URBAN RESILIENCE & INTEGRATED ECOSYSTEMS: A HOLISTIC & PRAGMATIC APPROACH OF URBAN RIVERS

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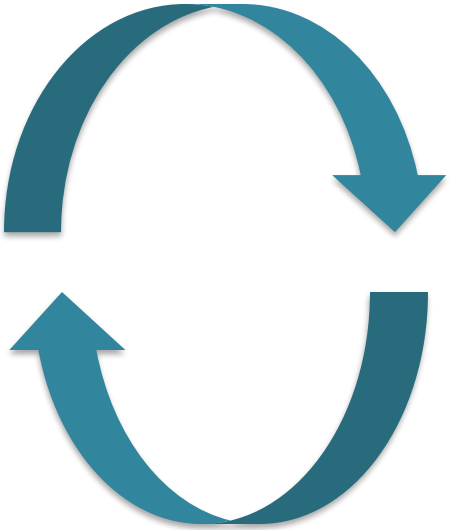
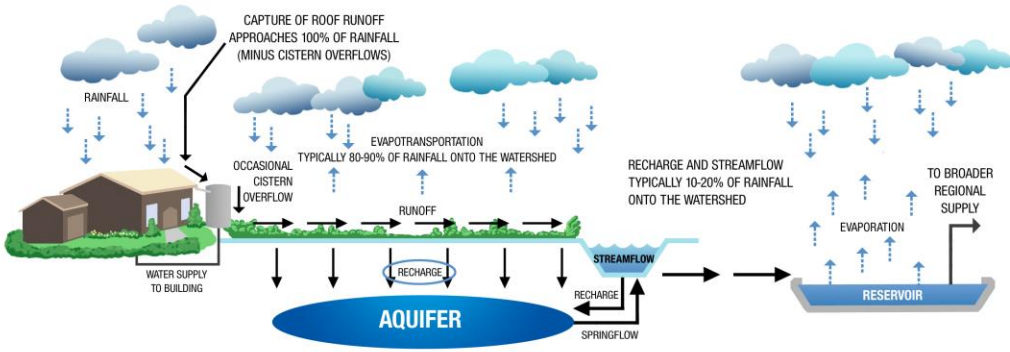
INTEGRATED URBAN WATER MANAGEMENT PRINCIPLES FOR MORE RESILIENCE

CLASSIC URBAN WATER MANAGEMENT	INTEGRATED URBAN WATER MANAGEMENT
WATER FOLLOWS ONE WAY PATH FROM SUPPLY, TO SINGLE USE, TO TREATMENT AND DISPOSAL	WATER CAN BE RECLAIMED AND REUSED MULTIPLE TIMES, FROM HIGHER TO LOWER QUALITY



INTEGRATED URBAN WATER MANAGEMENT PRINCIPLES FOR MORE RESILIENCE

CLASSIC URBAN WATER MANAGEMENT	INTEGRATED URBAN WATER MANAGEMENT
STORMWATER IS A NUISANCE TO BE CONVEYED QUICKLY FROM URBAN AREAS	STORMWATER IS A RESOURCE TO BE HARVESTED AS A WATER SUPPLY AND INFILTRATED OR RETAINED TO SUPPORT AQUIFERS, WATERWAYS AND VEGETATION



BUILDING-SCALE RAINWATER HARVESTING WATER SUPPLY SYSTEM

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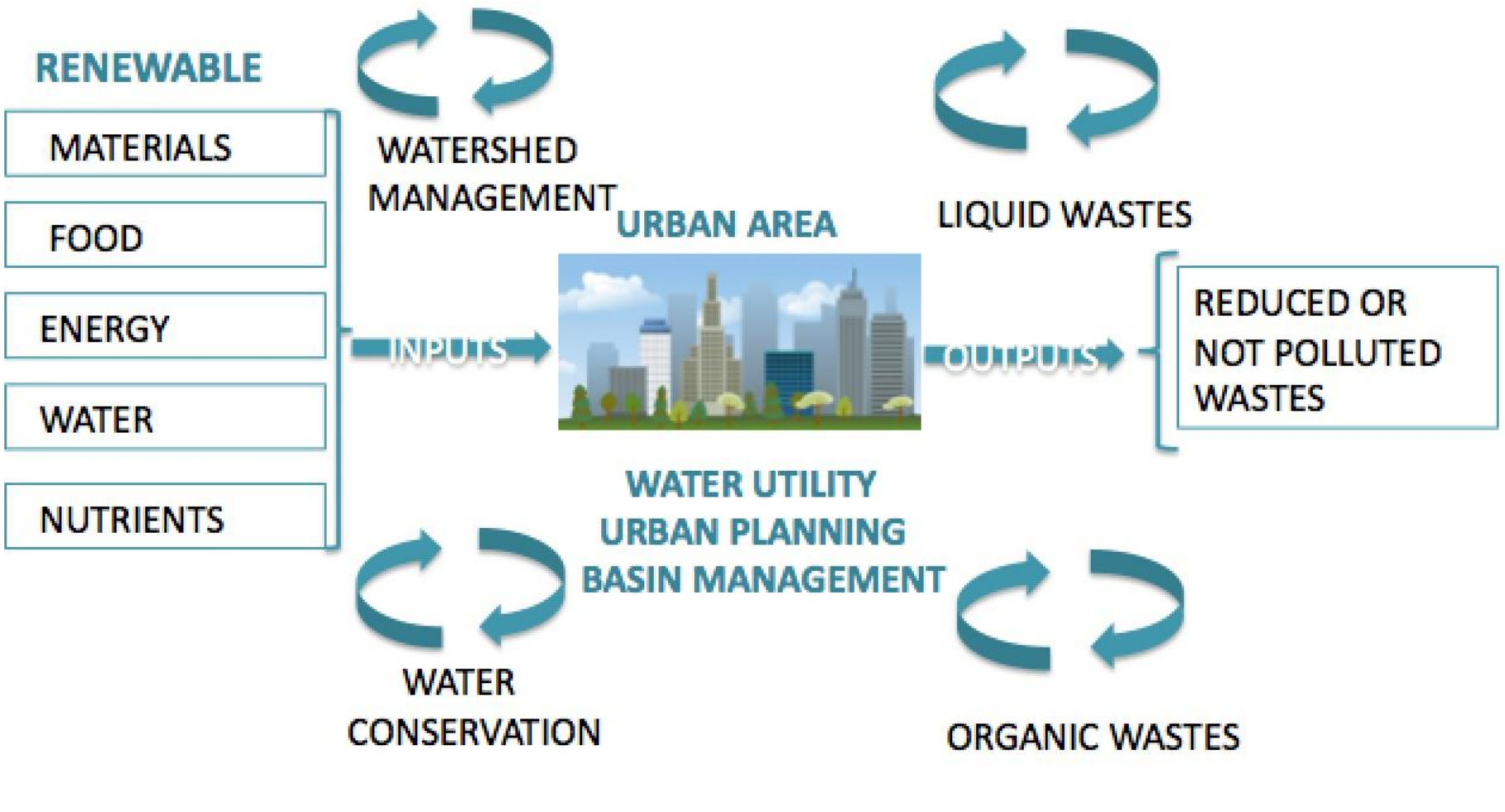
INTEGRATED URBAN WATER MANAGEMENT PRINCIPLES FOR MORE RESILIENCE

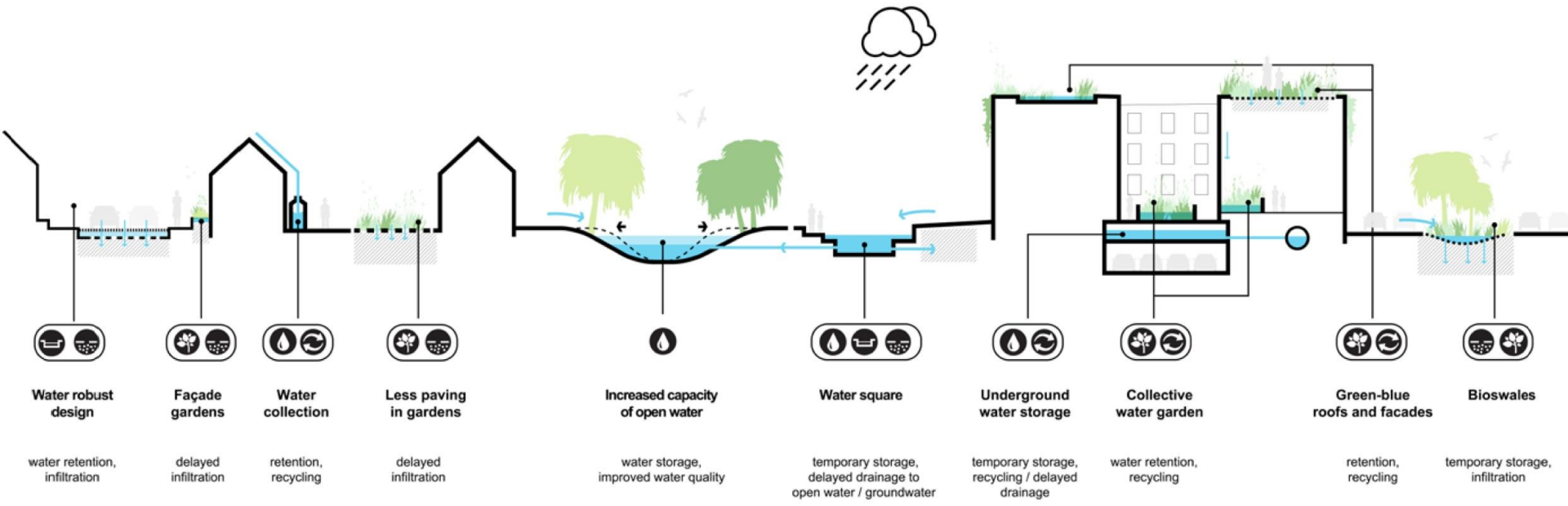
CLASSIC URBAN WATER MANAGEMENT	INTEGRATED URBAN WATER MANAGEMENT
GREY INFRASTRUCTURE IS MADE OF CONCRETE, METAL OR PLASTIC	GREEN INFRASTRUCTURE INCLUDES SOIL AND VEGETATION

UNBALANCED LINEAR URBAN METABOLISM

BALANCED URBAN METABOLISM



A TYPICAL APPROACH OF THE SPONGE CITY



WATER AS A LANDMARK IN THE CITY

WATER HARVESTING FOR DOMESTIC USE

RESILIENT URBAN RIVER

SPONGE PUBLIC SPACE

INTEGRATED WATER MANAGEMENT INSIDE URBAN BLOCKS

GREEN & BLUE NETWORKS FOR A BETTER MOBILITY

1. THE CASE OF SINGAPORE : CREATING A CITY OF GARDENS AND WATER

SINGAPORE HAS DEVELOPED A NETWORK OF WATERWAYS AND RESERVOIRS TO OVERCOME ITS WATER CHALLENGES.

