATIONS, EXPLOITATION, MINING, CULTIVATION, HARVEST, ETC.

- RESIDUAL WASTES
- RESIDUAL ENERGY

} IMMOBILISATION / DIFFUSION & DISSIPATION

	INFORMATION IN / OUT
	MASS - TRANSPORT
	ENERGY - TRANSPORT
1a	CONTROL VALVE PRODUCT (QUALITY & QUANTITY)
1b	CONTROL VALVE ENERRGY SUPPLY (QUALITY & QUANTITY)
2a	CONTROL VALVE RAW MATERIALS (QUALITY & QUANTITY)
2b	CONTROL PRIMARY ENERGY FROM VARIOUS SOURCES (QUALITY & QUANTITY)
3a,b,c	CONTROL VALVE EMISSION REDUCTION (OF HARMFUL COMPONENTS TO AIR - WATER - SOIL
4a, 5a	CONTROL VALVE FOR BY-PRODUCTS & RESIDUAL WASTES (USE - CONVERSION - USE, IMMOBILISATION, DIFFUSION
4b, 5b	CONTROL VALVE FOR SECUNDARY & RESIDUAL ENERGY (USE - STORAGE, DIFFUSION & DISSIPATION)

© J. Quakernaat, R.E Waterman

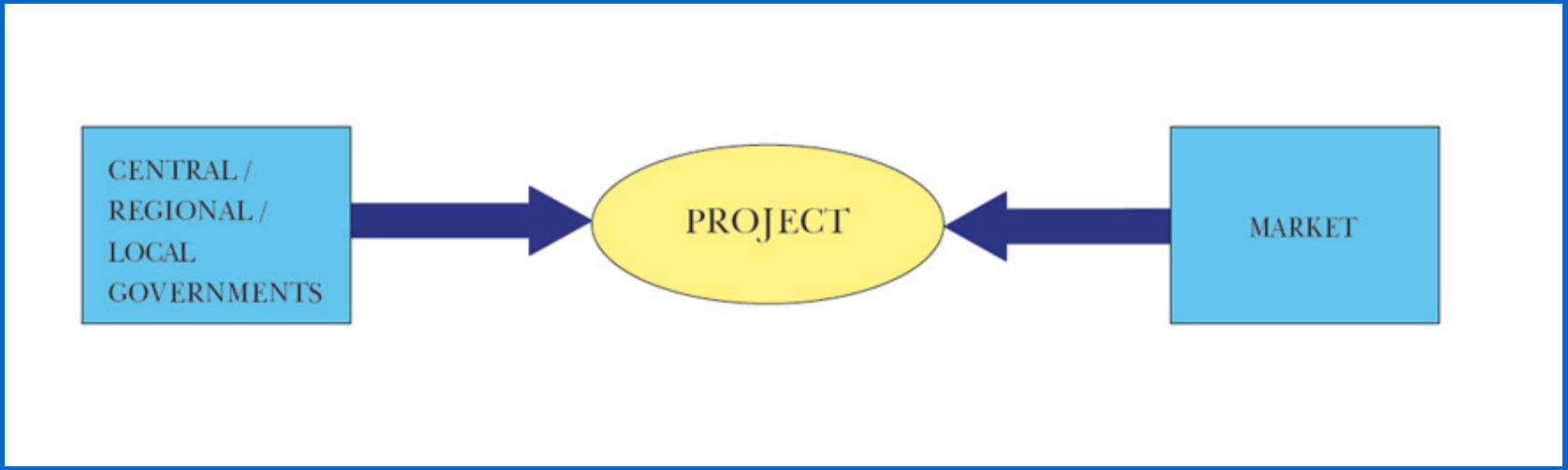


Special attention for the Energy Conversion – Storage – Transport and for the application of Photovoltaic Cells, Concentrated Solar Power & Biomass