2/3 OF THE NATION FUNCTIONS AS LOCAL CATCHMENT AREAS COLLECTING AND STORING RAINWATER IN **17 RESERVOIRS, 32 MAJOR RIVERS AND MORE THAN 7000KM OF CANALS AND DRAINS FOR WATER SUPPLY.**

1. THE CASE OF SINGAPORE : CREATING A CITY OF GARDENS AND WATER

1. THE CASE OF SINGAPORE : CREATING A CITY OF GARDENS AND WATER

THROUGH CAREFUL PLANNING, SINGAPORE HAS CLOSED ITS WATER LOOP AND BUILT A DIVERSIFIED AND SUSTAINABLE WATER SUPPLY FROM FOUR SOURCES:

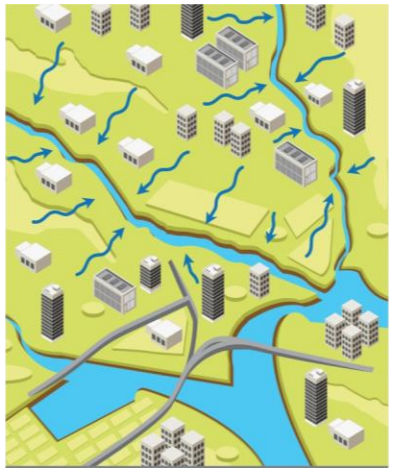
-WATER FROM LOCAL CATCHMENT AREAS

-IMPORTED WATER

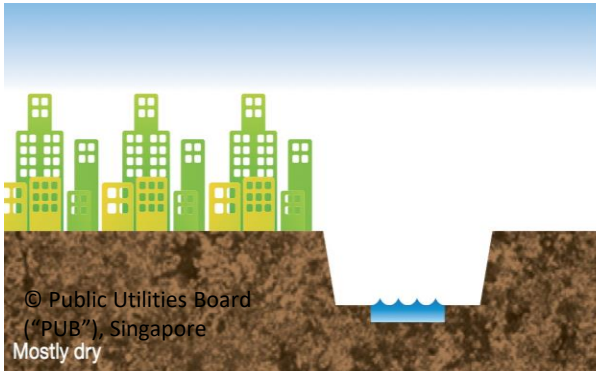
-NEWATER (HIGH-GRADE RECLAIMED WATER)

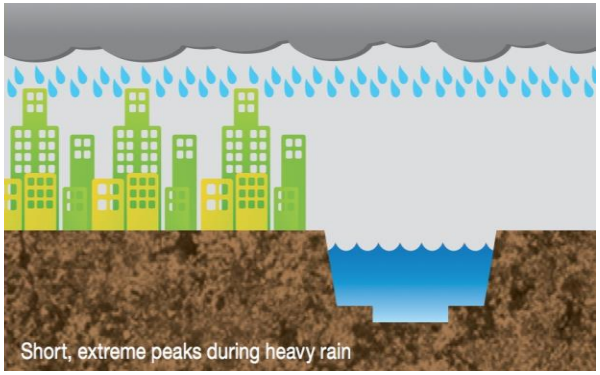
- DESALINATED WATER

THE CASE OF SINGAPORE : TRADITIONAL STORMWATER MANAGEMENT



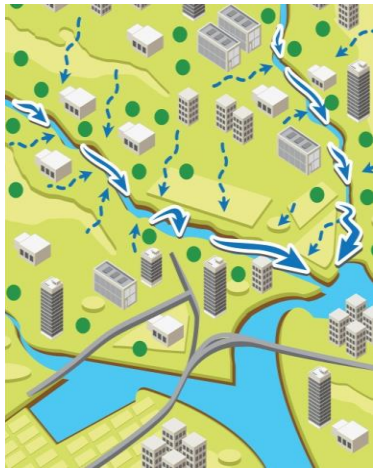
STORMWATER GOES INTO THE DRAINS AND THEN DIRECTLY TO THE CANALS



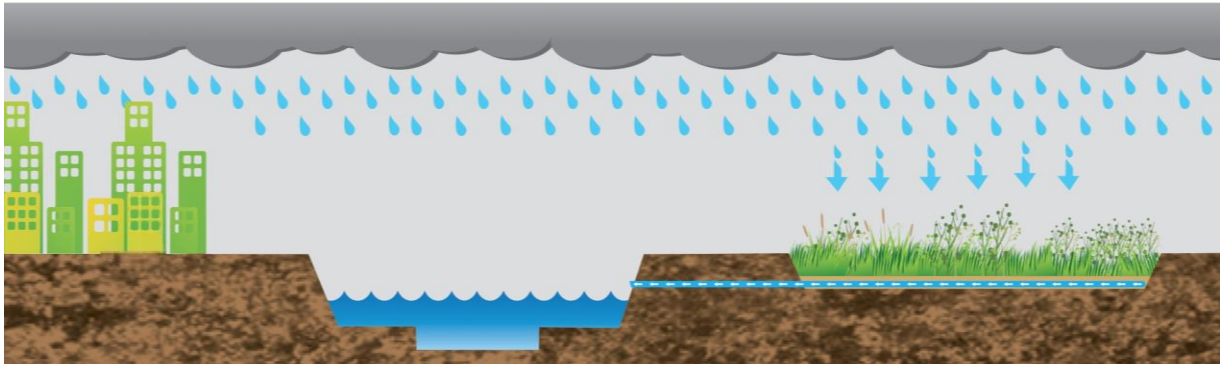


THE WATER LEVEL IN THE CANALS RISES VERY QUICKLY

THE CASE OF SINGAPORE : INTEGRATED STORMWATER MANAGEMENT

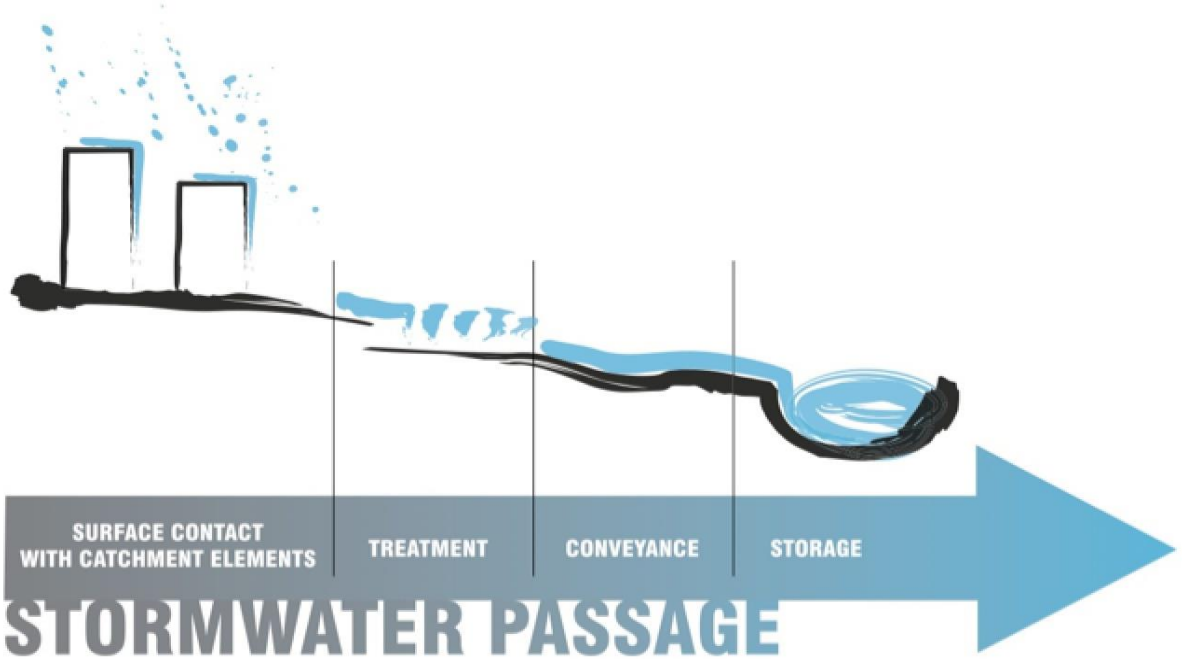


STORMWATER IS TREATED ON SITE AND THEN SLOWLY RELEASED INTO DRAINS AND CANAL



CLEANER WATER FLOWS INTO THE RESERVOIRS

THE CASE OF SINGAPORE : STORMWATER MANAGEMENT



RAINWATER IS RELATIVELY CLEAN. WHEN IT COMES IN CONTACT WITH THE SURFACES OF A CATCHMENT, IT PICKS UP SEDIMENTS, NUTRIENTS AND OTHER IMPURITIES.
WITH THE USE OF WATERS DESIGN FEATURES, THIS RAINWATER RUNOFF WILL BE TEMPORARILY DETAINED AND CLEANSED BEFORE IT FLOWS INTO RESERVOIRS.

STORMWATER MANAGEMENT :CATCHMENT ELEMENTS

CATCHMENT ELEMENTS : SURFACES FOUND IN OUR URBAN ENVIRONMENT

- **CIRCULATION INFRASTRUCTURE** : VEHICLE ROADS, BICYCLE PATHS AND PEDESTRIAN WALKWAYS

- **STRUCTURES** : BUILDINGS, SHELTERS AND URBAN PLAZAS

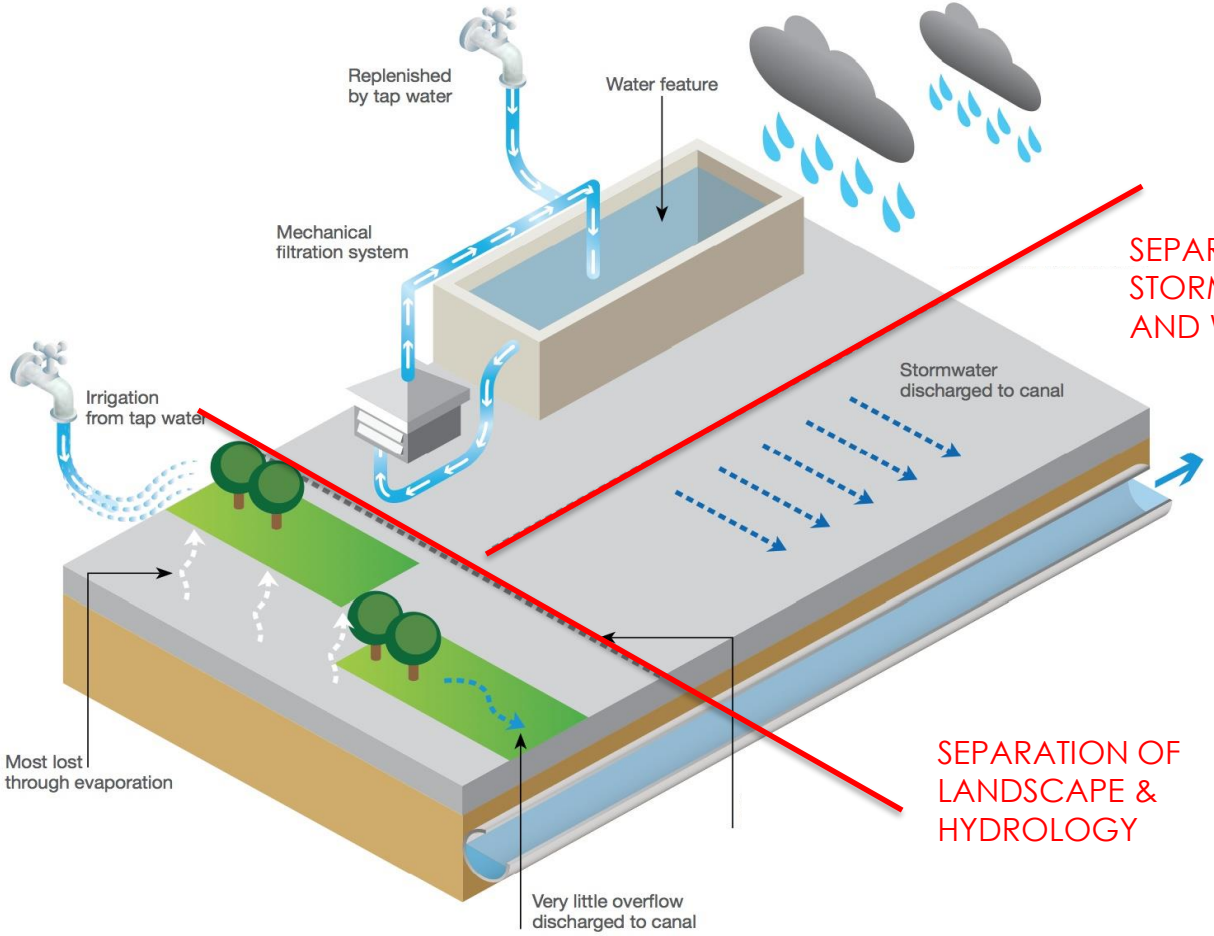
- **SOFTSCAPE** : FIELDS AND PARKS

- **WATERWAYS** : RIVERS, CANALS AND OUTLET DRAINS

- **WATERBODIES** : LAKES, PONDS AND RESERVOIRS

CATCHMENT ELEMENTS : THE URBAN PLAZA CONVENTIONAL TREATMENT

LANDSCAPE AND HYDROLOGY ARE OFTEN KEPT AS SEPARATE SYSTEMS IN THE DESIGN OF URBAN PUBLIC PLAZAS



CATCHMENT ELEMENTS : THE URBAN INTEGRATED PLAZA

WATER QUALITY IMPROVEMENT ENHANCES THE AESTHETIC AND RECREATIONAL VALUE OF THE WATERBODIES

COLLECTED RAINWATER IRRIGATES PLANTS

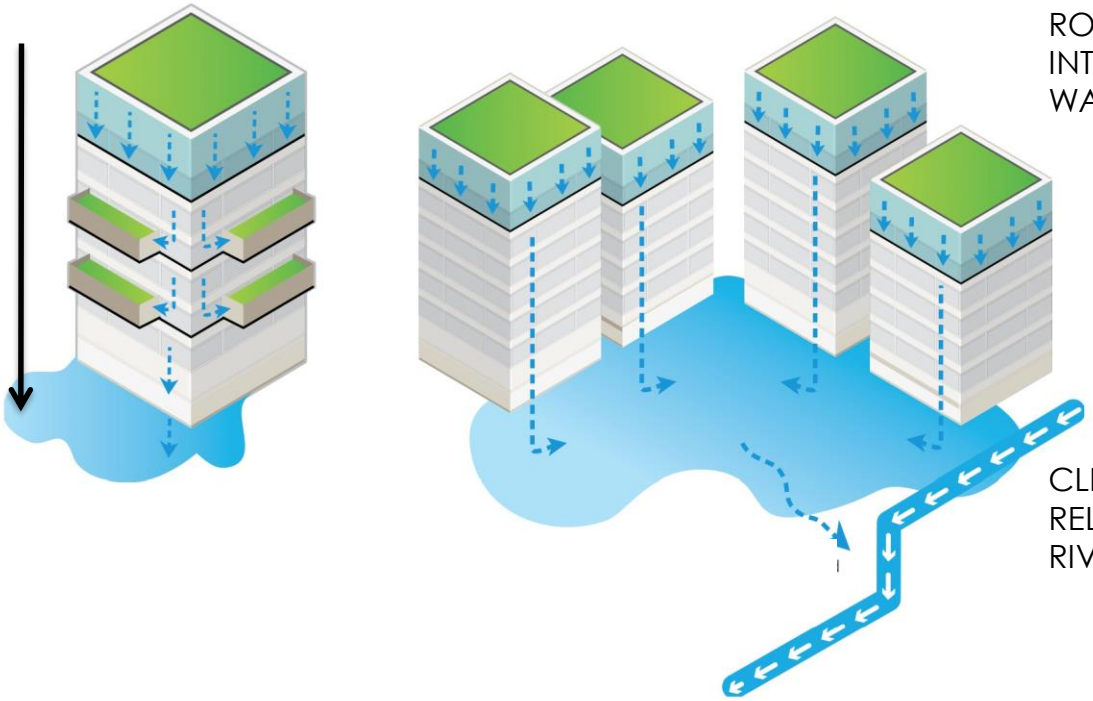
RAINWATER IS COLLECTED IN WATERBODIES

AQUATIC PLANTS AND SUBSTRATE CLEAN COLLECTED WATER WHILE ENHANCING THE ENVIRONMENT

CATCHMENT ELEMENTS : ARCHITECTURAL STRUCTURES

ROOFTOP , SKY GARDEN OR TERRACE :
RAINWATER CAN FIRST BE COLLECTED AND CLEANED (USING RAIN GARDENS OR CLEANSING BIOTOPES) ON THE ROOF, THEN CHANNELLED TO THE VARIOUS WATER FEATURES.
THE CLEANSED RAINWATER CAN BE USED TO WATER THE PLANTS OR FOR THE WASHING OF PAVEMENTS AND WALKWAYS.

WATER FILTERED THROUGH GREEN ROOFS :
- PORTION FOR WATERING
- REST FOR WATER FEATURE

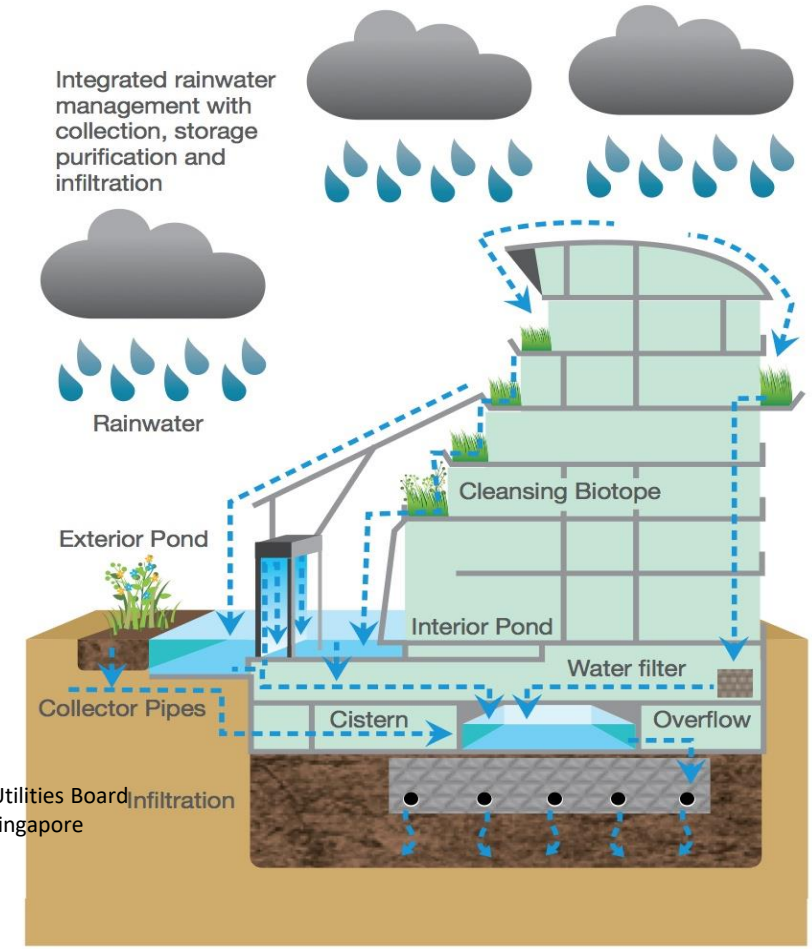


WATER FROM SEVERAL ROOFTOPS COLLECTED INTO A LARGER WATERBODY

CLEANED WATER SLOWLY RELEASED IN RESERVOIR OR RIVER

CATCHMENT ELEMENTS : ARCHITECTURAL STRUCTURES

NUREMBERG PRISMA, GERMANY: **SEQUENTIAL CLEANSING SYSTEMS**



MULTI-LEVEL PLANTERS OF CLEANSING BIOTOPES CLEAN RAINWATER WHILE CREATING A PLEASANT ATMOSPHERE IN THE BUILDING ALL YEAR ROUND.

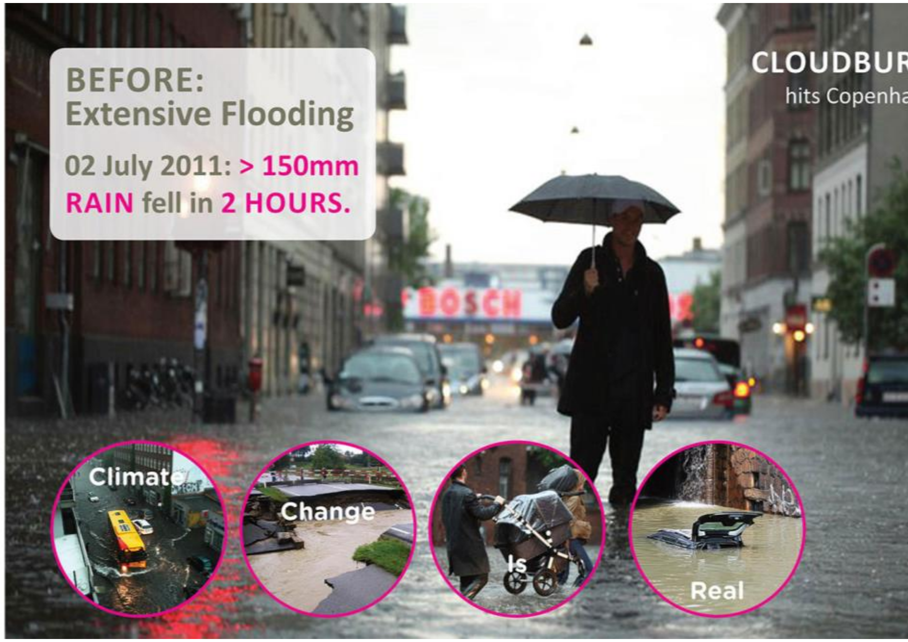
THE WATER FROM THE CLEANSING BIOTOPES FEEDS INTERIOR AND EXTERIOR PONDS THIS CREATES A CONSTANT LIGHT WIND THAT MODERATES THE HEAT DURING THE SUMMER.