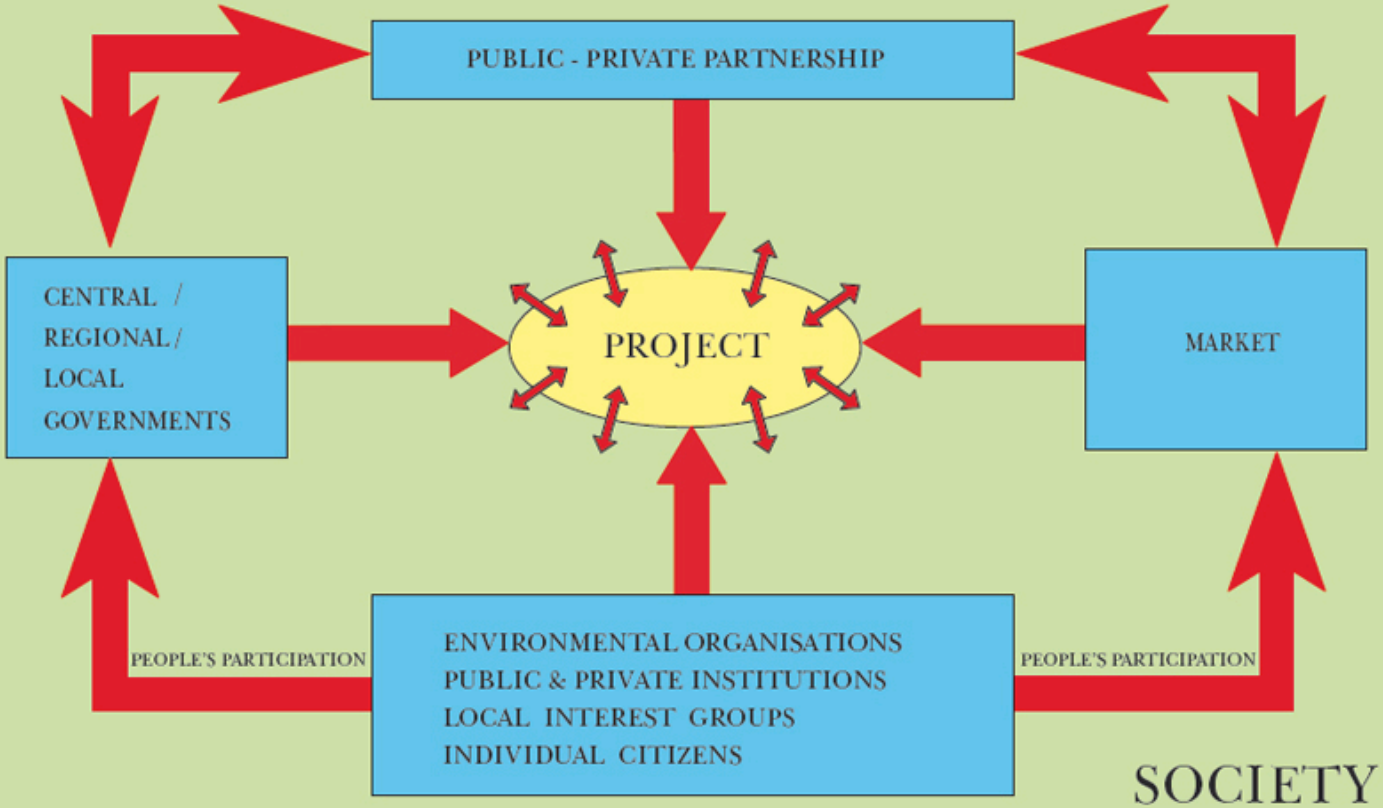
SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Interactive Plan Development