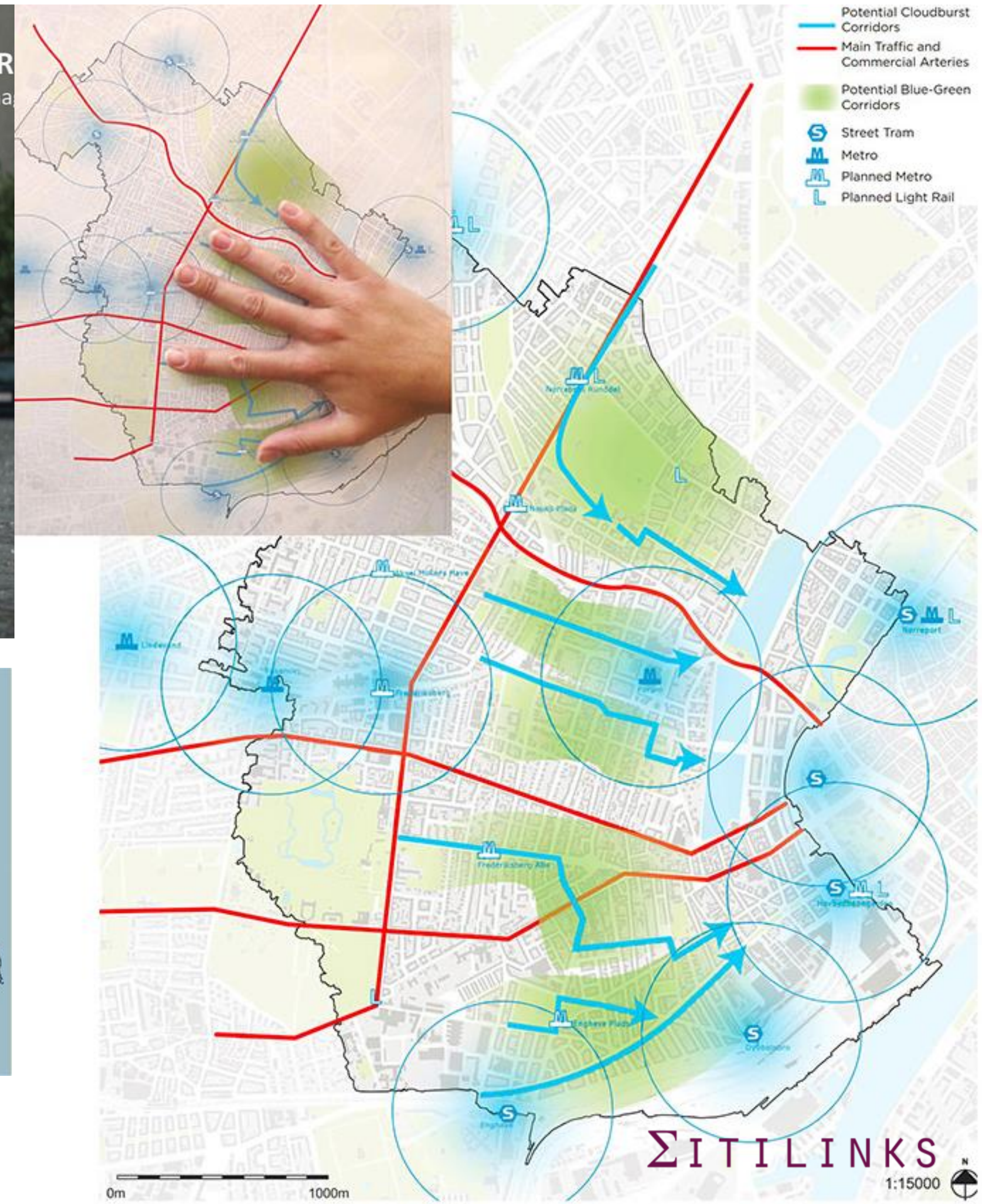
WATER IS USED AS NATURAL AIR CONDITIONNING, FIRE-FIGHTING AND IRRIGATION

INTENSIVE GREEN ROOF IN SINGAPORE

2. COPENHAGEN SPONGE CITY APPROACH (DENMARK)

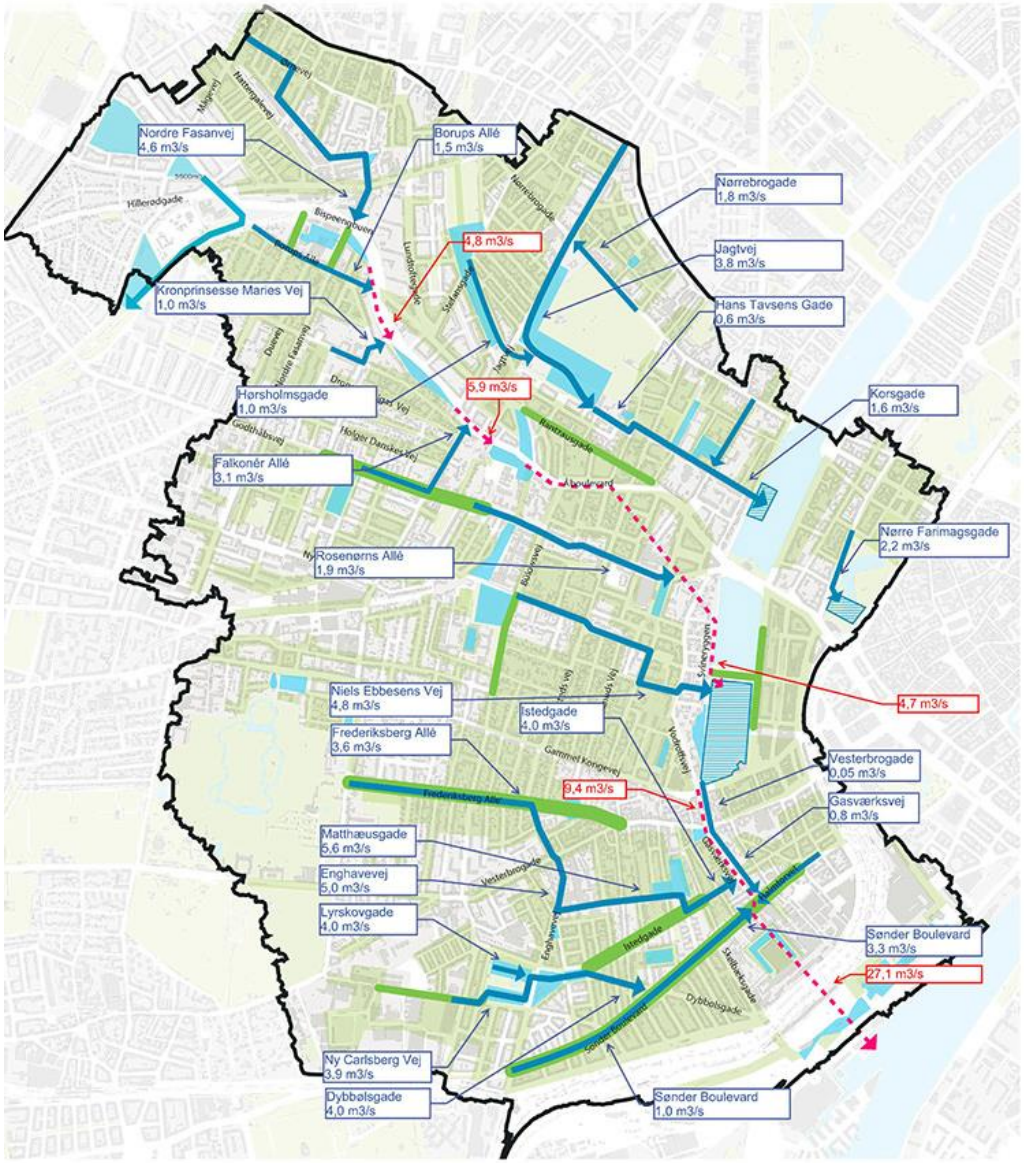
INTEGRATING RESILIENT STREETS & URBAN PONDS WITHIN THE URBAN CANAL NETWORK





FROM THE METROPOLITAN TO THE LOCAL FINGER PLAN

2. COPENHAGEN SPONGE CITY APPROACH (DENMARK)



Cloudburst Road

Cloudburst roads are used to channel and direct cloudburst water. These streets can be formed with a unique V-shaped profile and raised kerbs to ensure water will flow in the middle of the road, away from the buildings - contrary to standard engineering practice. Channels and swales can be established along road edges so that water runs in urban rivers or green strips. Cloudburst roads may also be combined with Cloudburst piping below the surface to create tool synergies.

Detention Street

Detention streets are streets that are typically located slightly upstream of vulnerable low-points. In these streets there should be a detention volume established to handle stormwater before reaching the more vulnerable points downstream.

Green Street

Green streets are proposed as upstream conections to all Cloudburst roads. The green streets should be established with a combination of small-scale channels and stormwater planters or permeable paving. Stormwater should be collected, delayed and then channeled towards the Cloudburst roads.

Central Retention Area

Central retention areas are proposed in the squares and parks where it is possible to delay stormwater, so that Cloudburst roads can be established in smaller dimensions. The central retention elements can be, for example, open depressions in the parkland or lowered seating areas. Alternatively, they can be established as underground storage such as soak-away crates or rain gardens. Central retention elements will typically be placed in connection with adjacent Cloudburst roads.

Cloudburst Pipe

A Cloudburst pipe handles rainwater in the same way as Cloudburst roads. This is placed just below street level to ensure connection to other surface solutions. This solution is used if there is no useable space for aboveground solutions.

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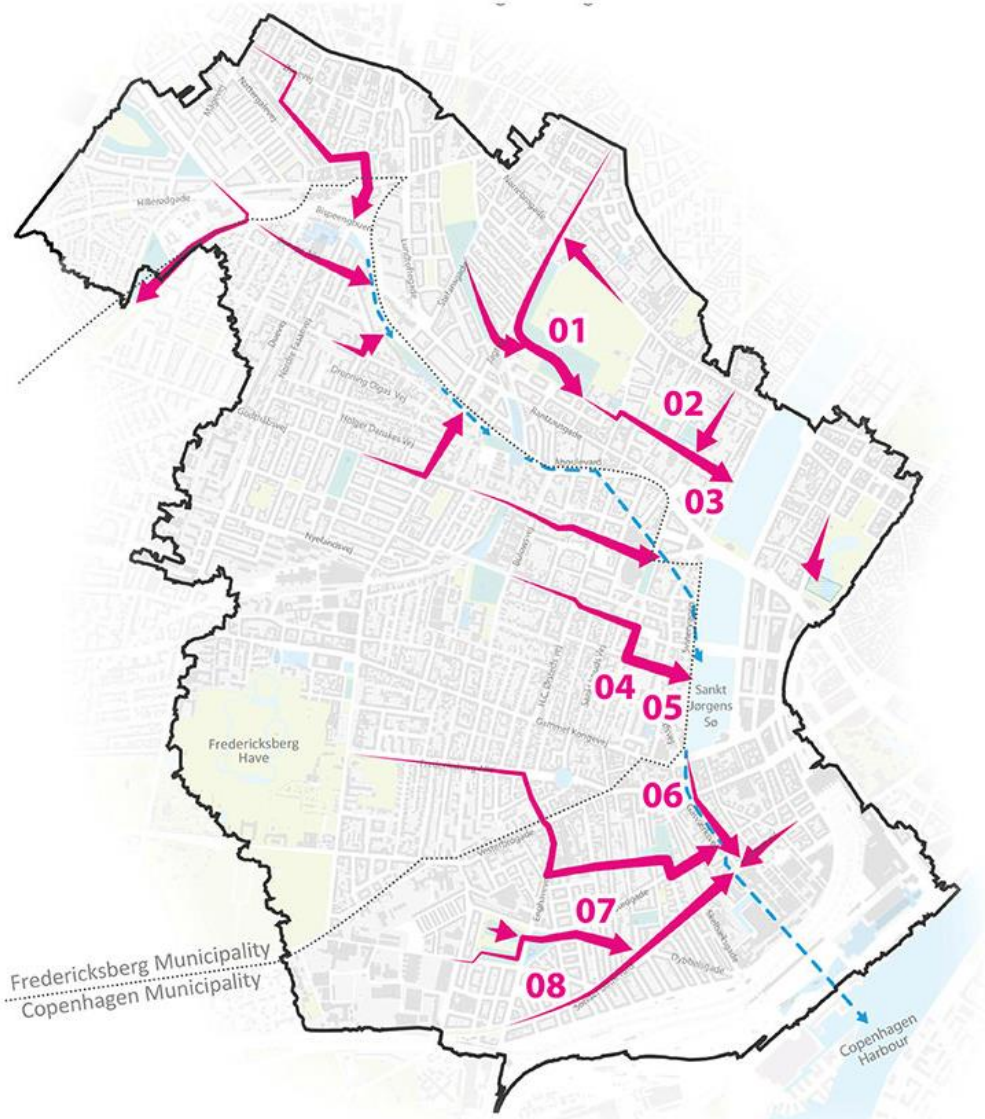

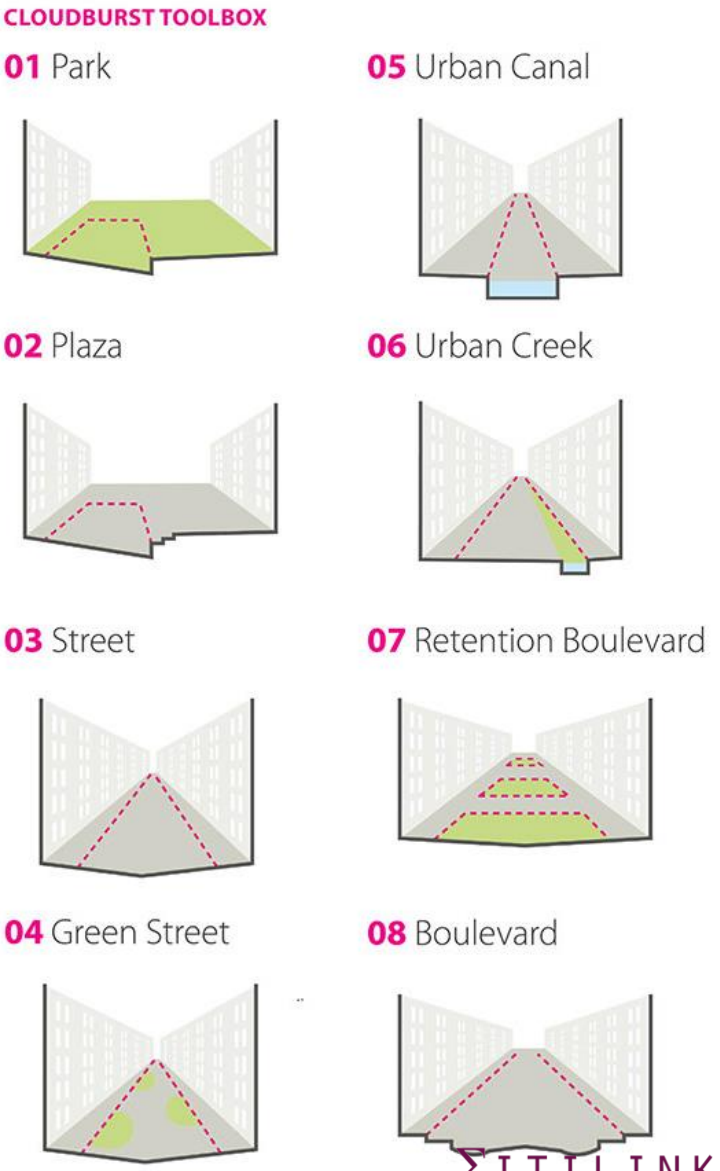

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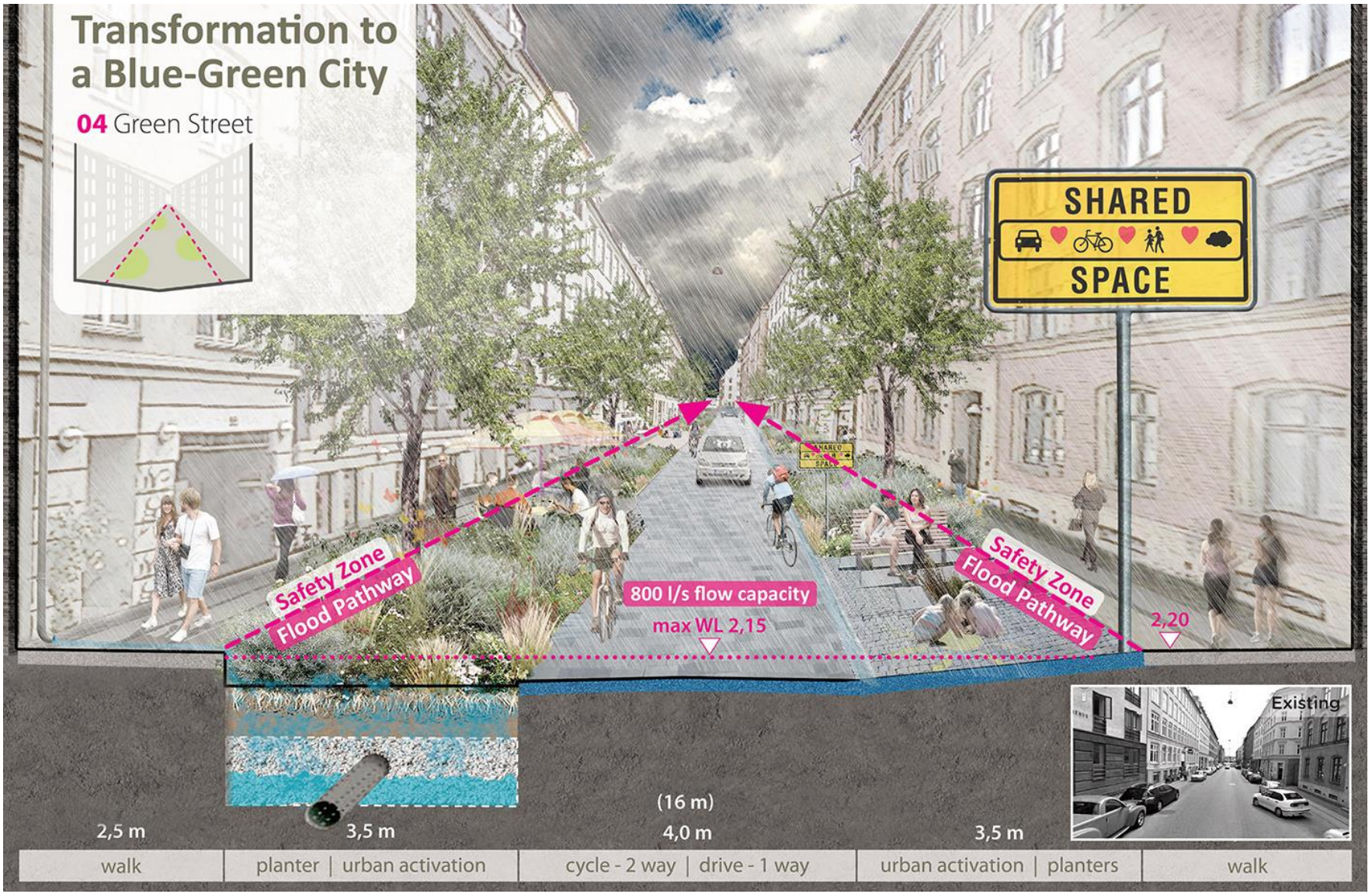
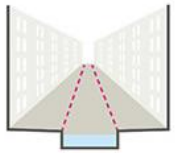
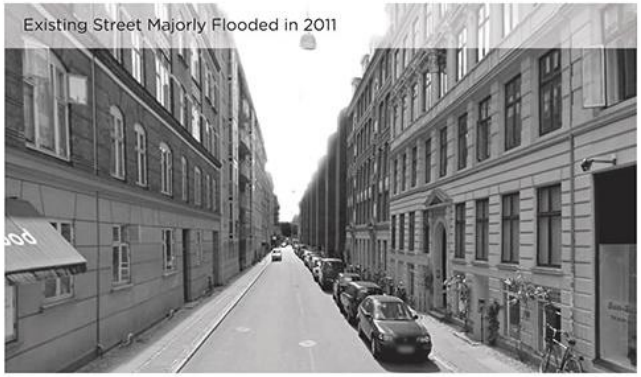
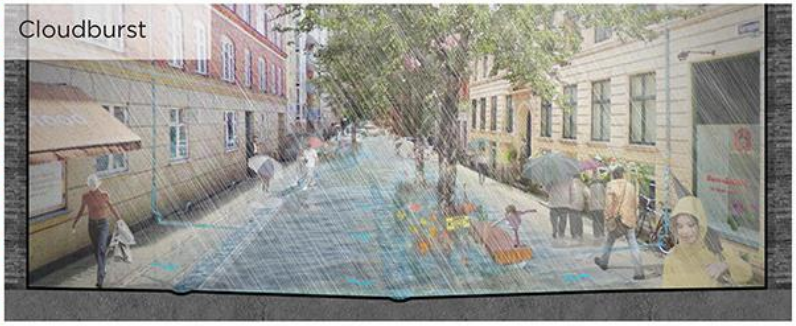


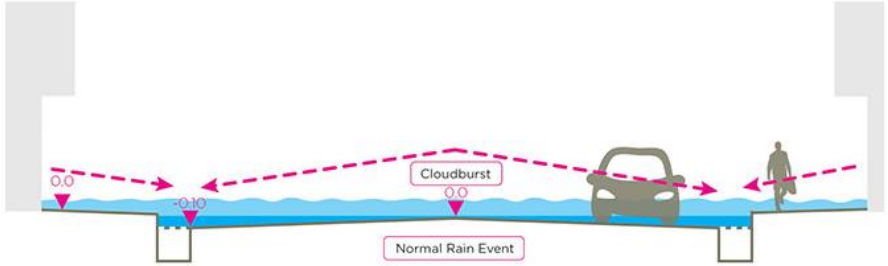
2. COPENHAGEN SPONGE CITY APPROACH (DENMARK)

05 Urban Canal

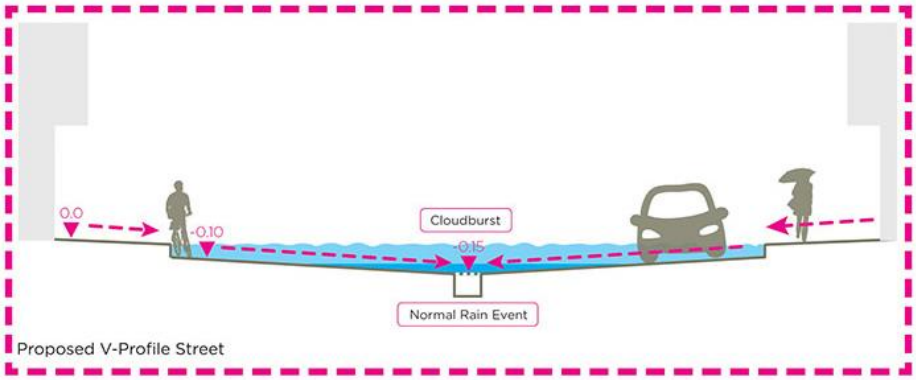






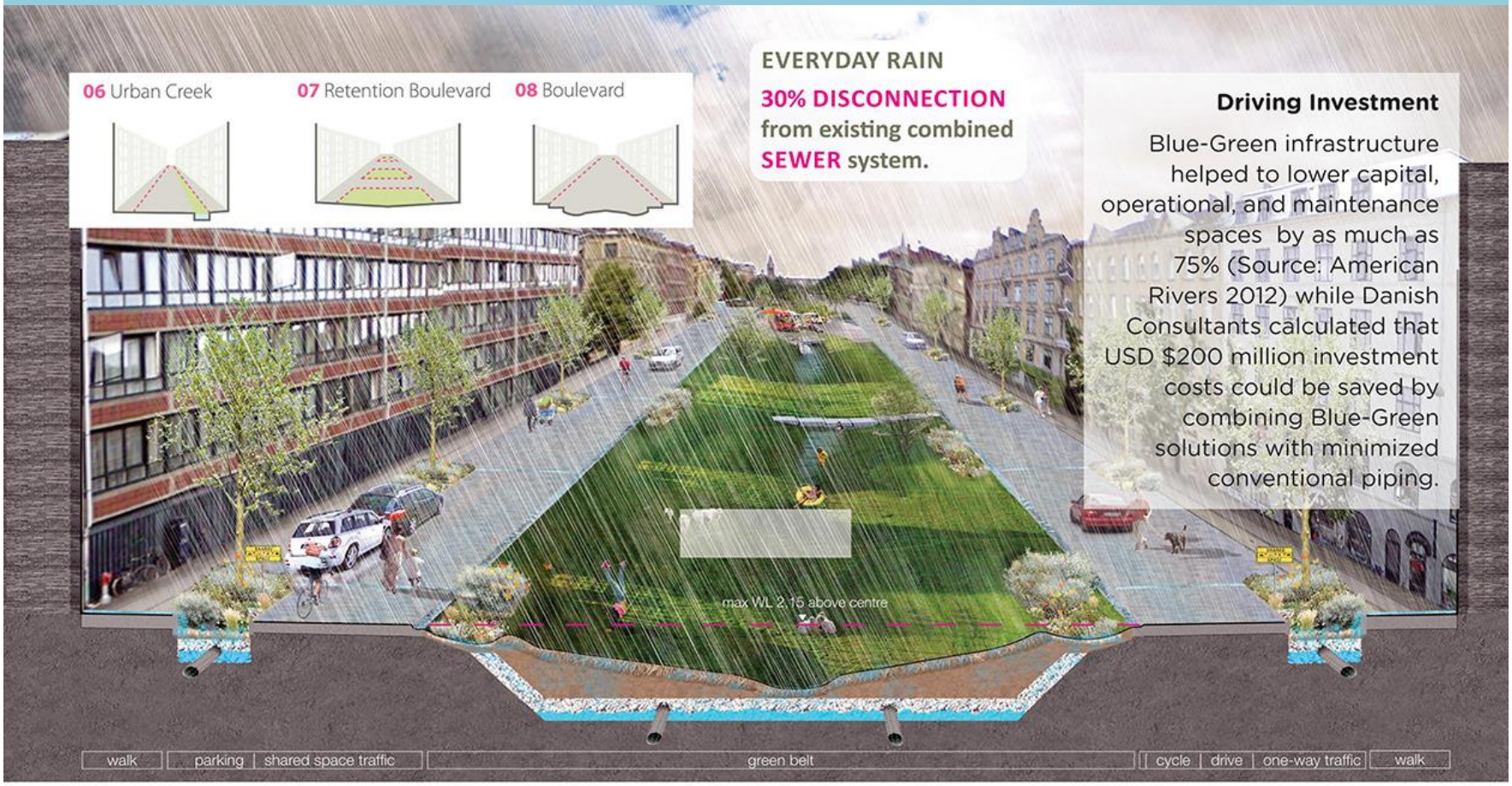


Conventional: Existing Crowned Street

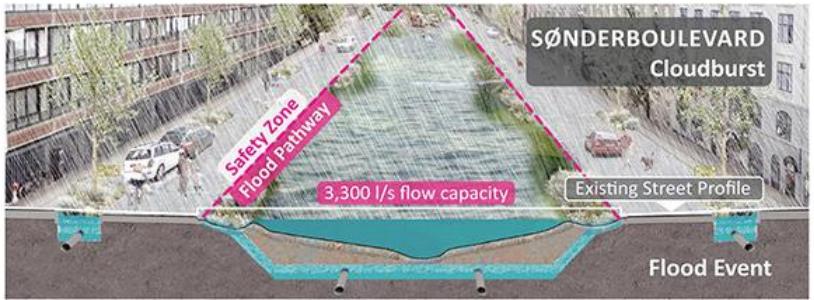


Proposed V-Profile Street

2. COPENHAGEN SPONGE CITY APPROACH (DENMARK)



Rain Event Handled within Multi-Functional Tools including Urban Creek, Retention Boulevard, and Boulevard