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE



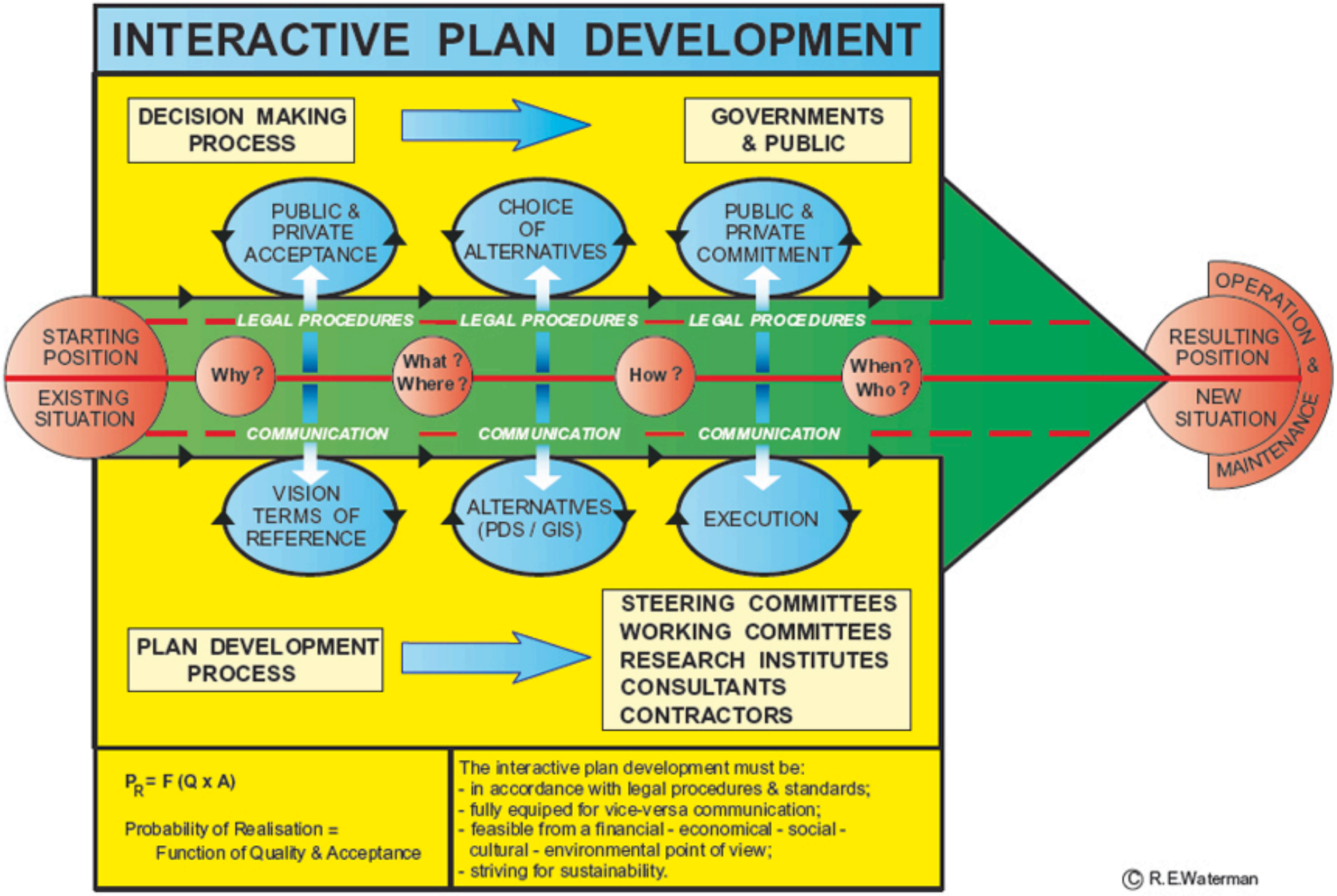
ENVIRONMENT



SOCIETY



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


INTERACTIVE PLAN DEVELOPMENT
DECISION MAKING PROCESS
GOVERNMENTS & PUBLIC
PUBLIC & PRIVATE ACCEPTANCE
CHOICE OF ALTERNATIVES
PUBLIC & PRIVATE COMMITMENT
LEGAL PROCEDURES
LEGAL PROCEDURES
LEGAL PROCEDURES
STARTING POSITION
EXISTING SITUATION
Why ?
What ? Where ?
How ?
When? Who ?
COMMUNICATION
COMMUNICATION
COMMUNICATION
VISION TERMS OF REFERENCE
ALTERNATIVES (PDS / GIS)
EXECUTION
OPERATION & MAINTENANCE
RESULTING POSITION
NEW SITUATION
PLAN DEVELOPMENT PROCESS
STEERING COMMITTEES
WORKING COMMITTEES
RESEARCH INSTITUTES
CONSULTANTS
CONTRACTORS
$P_R = F (Q \times A)$
Probability of Realisation = Function of Quality & Acceptance
The interactive plan development must be:
- in accordance with legal procedures & standards;
- fully equiped for vice-versa communication;
- feasible from a financial - economical - social - cultural - environmental point of view;
- striving for sustainability.
© R.E.Waterman