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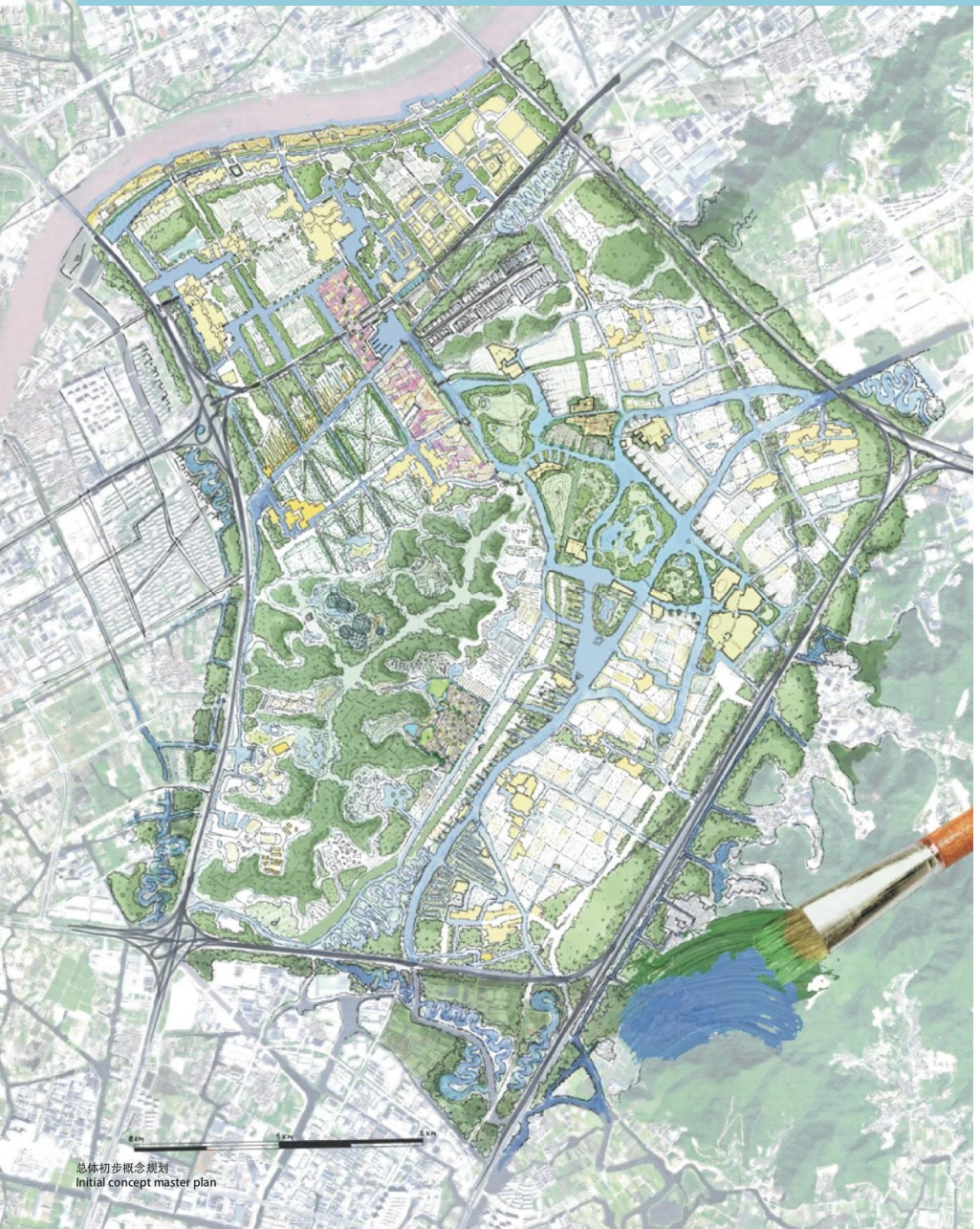
PUBLIC SPACES TURNED INTO URBAN PONDS RETAINING AND CLEANING STORMWATER

3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)



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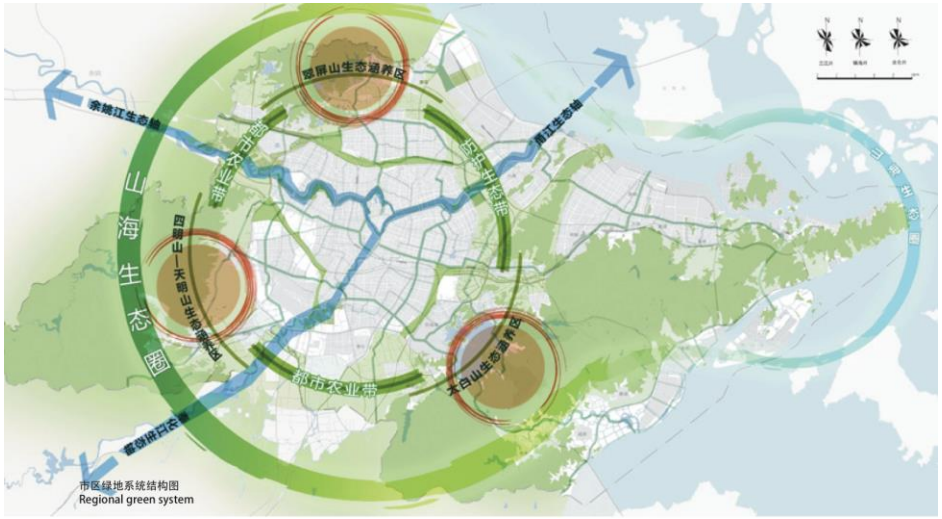

Ningbo is a growing industrial city of 7 million inhabitants. Local authorities are looking for scenarios of preservation of a green and blue belt around the city, protecting the water canal networks and the traditional villages from urbanization and conferring them a social and economic sustainability.
The master plan proposes a sponge area of 22 km2 where water becomes the central element of environmental protection, social life and economic activities.

3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)

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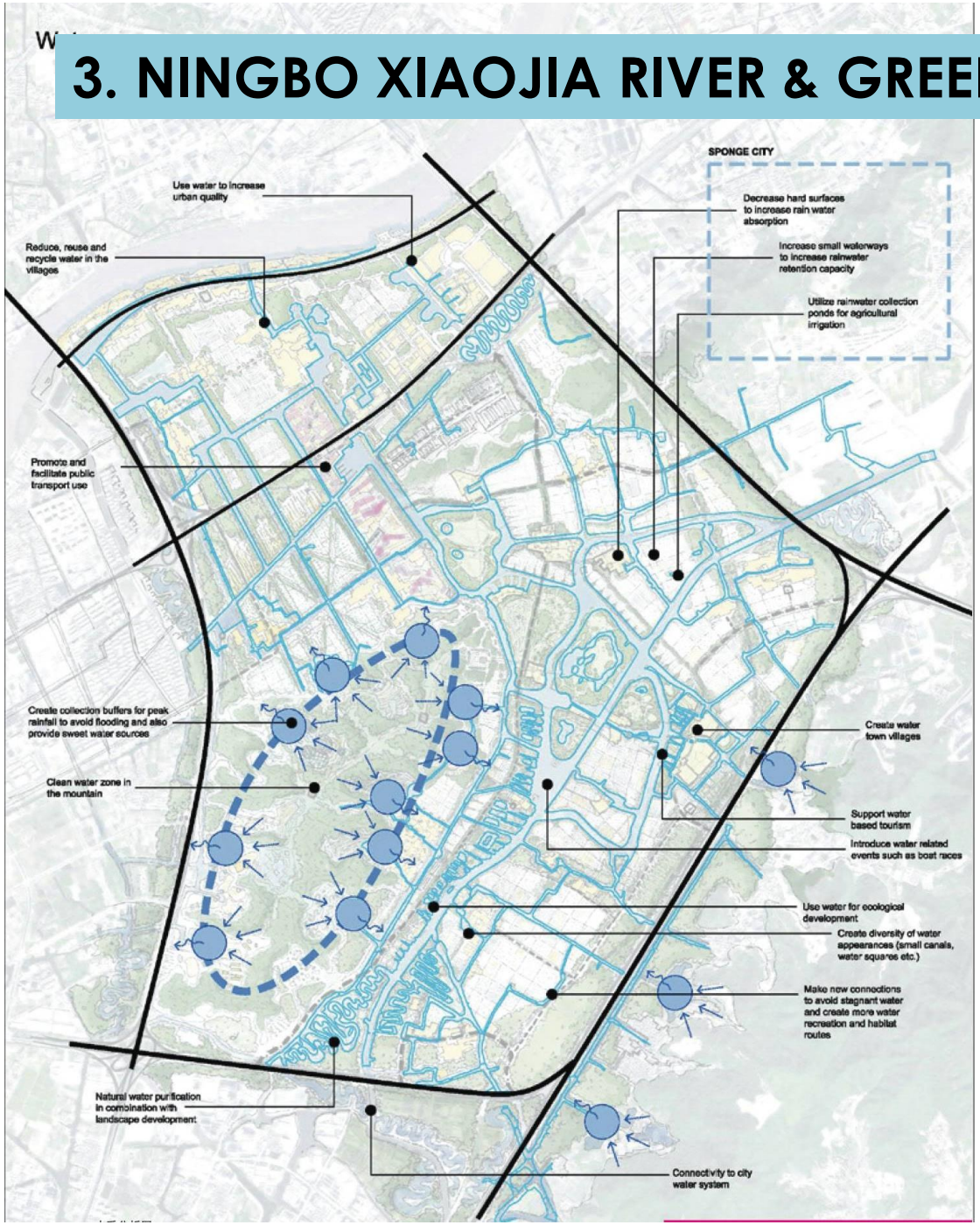
3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)



The rehabilitated water system is made of a dense network of water canals that can absorb enough storm water during cloudburst while waterfront villages are protected.

Multiple ponds are created downstream the mountains to harvest storm water and smoothly redistribute it in different directions.

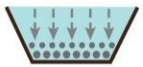
Private cars are banned of the area and are replaced by a system of shared electric vehicles.

Farmlands include educational farms and selling points for organic food. Villages turn their empty houses into shared used indoor spaces for various kinds of visitors.

3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)

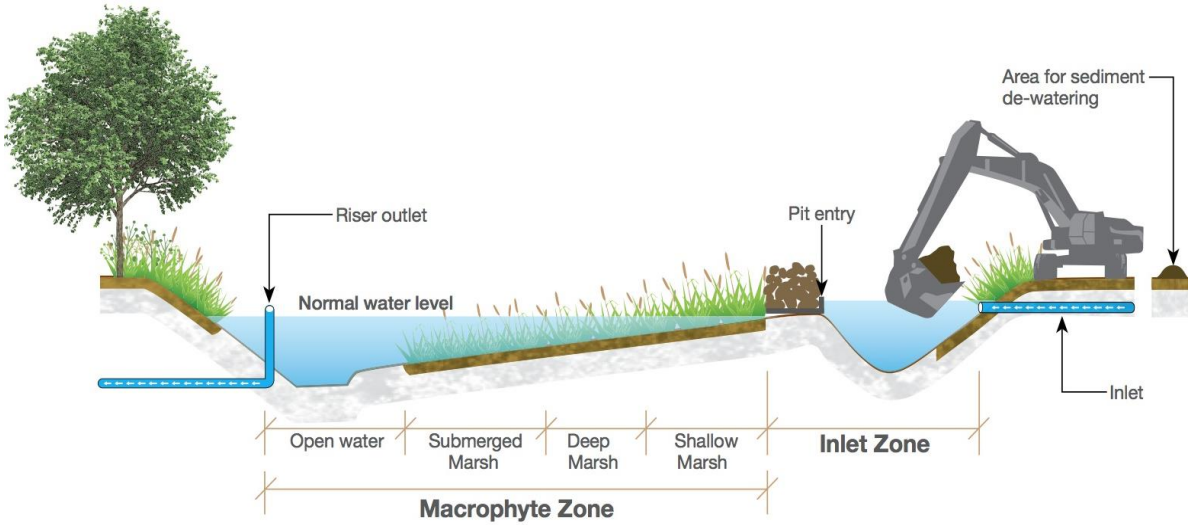
TREATMENT ELEMENTS :
CONSTRUCTED WETLANDS

RETENTION ELEMENT



SEDIMENTATION

BIOLOGICAL UPTAKE



CONSTRUCTED WETLAND SYSTEMS ARE SHALLOW AND EXTENSIVE VEGETATED WATERBODIES THAT GENERALLY CONSIST OF THE FOLLOWING ZONES:

- AN INLET ZONE DESIGNED AS A SEDIMENTATION BASIN TO REMOVE COARSE TO MEDIUM SIZED SEDIMENTS
- A MACROPHYTE ZONE (A SHALLOW HEAVILY VEGETATED AREA TO REMOVE FINE PARTICLES AND SOLUBLE POLLUTANTS)
-A HIGH FLOW BYPASS CHANNEL (TO PROTECT THE MACROPHYTE ZONE)
-WETLANDS CAN BE CONSTRUCTED ON DIFFERENT SCALES, FROM BUILDING SCALE, PARK SCALE TO LARGE REGIONAL SYSTEMS.