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

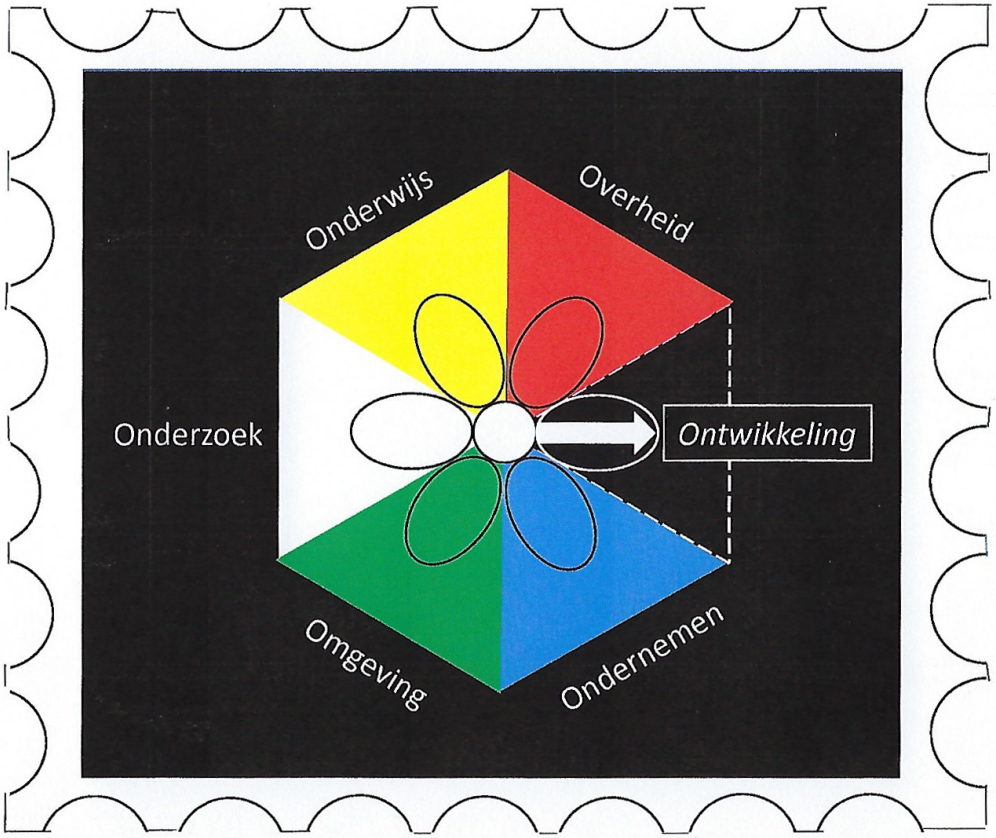
The described method is scientifically based and can be broadened and deepened.

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 6e O van Duurzame, Bio-based Circulaire Ontwikkeling

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

Leading to Sustainable, Bio-based Circulair Development

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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)