3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)

面对巨大的城市化压力，城市生态带中的小浃江区域的交通策略应为限制基地内的机动车和交通设施。所有的城市生态带都面临城市基础设施分割的威胁。规划旨在平衡三个要素：基地可达性（从宁波）、基地和外围城市联系、小浃江生态景观的维持。为限制基地交通，规划提出尊重基地自然的创新交通方式，增加基地价值。

为实现绿色交通、生态旅游、景观、当地社区的协调发展，停车管理和交通应用是将挑战转化为机遇的关键。生态多样的交通方式的一个主要优势是创建社会经济生活的节点，节点中设计应关注环境、景观和村庄，游客可以和当地居民互动，在都市农村区域探寻生态慢生活。

通过创建多样生态的交通体系，规划为人们提供多种交通方式的选择。交通网络将各个节点通过技术和管理相联系。自行车、水上巴士、缆车共同组成的“P+R”模式交通系统使游客可以轻松到达公园各个区域，并采取一体化的售票管理。游客还可以查询到停车位、公共自行车、班车和缆车时间表，方便提前规划行程。小浃江基地的手机应用会向宁波市民推送游玩建议。

Preserving Xiaojia River District from the pressure of urbanization in a metropolitan green belt is also a matter of limitation of both motorized traffic limitation and road infrastructure through the site. Every metropolitan green belt faces the challenge of avoiding the segmentation of its landscape by urban infrastructure. Our strategy aims to balance three factors: the accessibility of the area (from Ningbo), the connectivity of local communities with the city and the preservation of Xiaojia River District's natural landscapes. By keeping commuting traffic away from Xiaojia River District, we find the opportunity to innovate and create new solutions for mobility that will take care of the natural environment of the site and create local added value.

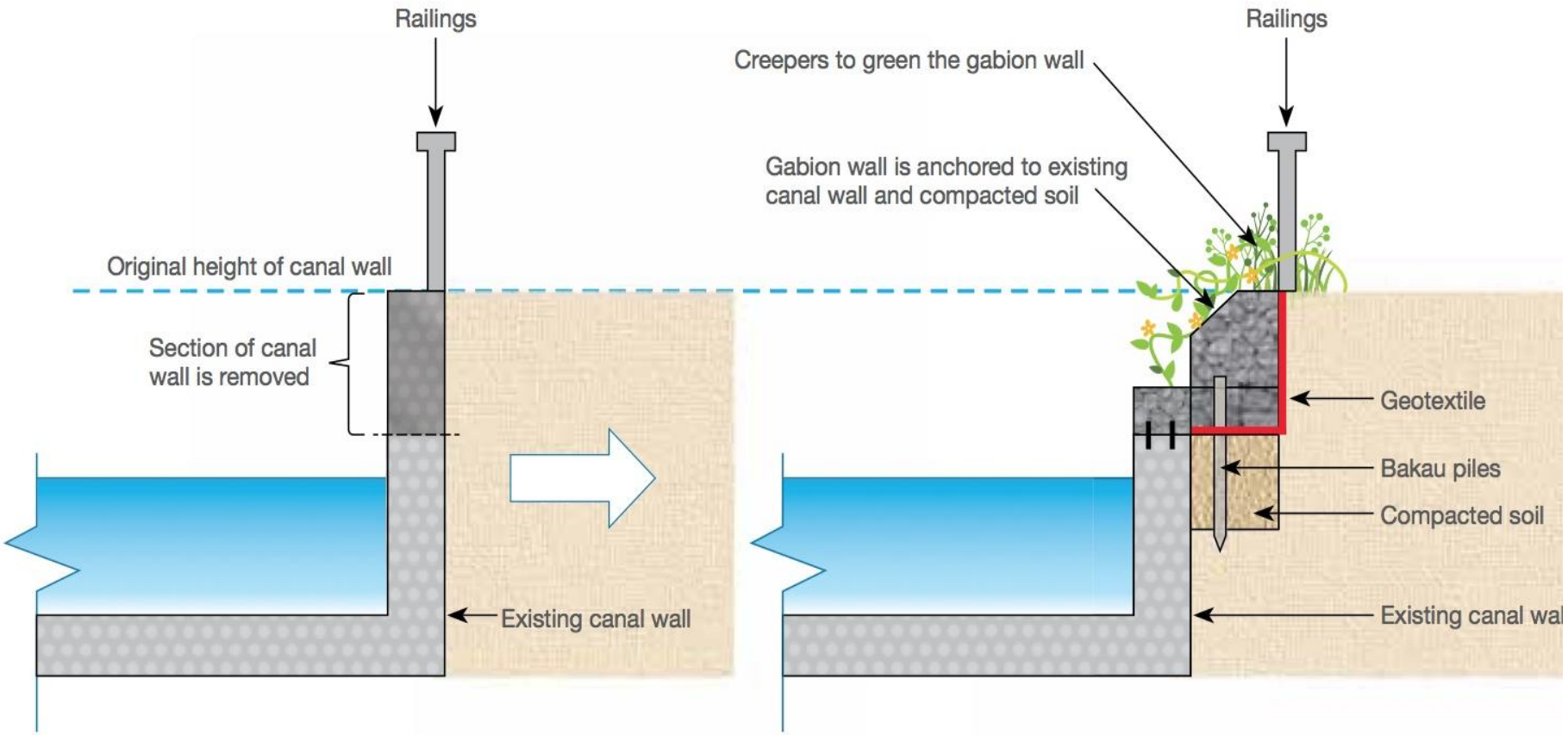
Achieving smart synergies between green mobility, eco-tourism, landscape, local communities, parking management and mobile applications, is the key to transform this challenge into an opportunity. One of the main interests of a green and multimodal transport model is to create nodes of social and economic life, where the design takes care of the environment and the landscape and of the image of the villages; where visitors can meet and interact with local villagers, where they can discover greener and slower lifestyles in a modern rural area.

By creating a complete multimodal and eco-friendly transport system, we give accessibility to everyone through a diverse range of transport modes. One of the keys of success of such network is to integrate each mode not only technically but also in terms of management. By combining smartly the use of a P+R with a shared bicycle, a water shuttle ticket, a trip with the cable car, users can save time and money, access easily to every site with practical combinations that include fare integration. By distance, users can be informed of the availability of parking places, shared bicycles, of the schedules of the shuttles and cable cars, and plan their own combination of trips through the site before they arrive. A mobile application dedicated to Xiaojia River District will inform Ningbo citizens in real time about the best way to enjoy the area.

WATERWAYS AND WATERBODIES : GREENING WATERWAYS ASSOCIATE THEM WITH CLEAN MOBILITY AND VEHICLES

3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)

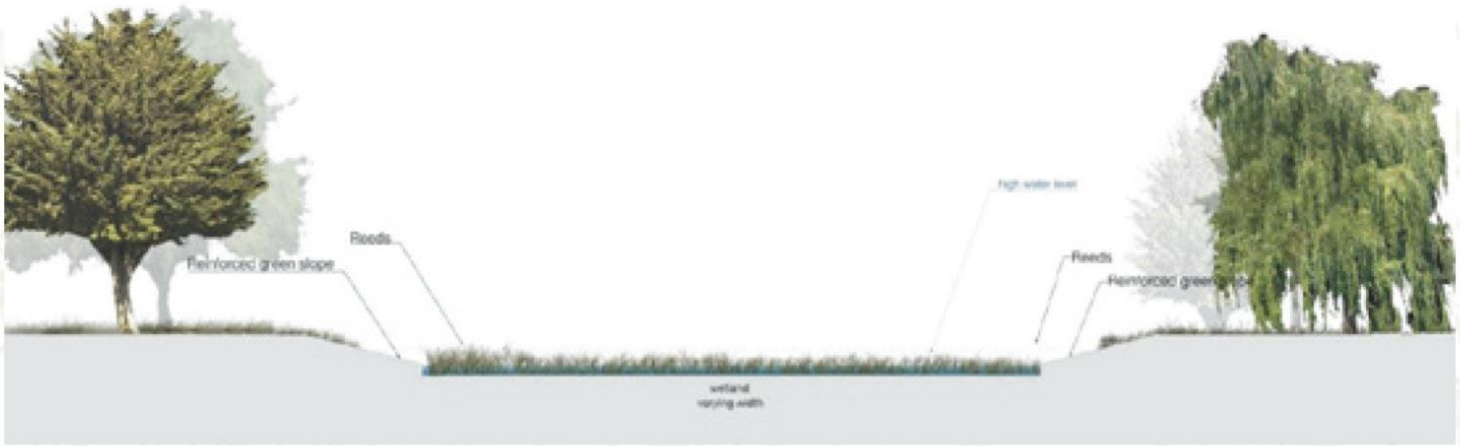
WATERWAYS AND WATERBODIES : GREENING WATERWAYS



3. NINGBO XIAOJIA RIVER & GREEN BELT (CHINA)

项目区域内主要河道的生态处理方式
沿河道的布置湿地，芦苇丛和水生植物群。将助于过滤城市地表水，提升水体品质。同时有助于在项目区域内建立更多样化的生态环境。

Typical water section - Main rivers/canals
Water purifying streams and wetlands will be created along the shores of the main canals. It help to filter urban water which enters the project site. In addition, it will help to create a better water quality a more diverse ecological environment within the park.



自然水体净化的典型断面

Typical water section - Natural water purification

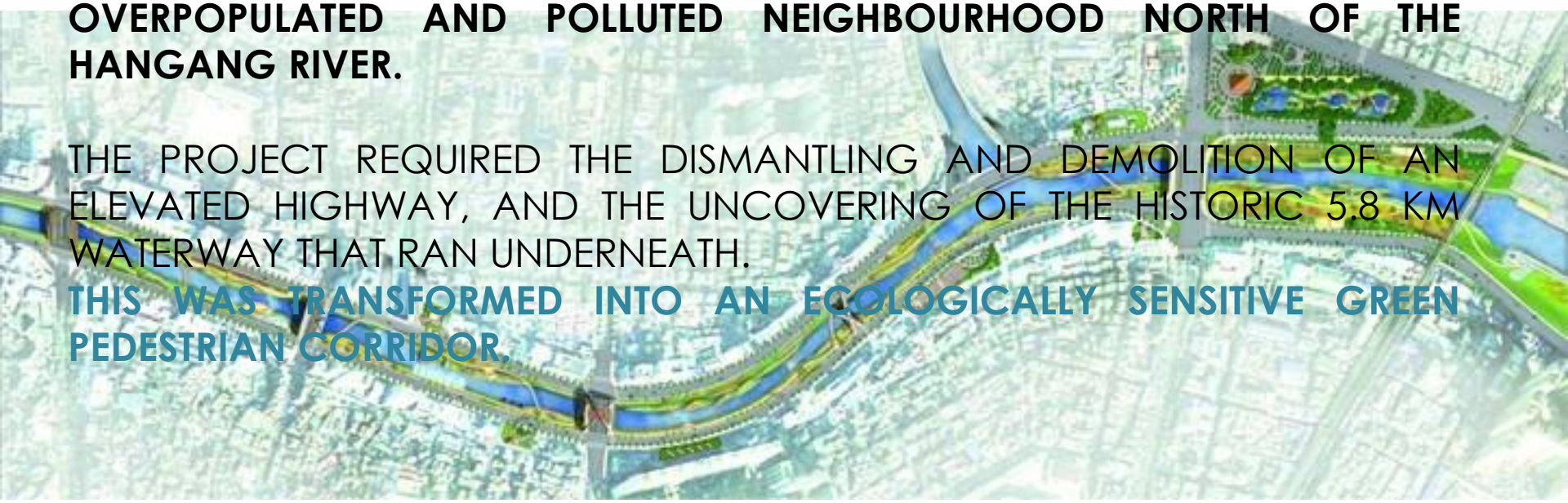
4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

CREATION OF **5.8KM LANDSCAPED GREEN PATHWAY** ALONGSIDE THE REVITALISED CHEONGGYECHEON STREAM IN SEOUL, SOUTH KOREA.