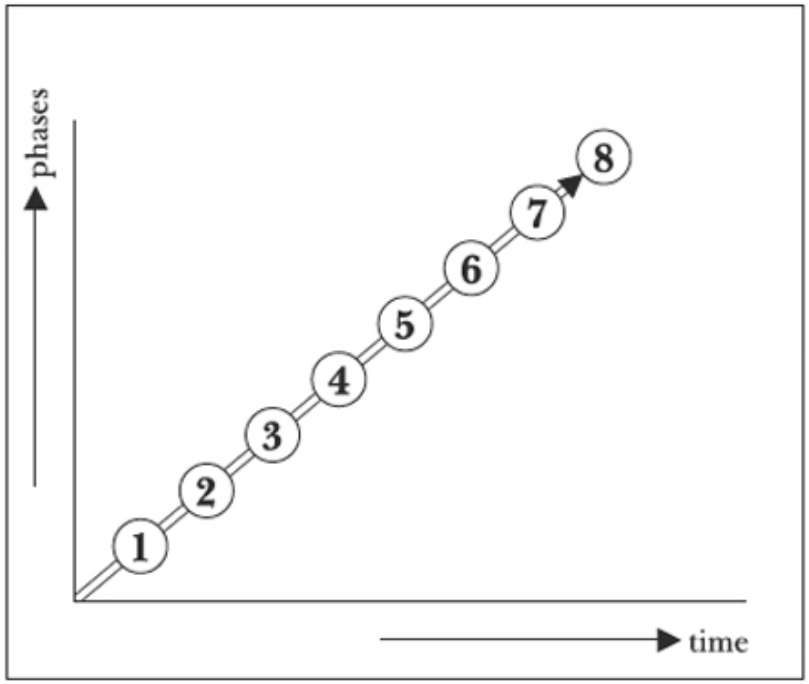
3.2 *"Who doesn't believe in dreams, is not a realist."*
D. Ben Goerion (1886-1973)

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

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

1. PLAN DEVELOPMENT & EXECUTION



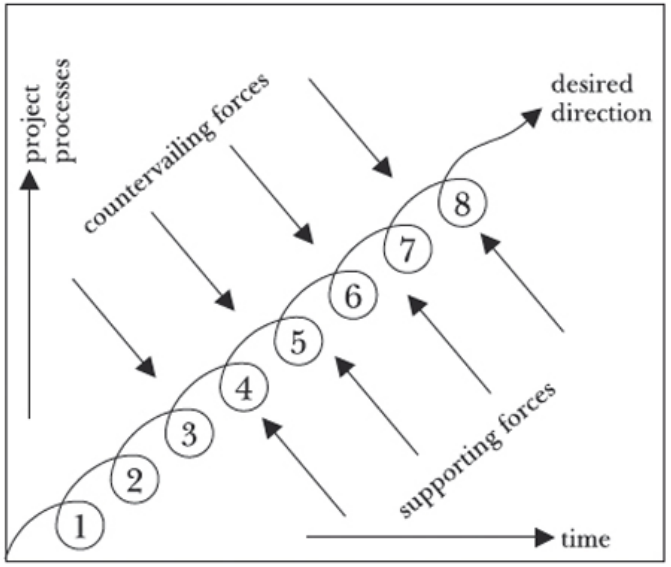
In the development and execution of a plan many phases can be distinguished. All other interacting processes, although of extreme importance, have been left out.

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

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

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

Strengths	Weaknesses
Opportunities	Threats

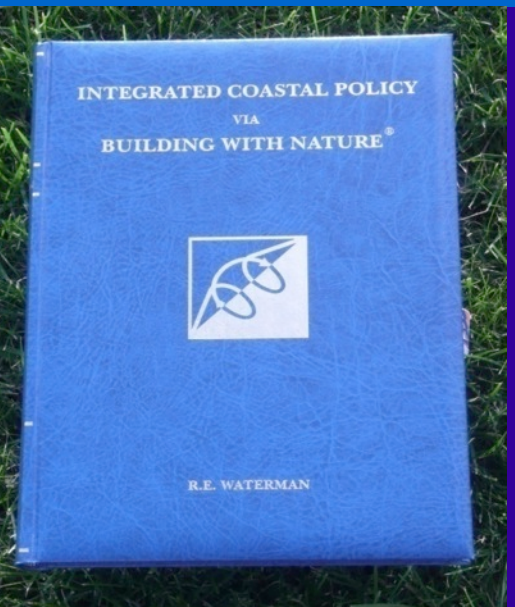
4. MULTI-CRITERIA ANALYSIS

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

Thank you for your attention

Integrated Coastal Policy via Building with Nature®



Ronald E. Waterman

Paul T.A. Liesting
Cartography

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