THE CORRIDOR RUNS FROM SEOUL TO AN ECOLOGICAL CONSERVATION AREA OUTSIDE THE CITY.

CHEONGGYECHEON RESTORATION PROJECT OPENS UP A CONGESTED, OVERPOPULATED AND POLLUTED NEIGHBOURHOOD NORTH OF THE HANGANG RIVER.

THE PROJECT REQUIRED THE DISMANTLING AND DEMOLITION OF AN ELEVATED HIGHWAY, AND THE UNCOVERING OF THE HISTORIC 5.8 KM WATERWAY THAT RAN UNDERNEATH.
THIS WAS TRANSFORMED INTO AN ECOLOGICALLY SENSITIVE GREEN PEDESTRIAN CORRIDOR.



4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

BEFORE

AFTER

4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

ENVIRONMENTAL

PROVIDES FLOOD PROTECTION

INCREASES OVERALL BIODIVERSITY WITH THE INCREASING NUMBER OF PLANT, FISH, BIRDS, INSECTS, MAMMALS AND AMPHIBIANS.

REDUCES THE URBAN HEAT ISLAND EFFECT WITH TEMPERATURES ALONG THE STREAM 3.3° TO 5.9°C COOLER THAN ON A PARALLEL ROAD.

REDUCED SMALL-PARTICLE AIR POLLUTION BY 35%.

4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

SOCIAL

CONTRIBUTED TO A SIGNIFICANT INCREASE OF BUS AND SUBWAY USE IN SEOUL.

ATTRACTS AN AVERAGE OF 64,000 VISITORS DAILY AND FOREIGN TOURISTS WHO CONTRIBUTE TO IMPROVE SEOUL ECONOMY.

4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

ECONOMIC

INCREASE OF THE PRICE OF LAND BY 30-50% FOR PROPERTIES WITHIN 50 METERS OF THE RESTORATION PROJECT.

INCREASED NUMBER OF BUSINESSES IN SEOUL

INCREASE OF THE NUMBER OF WORKING PEOPLE IN THE CHEONGGYECHEON AREA.

4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

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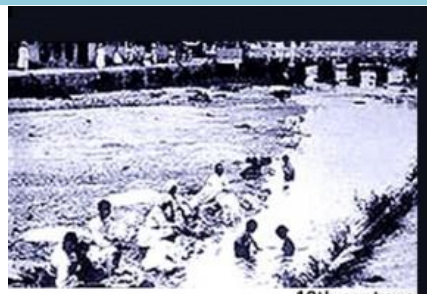
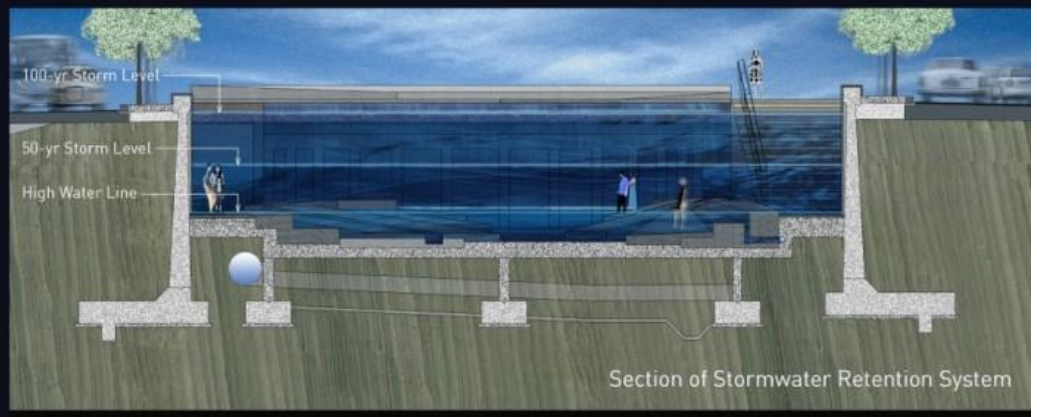


19th century

ca. 1945

Historical Photos of Canal



Section of Stormwater Retention System

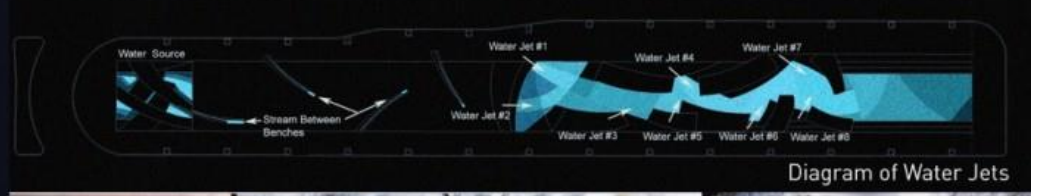


Diagram of Water Jets

Site Models of Stone Provinces

4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

THE CHONGAE CANAL RESTORATION PROJECT IS AN AMBITIOUS REDEVELOPMENT INITIATIVE THAT TRANSFORMED THE URBAN FABRIC OF SEOUL, KOREA.

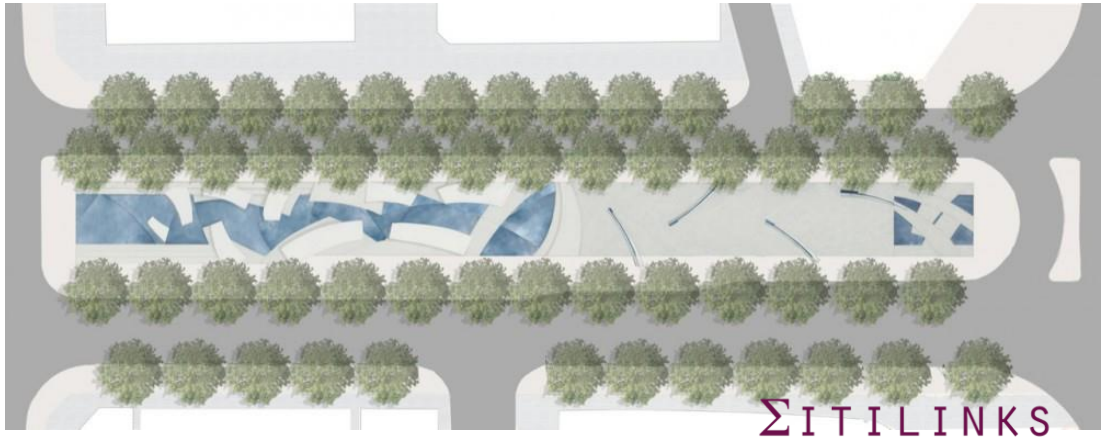
THE CHONGAE RIVER RESTORATION PROJECT IS LOCATED AT THE IMPORTANT SOURCE POINT OF THIS 11KM GREEN CORRIDOR THAT BEGINS IN THE CENTRAL BUSINESS AND COMMERCIAL DISTRICT OF THE CITY.

THE OUTCOME IS THE CREATION OF A PEDESTRIAN FOCUSED ZONE FROM THIS FORMER VEHICULAR ACCESS WAY THAT BRINGS PEOPLE TO THE HISTORIC CHONGAE RIVER WHILE MITIGATING FLOODING AND IMPROVING WATER QUALITY.

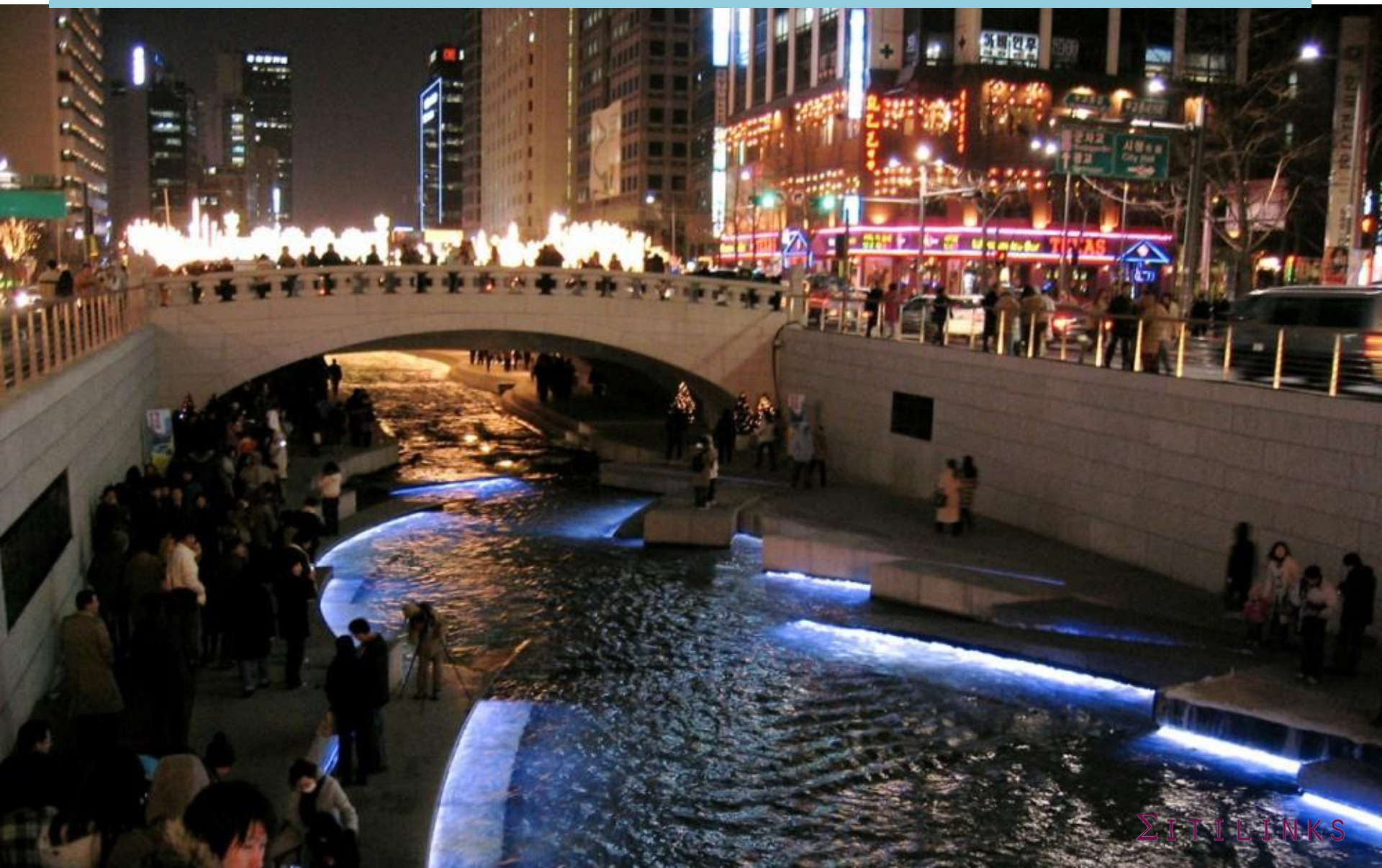
4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)

THE DESIGN WAS GUIDED BY THE WATER LEVELS FROM HOUR TO HOUR AND SEASON TO SEASON, WHILE ADDRESSING THE CATASTROPHIC FLOODING THAT OCCURS DURING INTENSE STORMS IN THE MONSOON SEASON.

IN ADDITION TO THE ENVIRONMENTAL RESTORATION EFFORT, THIS URBAN OPEN SPACE HAS BECOME A CENTRAL GATHERING PLACE FOR THE CITY WHICH IS IN DIRE NEED OF MORE PUBLIC LANDSCAPES. THE CLASS II WATER QUALITY LEVEL HAS ALLOWED FOR FAMILIES TO COME AND REENGAGE WITH THIS HISTORICAL RIVER.



4. THE CHEONGGYECHEON RESTORATION PROJECT (SOUTH KOREA)



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Larissa, 8th December 2017

ΣITILINKS